7450 ETHERNET SERVICE SWITCH
7750 SERVICE ROUTER
7950 EXTENSIBLE ROUTING SYSTEM

ROUTER CONFIGURATION GUIDE
RELEASE 14.0.R4

3HE 10794 AAAB TQZZA 01

Issue: 01

July 2016

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1 Getting Started

1.1 About This Guide

This guide describes logical IP routing interfaces, virtual routers, IP and MAC-based filtering, and cflowd support and presents configuration and implementation examples.

This guide is organized into functional chapters and provides concepts and descriptions of the implementation flow, as well as Command Line Interface (CLI) syntax and command usage.

The topics and commands described in this document apply to the:

- 7450 ESS
- 7750 SR
- 7950 XRS

Table 1 lists the available chassis types for each SR OS router.

Table 1 **Supported SR OS Router Chassis Types**

7450 ESS	7750 SR	7950 XRS
• 7450 ESS-6/6v • 7450 ESS-7/12 running in standard mode (not mixed-mode)	• 7450 ESS-7/12 running in mixed-mode (not standard mode) • 7750 SR-a4/a8 • 7750 SR-c4/c12 • 7750 SR-1e/2e/3e • 7750 SR-7/12 • 7750 SR-12e	• 7950 XRS-16c • 7950 XRS-20/40

For a list of unsupported features by platform and chassis, refer to the *SR OS R14.0.Rx Software Release Notes*, part number 3HE10818 000*x* TQZZA.

Command outputs shown in this guide are examples only; actual displays may differ depending on supported functionality and user configuration.

Note: This guide generically covers Release 14.0 content and may contain some content that will be released in later maintenance loads. Please refer to the *SR OS R14.0.Rx Software Release Notes*, part number 3HE10818 000*x* TQZZA, for information on features supported in each load of the Release 14.0 software.

1.2 In This Chapter

This chapter provides process flow information to configure routing entities, virtual routers, IP and MAC filters, and Cflowd.

1.3 Router Configuration Process

Table 2 lists the tasks necessary to configure logical IP routing interfaces, virtual routers, IP and MAC-based filtering, and Cflowd.

This guide is presented in an overall logical configuration flow. Each section describes a software area and provides CLI syntax and command usage to configure parameters for a functional area.

Table 2 **Configuration Process**

Area	Task	Chapter	Supported Platfrom
Router configuration	Configure router parameters, including router interfaces and addresses, router IDs, autonomous systems, and confederations.	IP Router Configuration	All
Protocol configuration	VRRP	VRRP	All
	IP and MAC filters	Filter Policies	All
	Cflowd	Cflowd	7750 SR, 7950 SR
Reference	List of IEEE, IETF, and other proprietary entities.	Standards and Protocol Support	All

2 IP Router Configuration

2.1 In This Chapter

This chapter provides information about commands required to configure basic router parameters.

Topics in this chapter include:

2.2 Configuring IP Router Parameters

In order to provision services on a Nokia router, logical IP routing interfaces must be configured to associate attributes such as an IP address, port or the system with the IP interface.

A special type of IP interface is the system interface. A system interface must have an IP address with a 32-bit subnet mask. The system interface is used as the router identifier by higher-level protocols such as OSPF and BGP, unless overwritten by an explicit router ID.

The following router features can be configured:

- Interfaces
- Creating an IP Address Range
- Autonomous Systems (AS)
- Confederations
- Proxy ARP

Refer to the *Triple Play Guide* for information about DHCP and support as well as configuration examples for the 7750 SR and 7450 ESS.

2.2.1 Interfaces

Nokia routers use different types of interfaces for various functions. Interfaces must be configured with parameters such as the interface type (network and system) and address. A port is not associated with a system interface. An interface can be associated with the system (loopback address).

2.2.1.1 Network Interface

A network interface (a logical IP routing interface) can be configured on one of the following entities:

- A physical or logical port
- A SONET/SDH channel for the 7750 SR or 7450 ESS

2.2.1.2 Network Domains

In order to determine which network ports (and hence which network complexes) are eligible to transport traffic of individual SDPs, network-domain is introduced. This information is then used for the sap-ingress queue allocation algorithm applied to VPLS SAPs. This algorithm is optimized in such a way that no sap-ingress queues are allocated if the given port does not belong to the network-domain used in the given VPLS. In addition, sap-ingress queues will not be allocated towards network ports (regardless of the network-domain membership) if the given VPLS does not contain any SDPs.

Sap-ingress queue allocation takes into account the following aspects:

- SHG membership of individual SDPs
- Network-domain definition under SDP to restrict the topology the given SDP can be set-up in

The implementation supports four network-domains within any given VPLS.

Network-domain configuration at the SDP level is ignored when the given SDP is used for Epipe, Ipipe, or Apipe bindings.

Network-domain configuration is irrelevant for Layer 3 services (Layer 3 VPN and/or IES service). It can be defined in the base routing context and associated only with network interfaces in this context. Network domains are not applicable to loopback and system interfaces.

The network-domain information will only be used for ingress VPLS sap queue-allocation. It will not be taken into account by routing during SDP setup. As a consequence, if the given SDP is routed through network interfaces that are not part of the configured network domain, the packets will be still forwarded, but their QoS and queuing behavior will be based on default settings. In addition, the packet will not appear in SAP stats.

There will be always one network-domain that exists with reserved name default. The interfaces will always belong to a default network-domain. It will be possible to assign given interface to different user-defined network-domains. The loopback and system interface will be also associated with the default network-domain at the creation. However, any attempt to associate such interfaces with any explicitly defined network-domain will be blocked at the CLI level as there is no benefit for that association.

Any SDP can be assigned only to one network domain. If none is specified, the system will assign the default network-domain. This means that all SAPs in VPLS will have queue reaching all fwd-complexes serving interfaces that belong to the same network-domains as the SDPs.

It is possible to assign/remove network-domain association of the interface/SDP without requiring deletion of the respective object.

2.2.1.3 System Interface

The system interface is associated with the network entity (such as a specific router or switch), not a specific interface. The system interface is also referred to as the loopback address. The system interface is associated during the configuration of the following entities:

- The termination point of service tunnels
- The hops when configuring MPLS paths and LSPs
- The addresses on a target router for BGP and LDP peering

The system interface is used to preserve connectivity (when routing reconvergence is possible) when an interface fails or is removed. The system interface is also referred to as the loopback address and is used as the router identifier. A system interface must have an IP address with a 32-bit subnet mask.

2.2.1.4 Unicast Reverse Path Forwarding Check (uRPF)

uRPF helps to mitigate problems that are caused by the introduction of malformed or forged (spoofed) IP source addresses into a network by discarding IP packets that lack a verifiable IP source address. For example, a number of common types of denial-of-service (DoS) attacks, including smurf and tribe flood network (TFN), can take advantage of forged or rapidly changing source IP addresses to allow attackers to thwart efforts to locate or filter the attacks. For Internet service providers (ISPs) that provide public access, Unicast RPF deflects such attacks by forwarding only packets that have source addresses that are valid and consistent with the IP routing table. This action protects the network of the ISP, its customer, and the rest of the Internet.

uRPF is supported for both IPv4 and IPv6 on network and access. It is supported on any IP interface, including base router, IES, VPRN and subscriber group interfaces.

In strict mode, uRPF checks whether the incoming packet has a source address that matches a prefix in the routing table, and whether the interface expects to receive a packet with this source address prefix.

In loose mode, uRPF checks whether the packet has a source address with a corresponding prefix in the routing table; loose mode does not check whether the interface expects to receive a packet with a specific source address prefix.

Loose uRPF check is supported for ECMP, IGP shortcuts and VPRN MP-BGP routes. Packets coming from a source that matches any ECMP, IGP shortcut or VPRN MP-BGP route will pass the uRPF check even when the uRPF mode is set to strict mode on the incoming interface.

In the case of ECMP, this allows a packet received on an IP interface configured in strict URPF mode to be forwarded if the source address of the packet matches an ECMP route, even if the IP interface is not a next-hop of the ECMP route and even if the interface is not a member of any ECMP routes. The strict-no-ecmp uRPF mode may be configured on any interface which is known to not be a next-hop of any ECMP route. When a packet is received on this interface and the source address matches an ECMP route the packet is dropped by uRPF.

If there is a default route then this is included in the uRPF check, as follows:

If there is a default route:

- A loose mode uRPF check always succeeds.
- A strict mode uRPF check only succeeds if the SA matches any route (including the default route) where the next-hop is on the incoming interface for the packet.

Otherwise the uRPF check fails.

If the source IP address matches a discard/blackhole route, the packet is treated as if it failed uRPF check.

2.2.1.5 Creating an IP Address Range

An IP address range can be reserved for exclusive use for services by defining the **config>router>service-prefix** command. When the service is configured, the IP address must be in the range specified as a service prefix. If no service prefix command is configured, then no limitation exists.

Addresses in the range of a service prefix can be allocated to a network port unless the *exclusive* parameter is used. Then, the address range is exclusively reserved for services.

When defining a range that is a superset of a previously defined service prefix, the subset will be replaced with the superset definition. For example, if a service prefix exists for 10.10.10.0/24, and a new service prefix is configured as 10.10.0.0/16, then the old address (10.10.10.0/24) will be replaced with the new address (10.10.0.0/16).

When defining a range that is a subset of a previously defined service prefix, the subset will replace the existing superset, providing addresses used by services are not affected; for example, if a service prefix exists for 10.10.0.0/16, and a new service prefix is configured as 10.10.10.0/24, then the 10.10.0.0/16 entry will be removed, provided that no services are configured that use 10.10.x.x addresses other than 10.10.10.x.

2.2.1.6 QoS Policy Propagation Using BGP (QPPB)

This section discusses QPPB as it applies to VPRN, IES, and router interfaces. Refer to the Internet Enhanced Service section in the Services Guide and the IP Router Configuration section in the Router Configuration Guide.

QoS policy propagation using BGP (QPPB) is a feature that allows a route to be installed in the routing table with a forwarding-class and priority so that packets matching the route can receive the associated QoS. The forwarding-class and priority associated with a BGP route are set using BGP import route policies. In the industry this feature is called QPPB, and even though the feature name refers to BGP specifically. On SR OS, QPPB is supported for BGP (IPv4, IPv6, VPN-IPv4, VPN-IPv6), RIP and static routes.

While SAP ingress and network QoS policies can achieve the same end result as QPPB (for example, by assigning a packet arriving on a particular IP interface to a specific forwarding-class and priority/profile based on the source IP address or destination IP address of the packet) the effort involved in creating the QoS policies, keeping them up-to-date, and applying them across many nodes is much greater than with QPPB. In a typical application of QPPB, a BGP route is advertised with a BGP community attribute that conveys a particular QoS. Routers that receive the advertisement accept the route into their routing table and set the forwarding-class and priority of the route from the community attribute.

2.2.1.6.1 QPPB Applications

There are two typical applications of QPPB:

1. Coordination of QoS policies between different administrative domains.
2. Traffic differentiation within a single domain, based on route characteristics.

2.2.1.6.2 Inter-AS Coordination of QoS Policies

The operator of an administrative domain A can use QPPB to signal to a peer administrative domain B that traffic sent to certain prefixes advertised by domain A should receive a particular QoS treatment in domain B. More specifically, an ASBR of domain A can advertise a prefix XYZ to domain B and include a BGP community attribute with the route. The community value implies a particular QoS treatment, as agreed by the two domains (in their peering agreement or service level agreement, for example). When the ASBR and other routers in domain B accept and install the route for XYZ into their routing table, they apply a QoS policy on selected interfaces that classifies traffic towards network XYZ into the QoS class implied by the BGP community value.

QPPB may also be used to request that traffic sourced from certain networks receive appropriate QoS handling in downstream nodes that may span different administrative domains. This can be achieved by advertising the source prefix with a BGP community, as discussed above. However, in this case other approaches are equally valid, such as marking the DSCP or other CoS fields based on source IP address so that downstream domains can take action based on a common understanding of the QoS treatment implied by different DSCP values.

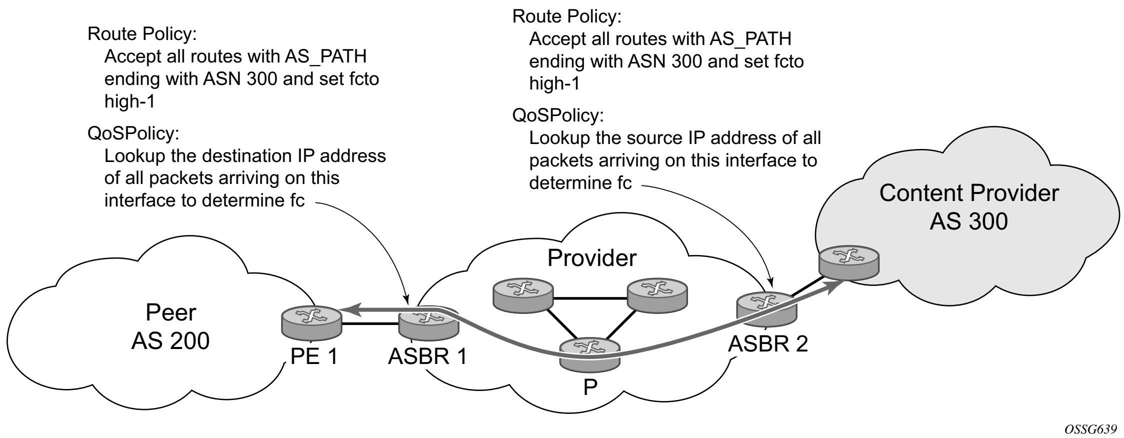
In the above examples, coordination of QoS policies using QPPB could be between a business customer and its IP VPN service provider, or between one service provider and another.

2.2.1.6.3 Traffic Differentiation Based on Route Characteristics

There may be times when a network operator wants to provide differentiated service to certain traffic flows within its network, and these traffic flows can be identified with known routes. For example, the operator of an ISP network may want to give priority to traffic originating in a particular ASN (the ASN of a content provider offering over-the-top services to the ISP’s customers), following a certain AS_PATH, or destined for a particular next-hop (remaining on-net vs. off-net).

Figure 1 shows an example of an ISP that has an agreement with the content provider managing AS300 to provide traffic sourced and terminating within AS300 with differentiated service appropriate to the content being transported. In this example we presume that ASBR1 and ASBR2 mark the DSCP of packets terminating and sourced, respectively, in AS300 so that other nodes within the ISP’s network do not need to rely on QPPB to determine the correct forwarding-class to use for the traffic. The DSCP or other COS markings could be left unchanged in the ISP’s network and QPPB used on every node.

Figure 1 **Use of QPPB to Differentiate Traffic in an ISP Network**



2.2.1.7 QPPB

There are two main aspects of the QPPB feature:

- The ability to associate a forwarding-class and priority with certain routes in the routing table.
- The ability to classify an IP packet arriving on a particular IP interface to the forwarding-class and priority associated with the route that best matches the packet.

2.2.1.7.1 Associating an FC and Priority with a Route

This feature uses a command in the route-policy hierarchy to set the forwarding class and optionally the priority associated with routes accepted by a route-policy entry. The command has the following structure:

```
fc fc-name [priority {low | high}]
```

The use of this command is illustrated by the following example:

```
config>router>policy-options
    begin
    community gold members 300:100
    policy-statement qppb_policy
        entry 10
            from
```

```
                protocol bgp
                community gold
            exit
            action accept
                fc h1 priority high
            exit
        exit
    exit
    commit
```

The **fc** command is supported with all existing from and to match conditions in a route policy entry and with any action other than reject, it is supported with next-entry, next-policy and accept actions. If a next-entry or next-policy action results in multiple matching entries then the last entry with a QPPB action determines the forwarding class and priority.

A route policy that includes the **fc** command in one or more entries can be used in any import or export policy but the **fc** command has no effect except in the following types of policies:

- VRF import policies:
  - config>service>vprn>vrf-import
- BGP import policies:
  - config>router>bgp>import
  - config>router>bgp>group>import
  - config>router>bgp>group>neighbor>import
  - config>service>vprn>bgp>import
  - config>service>vprn>bgp>group>import
  - config>service>vprn>bgp>group>neighbor>import
- RIP import policies:
  - config>router>rip>import
  - config>router>rip>group>import
  - config>router>rip>group>neighbor>import
  - config>service>vprn>rip>import
  - config>service>vprn>rip>group>import
  - config>service>vprn>rip>group>neighbor>import

As evident from above, QPPB route policies support routes learned from RIP and BGP neighbors of a VPRN as well as for routes learned from RIP and BGP neighbors of the base/global routing instance.

QPPB is supported for BGP routes belonging to any of the address families listed below:

- IPv4 (AFI=1, SAFI=1)
- IPv6 (AFI=2, SAFI=1)
- VPN-IPv4 (AFI=1, SAFI=128)
- VPN-IPv6 (AFI=2, SAFI=128)

A VPN-IP route may match both a VRF import policy entry and a BGP import policy entry (if vpn-apply-import is configured in the base router BGP instance). In this case the VRF import policy is applied first and then the BGP import policy, so the QPPB QoS is based on the BGP import policy entry.

This feature also introduces the ability to associate a forwarding-class and optionally priority with IPv4 and IPv6 static routes. This is achieved by specifying the forwarding-class within the static-route-entry next-hop or indirect context.

Priority is optional when specifying the forwarding class of a static route, but once configured it can only be deleted and returned to unspecified by deleting the entire static route.

2.2.1.7.2 Displaying QoS Information Associated with Routes

The following commands are enhanced to show the forwarding-class and priority associated with the displayed routes:

- show router route-table
- show router fib
- show router bgp routes
- show router rip database
- show router static-route

This feature uses a **qos** keyword to the **show>router>route-table** command. When this option is specified the output includes an additional line per route entry that displays the forwarding class and priority of the route. If a route has no fc and priority information then the third line is blank. The following CLI shows an example:

show router route-table [**family**] [*ip-prefix*[/*prefix-length*]] [**longer** | **exact**] [**protocol** *protocol-name*] **qos**

An example output of this command is shown below:

```
A:Dut-A# show router route-table 10.1.5.0/24 qos
===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix                                     Type    Proto    Age         Pref
```

```
       Next Hop[Interface Name]                                      Metric
       QoS
-------------------------------------------------------------------------------
10.1.5.0/24                                  Remote  BGP      15h32m52s   0
       PE1_to_PE2                                                     0
       h1, high
-------------------------------------------------------------------------------
No. of Routes: 1
===============================================================================
A:Dut-A#
```

2.2.1.7.3 Enabling QPPB on an IP interface

To enable QoS classification of ingress IP packets on an interface based on the QoS information associated with the routes that best match the packets the **qos-route-lookup** command is necessary in the configuration of the IP interface. The **qos-route-lookup** command has parameters to indicate whether the QoS result is based on lookup of the source or destination IP address in every packet. There are separate qos-route-lookup commands for the IPv4 and IPv6 packets on an interface, which allows QPPB to enabled for IPv4 only, IPv6 only, or both IPv4 and IPv6. Current QPPB based on a source IP address is not supported for IPv6 packets nor is it supported for ingress subscriber management traffic on a group interface.

The qos-route-lookup command is supported on the following types of IP interfaces:

- base router network interfaces (config>router>interface)
- VPRN SAP and spoke SDP interfaces (config>service>vprn>interface)
- VPRN group-interfaces (config>service>vprn>sub-if>grp-if)
- IES SAP and spoke SDP interfaces (config>service>ies>interface)
- IES group-interfaces (config>service>ies>sub-if>grp-if)

When the qos-route-lookup command with the destination parameter is applied to an IP interface and the destination address of an incoming IP packet matches a route with QoS information the packet is classified to the fc and priority associated with that route, overriding the fc and priority/profile determined from the sap-ingress or network qos policy associated with the IP interface (see section 5.7 for further details). If the destination address of the incoming packet matches a route with no QoS information the fc and priority of the packet remain as determined by the sap-ingress or network qos policy.

Similarly, when the qos-route-lookup command with the source parameter is applied to an IP interface and the source address of an incoming IP packet matches a route with QoS information the packet is classified to the fc and priority associated with that route, overriding the fc and priority/profile determined from the sap-ingress or network qos policy associated with the IP interface. If the source address of the incoming packet matches a route with no QoS information the fc and priority of the packet remain as determined by the sap-ingress or network qos policy.

Currently, QPPB is not supported for ingress MPLS traffic on network interfaces or on CsC PE'-CE' interfaces (config>service>vprn>nw-if).

Note: QPPB based on a source IP address is not supported for ingress subscriber management traffic on a group interface.

2.2.1.7.4 QPPB When Next-Hops are Resolved by QPPB Routes

In some circumstances (IP VPN inter-AS model C, Carrier Supporting Carrier, indirect static routes, etc.) an IPv4 or IPv6 packet may arrive on a QPPB-enabled interface and match a route A1 whose next-hop N1 is resolved by a route A2 with next-hop N2 and perhaps N2 is resolved by a route A3 with next-hop N3, etc. In release 9.0 the QPPB result is based only on the forwarding-class and priority of route A1. If A1 does not have a forwarding-class and priority association then the QoS classification is not based on QPPB, even if routes A2, A3, etc. have forwarding-class and priority associations.

2.2.1.7.5 QPPB and Multiple Paths to a Destination

When ECMP is enabled some routes may have multiple equal-cost next-hops in the forwarding table. When an IP packet matches such a route the next-hop selection is typically based on a hash algorithm that tries to load balance traffic across all the next-hops while keeping all packets of a given flow on the same path. The QPPB configuration model described in Associating an FC and Priority with a Route allows different QoS information to be associated with the different ECMP next-hops of a route. The forwarding-class and priority of a packet matching an ECMP route is based on the particular next-hop used to forward the packet.

When Edge PIC [1] is enabled some BGP routes may have a backup next-hop in the forwarding table in addition to the one or more primary next-hops representing the equal-cost best paths allowed by the ECMP/multipath configuration. When an IP packet matches such a route a reachable primary next-hop is selected (based on the hash result) but if all the primary next-hops are unreachable then the backup next-hop is used. The QPPB configuration model described in Associating an FC and Priority with a Route allows the forwarding-class and priority associated with the backup path to be different from the QoS characteristics of the equal-cost best paths. The forwarding class and priority of a packet forwarded on the backup path is based on the **fc** and priority of the backup route.

2.2.1.7.6 QPPB and Policy-Based Routing

When an IPv4 or IPv6 packet with destination address X arrives on an interface with both QPPB and policy-based-routing enabled:

- There is no QPPB classification if the IP filter action redirects the packet to a directly connected interface, even if X is matched by a route with a forwarding-class and priority
- QPPB classification is based on the forwarding-class and priority of the route matching IP address Y if the IP filter action redirects the packet to the indirect next-hop IP address Y, even if X is matched by a route with a forwarding-class and priority

2.2.1.8 QPPB and GRT Lookup

Source-address based QPPB is not supported on any SAP or spoke SDP interface of a VPRN configured with the **grt-lookup** command.

2.2.1.8.1 QPPB Interaction with SAP Ingress QoS Policy

When QPPB is enabled on a SAP IP interface the forwarding class of a packet may change from **fc1**, the original **fc** determined by the SAP ingress QoS policy to fc2, the new fc determined by QPPB. In the ingress datapath SAP ingress QoS policies are applied in the first P chip and route lookup/QPPB occurs in the second P chip. This has the implications listed below:

- Ingress remarking (based on profile state) is always based on the original fc (fc1) and sub-class (if defined).

- The profile state of a SAP ingress packet that matches a QPPB route depends on the configuration of **fc2** only. If the de-1-out-profile flag is enabled in **fc2** and **fc2** is not mapped to a priority mode queue then the packet will be marked out of profile if its DE bit = 1. If the profile state of **fc2** is explicitly configured (in or out) and **fc2** is not mapped to a priority mode queue then the packet is assigned this profile state. In both cases there is no consideration of whether or not **fc1** was mapped to a priority mode queue.
- The priority of a SAP ingress packet that matches a QPPB route depends on several factors. If the de-1-out-profile flag is enabled in **fc2** and the DE bit is set in the packet then priority will be low regardless of the QPPB priority or **fc2** mapping to profile mode queue, priority mode queue or policer. If **fc2** is associated with a profile mode queue then the packet priority will be based on the explicitly configured profile state of **fc2** (in profile = high, out profile = low, undefined = high), regardless of the QPPB priority or **fc1** configuration. If **fc2** is associated with a priority mode queue or policer then the packet priority will be based on QPPB (unless DE=1), but if no priority information is associated with the route then the packet priority will be based on the configuration of **fc1** (if **fc1** mapped to a priority mode queue then it is based on DSCP/IP prec/802.1p and if **fc1** mapped to a profile mode queue then it is based on the profile state of **fc1**).

Table 3 summarizes these interactions.

Table 3 **QPPB Interactions with SAP Ingress QoS**

Original FC object mapping	New FC object mapping	Profile	Priority (drop preference)	DE=1 override	In/out of profile marking
Profile mode queue	Profile mode queue	From new base FC unless overridden by DE=1	From QPPB, unless packet is marked in or out of profile in which case follows profile. Default is high priority	From new base FC	From original FC and sub-class
Priority mode queue	Priority mode queue	Ignored	If DE=1 override then low otherwise from QPPB. If no DEI or QPPB overrides then from original dot1p/exp/DSCP mapping or policy default.	From new base FC	From original FC and sub-class

Table 3 **QPPB Interactions with SAP Ingress QoS (Continued)**

Original FC object mapping	New FC object mapping	Profile	Priority (drop preference)	DE=1 override	In/out of profile marking
Policer	Policer	From new base FC unless overridden by DE=1	If DE=1 override then low otherwise from QPPB. If no DEI or QPPB overrides then from original dot1p/ exp/DSCP mapping or policy default.	From new base FC	From original FC and sub-class
Priority mode queue	Policer	From new base FC unless overridden by DE=1	If DE=1 override then low otherwise from QPPB. If no DEI or QPPB overrides then from original dot1p/ exp/DSCP mapping or policy default.	From new base FC	From original FC and sub-class
Policer	Priority mode queue	Ignored	If DE=1 override then low otherwise from QPPB. If no DEI or QPPB overrides then from original dot1p/ exp/DSCP mapping or policy default.	From new base FC	From original FC and sub-class
Profile mode queue	Priority mode queue	Ignored	If DE=1 override then low otherwise from QPPB. If no DEI or QPPB overrides then follows original FC's profile mode rules.	From new base FC	From original FC and sub-class
Priority mode queue	Profile mode queue	From new base FC unless overridden by DE=1	From QPPB, unless packet is marked in or out of profile in which case follows profile. Default is high priority	From new base FC	From original FC and sub-class
Profile mode queue	Policer	From new base FC unless overridden by DE=1	If DE=1 override then low otherwise from QPPB. If no DEI or QPPB overrides then follows original FC's profile mode rules.	From new base FC	From original FC and sub-class

Table 3 **QPPB Interactions with SAP Ingress QoS (Continued)**

Original FC object mapping	New FC object mapping	Profile	Priority (drop preference)	DE=1 override	In/out of profile marking
Policer	Profile mode queue	From new base FC unless overridden by DE=1	From QPPB, unless packet is marked in or out of profile in which case follows profile. Default is high priority	From new base FC	From original FC and sub-class

2.2.2 Router ID

The router ID, a 32-bit number, uniquely identifies the router within an autonomous system (AS) (see Autonomous Systems (AS)). In protocols such as OSPF, routing information is exchanged between areas, groups of networks that share routing information. It can be set to be the same as the loopback address. The router ID is used by both OSPF and BGP routing protocols in the routing table manager instance.

There are several ways to obtain the router ID. On each router, the router ID can be derived in the following ways.

- Define the value in the **config>router** *router-id* context. The value becomes the router ID.
- Configure the system interface with an IP address in the **config>router>interface** *ip-int-name* context. If the router ID is not manually configured in the **config>router** *router-id* context, then the system interface acts as the router ID.
- If neither the system interface or router ID are implicitly specified, then the router ID is inherited from the last four bytes of the MAC address.
- The router can be derived on the protocol level; for example, BGP.

2.2.3 Autonomous Systems (AS)

Networks can be grouped into areas. An area is a collection of network segments within an AS that have been administratively assigned to the same group. An area's topology is concealed from the rest of the AS, which results in a significant reduction in routing traffic.

Routing in the AS takes place on two levels, depending on whether the source and destination of a packet reside in the same area (intra-area routing) or different areas (inter-area routing). In intra-area routing, the packet is routed solely on information obtained within the area; no routing information obtained from outside the area can be used. This protects intra-area routing from the injection of bad routing information.

Routers that belong to more than one area are called area border routers. All routers in an AS do not have an identical topological database. An area border router has a separate topological database for each area it is connected to. Two routers, which are not area border routers, belonging to the same area, have identical area topological databases.

Autonomous systems share routing information, such as routes to each destination and information about the route or AS path, with other ASs using BGP. Routing tables contain lists of next hops, reachable addresses, and associated path cost metrics to each router. BGP uses the information and path attributes to compile a network topology.

2.2.4 Confederations

Configuring confederations is optional and should only be implemented to reduce the IBGP mesh inside an AS. An AS can be logically divided into smaller groupings called sub-confederations and then assigned a confederation ID (similar to an autonomous system number). Each sub-confederation has fully meshed IBGP and connections to other ASs outside of the confederation.

The sub-confederations have EBGP-type peers to other sub-confederations within the confederation. They exchange routing information as if they were using IBGP. Parameter values such as next hop, metric, and local preference settings are preserved. The confederation appears and behaves like a single AS.

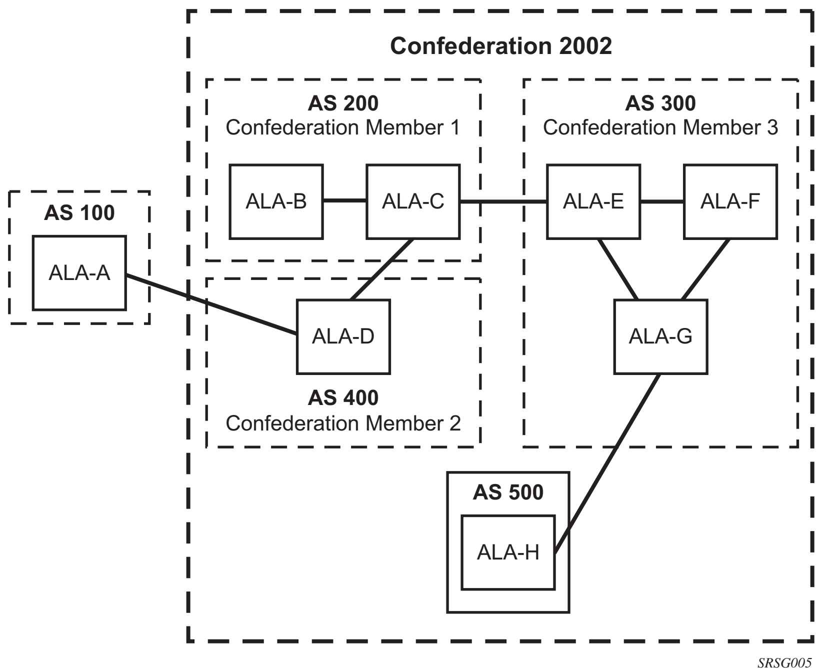
Confederations have the following characteristics.

- A large AS can be sub-divided into sub-confederations.
- Routing *within* each sub-confederation is accomplished via IBGP.
- EBGP is used to communicate *between* sub-confederations.
- BGP speakers within a sub-confederation must be fully meshed.
- Each sub-confederation (member) of the confederation has a different AS number. The AS numbers used are typically in the private AS range of 64512 — 65535.

To migrate from a non-confederation configuration to a confederation configuration requires a major topology change and configuration modifications on each participating router. Setting BGP policies to select an optimal path through a confederation requires other BGP modifications.

There are no default confederations. Router confederations must be explicitly created. Figure 2 depicts a confederation configuration example.

Figure 2 **Confederation Configuration**



2.2.5 Proxy ARP

Proxy ARP is the technique in which a router answers ARP requests intended for another node. The router appears to be present on the same network as the “real” node that is the target of the ARP and takes responsibility for routing packets to the “real” destination. Proxy ARP can help nodes on a subnet reach remote subnets without configuring routing or a default gateway.

Typical routers only support proxy ARP for directly attached networks; the router is targeted to support proxy ARP for all known networks in the routing instance where the virtual interface proxy ARP is configured.

In order to support DSLAM and other edge like environments, proxy ARP supports policies that allow the provider to configure prefix lists that determine for which target networks proxy ARP will be attempted and prefix lists that determine for which source hosts proxy ARP will be attempted.

In addition, the proxy ARP implementation will support the ability to respond for other hosts within the local subnet domain. This is needed in environments such as DSL where multiple hosts are in the same subnet but can not reach each other directly.

Static ARP is used when a Nokia router needs to know about a device on an interface that cannot or does not respond to ARP requests. Thus, the configuration can state that if it has a packet with a certain IP address to send it to the corresponding ARP address. Use proxy ARP so the router responds to ARP requests on behalf of another device.

2.2.6 Exporting an Inactive BGP Route from a VPRN

The **export-inactive-bgp** command under config>service>vprn introduces an IP VPN configuration option that allows the best BGP route learned by a VPRN to be exported as a VPN-IP route even when that BGP route is inactive due to the presence of a more preferred BGP-VPN route from another PE. This “best-external” type of route advertisement is useful in active/standby multi-homing scenarios because it can ensure that all PEs have knowledge of the backup path provided by the standby PE.

2.2.7 DHCP Relay

Refer to the *Triple Play Guide* for information about DHCP relay and support, as well as configuration examples.

2.2.8 Internet Protocol Versions

The TiMOS implements IP routing functionality, providing support for IP version 4 (IPv4) and IP version 6 (IPv6). IP version 6 (RFC 1883, *Internet Protocol, Version 6 (IPv6)*) is a newer version of the Internet Protocol designed as a successor to IP version 4 (IPv4) (RFC-791, *Internet Protocol*). The changes from IPv4 to IPv6 effect the following categories:

- Expanded addressing capabilities — IPv6 increases the IP address size from 32 bits (IPv4) to 128 bits, to support more levels of addressing hierarchy, a much greater number of addressable nodes, and simpler auto-configuration of addresses. The scalability of multicast routing is improved by adding a scope field to multicast addresses. Also, a new type of address called an anycast address is defined that is used to send a packet to any one of a group of nodes.
- Header format simplification — Some IPv4 header fields have been dropped or made optional to reduce the common-case processing cost of packet handling and to limit the bandwidth cost of the IPv6 header.
- Improved support for extensions and options — Changes in the way IP header options are encoded allows for more efficient forwarding, less stringent limits on the length of options, and greater flexibility for introducing new options in the future.
- Flow labeling capability — The capability to enable the labeling of packets belonging to particular traffic flows for which the sender requests special handling, such as non-default quality of service or “real-time” service was added in IPv6.
- Authentication and privacy capabilities — Extensions to support authentication, data integrity, and (optional) data confidentiality are specified for IPv6.

Figure 3 **IPv6 Header Format**

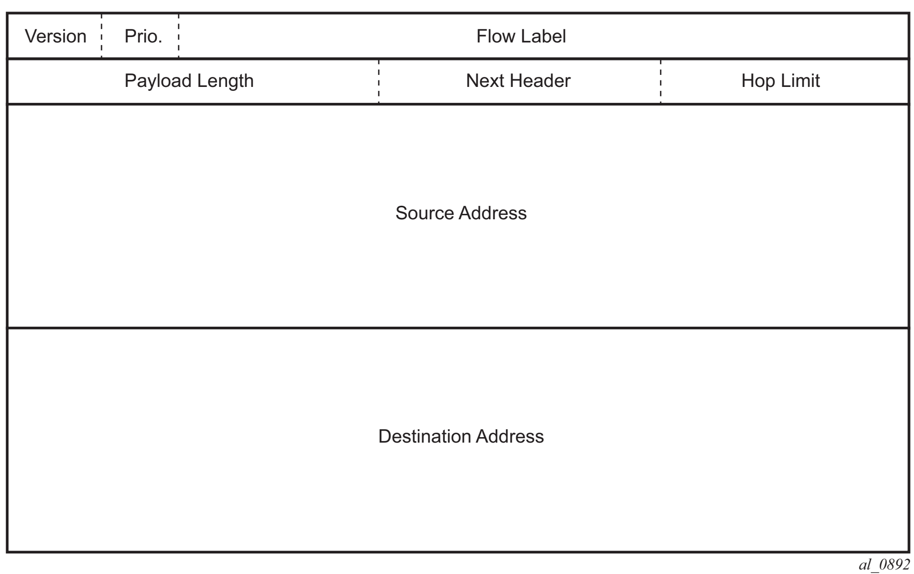


Table 4 **IPv6 Header Field Descriptions**

Field	Description
Version	4-bit Internet Protocol version number = 6.
Prio.	4-bit priority value.
Flow Label	24-bit flow label.
Payload Length	16-bit unsigned integer. The length of payload, for example, the rest of the packet following the IPv6 header, in octets. If the value is zero, the payload length is carried in a jumbo payload hop-by-hop option.
Next Header	8-bit selector. Identifies the type of header immediately following the IPv6 header. This field uses the same values as the IPv4 protocol field.
Hop Limit	8-bit unsigned integer. Decremented by 1 by each node that forwards the packet. The packet is discarded if the hop limit is decremented to zero.
Source Address	128-bit address of the originator of the packet.
Destination Address	128-bit address of the intended recipient of the packet (possibly not the ultimate recipient if a routing header is present).

2.2.8.1 IPv6 Address Format

IPv6 uses a 128-bit address, as opposed to the IPv4 32-bit address. Unlike IPv4 addresses, which use the dotted-decimal format, with each octet assigned a decimal value from 0 to 255, IPv6 addresses use the colon-hexadecimal format X:X:X:X:X:X:X:X, where each X is a 16-bit section of the 128-bit address. For example:

2001:0DB8:0000:0000:0000:0000:0000:0000

Leading zeros must be omitted from each block in the address. A series of zeros can be replaced with a double colon. For example:

2001:DB8::

The double colon can only be used once in an address.

The IPv6 prefix is the part of the IPv6 address that represents the network identifier. The network identifier appears at the beginning of the IP address. The IPv6 prefix length, which begins with a forward slash (/), shows how many bits of the address make up the network identifier. For example, the address 1080:6809:8086:6502::1/64 means that the first 64 bits of the address represent the network identifier; the remaining 64 bits represent the node identifier.

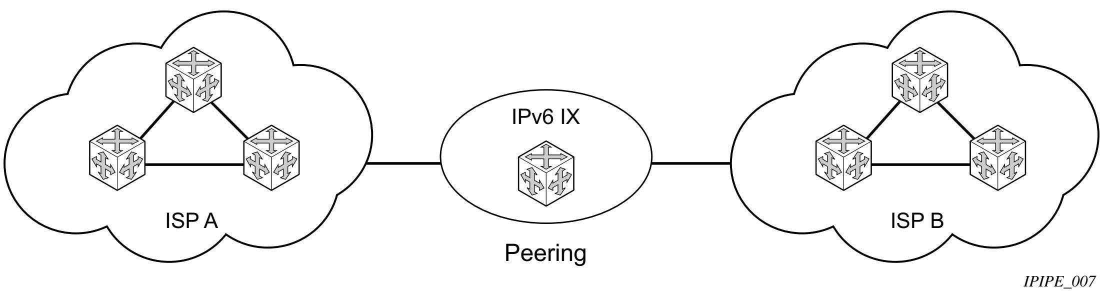
Note: In SR OS 12.0.R4 and later, any function that displays an IPv6 address or prefix changes to reflect rules described in RFC 5952, *A Recommendation for IPv6 Address Text Representation*. Specifically, hexadecimal letters in IPv6 addresses are now represented in lowercase, and the correct compression of all leading zeros is displayed. This changes visible display output compared to previous SR OS releases. Previous SR OS behavior can cause issues with operator scripts that use standard IPv6 address expressions and with libraries that have standard IPv6 parsing as per RFC 5952 rules.

2.2.8.2 IPv6 Applications

Examples of the IPv6 applications supported by the TiMOS include:

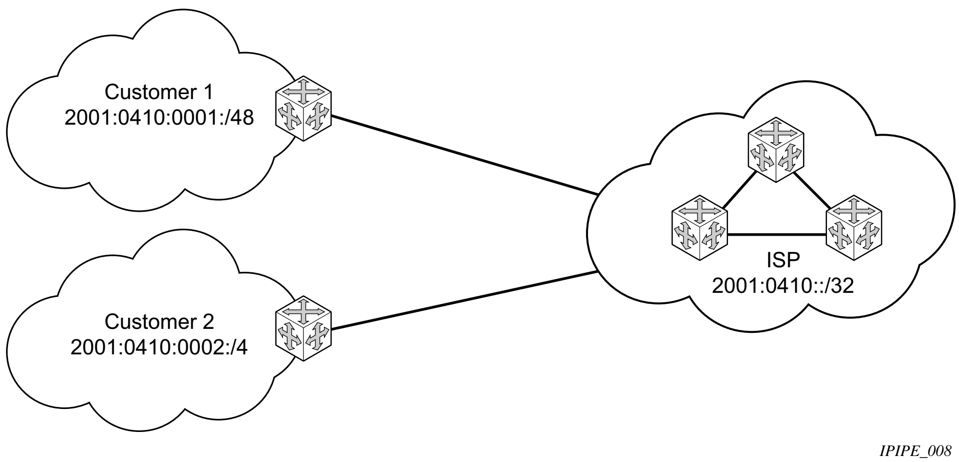
- IPv6 Internet exchange peering — Figure 4 shows an IPv6 Internet exchange where multiple ISPs peer over native IPv6.

Figure 4 **IPv6 Internet Exchange**



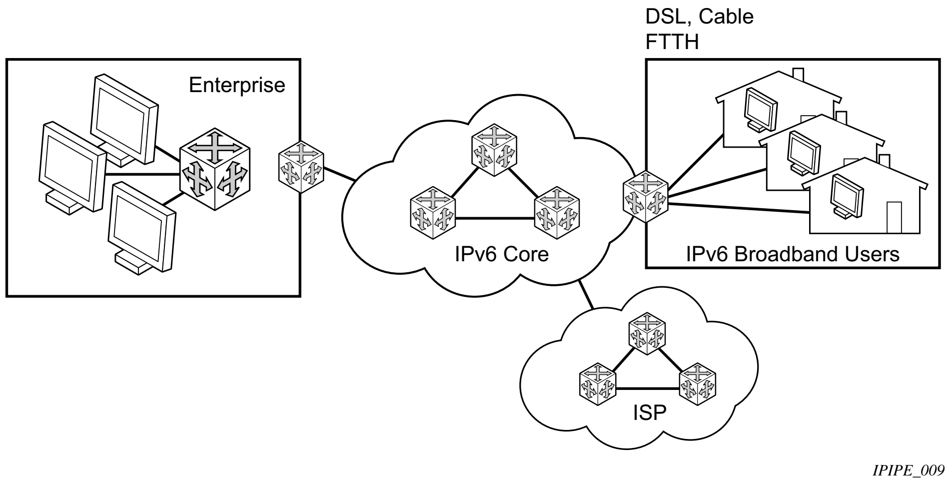
- IPv6 transit services — Figure 5 shows IPv6 transit provided by an ISP.

Figure 5 **IPv6 Transit Services**



- IPv6 services to enterprise customers and home users — Figure 6 shows IPv6 connectivity to enterprise and home broadband users.

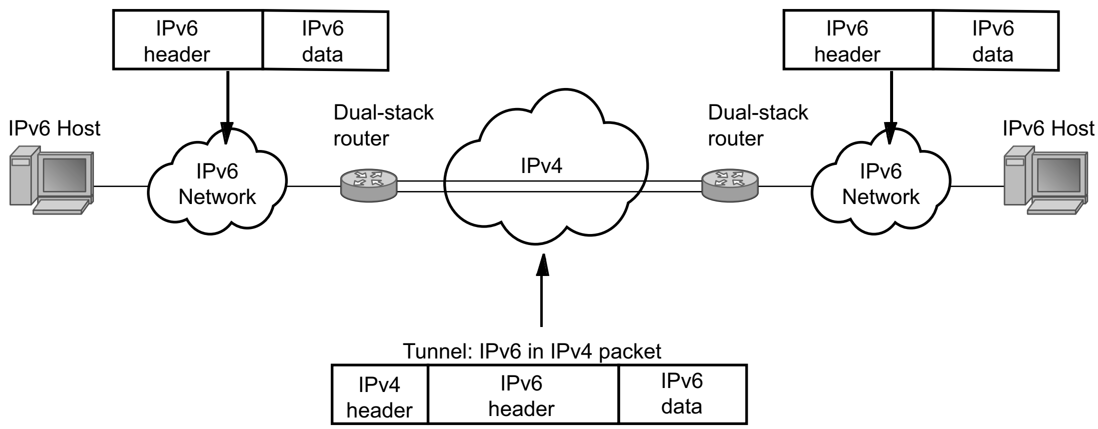
Figure 6 **IPv6 Services to Enterprise Customers and Home Users**



- IPv6 over IPv4 relay services — IPv6 over IPv4 tunnels are one of many IPv6 transition methods to support IPv6 in an environment where not only IPv4 exists but native IPv6 networks depend on IPv4 for greater IPv6 connectivity. Nokia routers support dynamic IPv6 over IPv4 tunneling. The ipv4 source and destination address are taken from configuration, the source address is the ipv4 system address and the ipv4 destination is the next hop from the configured 6over4 tunnel.

IPv6 over IPv4 is an automatic tunnel method that gives a prefix to the attached IPv6 network. Figure 7 shows IPv6 over IPv4 tunneling to transition from IPv4 to IPv6.

Figure 7 **IPv6 over IPv4 Tunnels**



2.2.8.3 DNS

The DNS client is extended to use IPv6 as transport and to handle the IPv6 address in the DNS AAAA resource record from an IPv4 or IPv6 DNS server. An assigned name can be used instead of an IPv6 address since IPv6 addresses are more difficult to remember than IPv4 addresses.

2.2.8.4 Secure Neighbor Discovery (SeND)

Secure Neighbor Discovery (SeND) in conjunction with Cryptographically Generated Addresses (CGAs) introduce a concept that allows operators to secure IPv6 neighbor discovery between nodes on a common Layer 2 network segment.

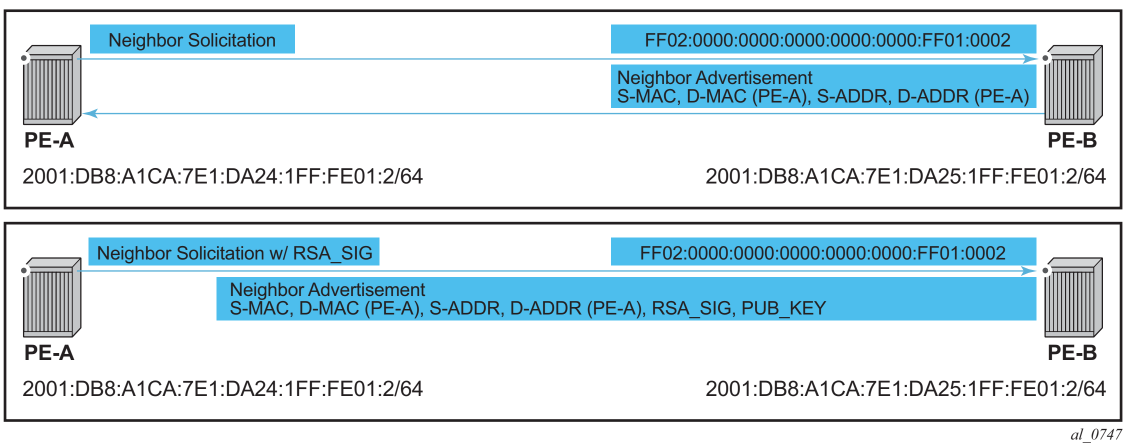
When SeND is enabled on an interface, CGAs must be enabled and static GUA/LLA IPv6 addressing is not supported. In this case, the router will generate a CGA from the configured prefix (GUA, LLA) and use that address for all communication. The router will validate NS/ND messages from other nodes on the network segment, and only install them in the neighbor cache if they pass validation.

A number of potential use-cases for SeND exist in order to secure the network from deliberate or accidental tampering during neighbor discovery; principally to prevent hijacking of in-use IPv6 addressing or man-in-the-middle attacks; but also to validate whether a node is permitted to participate in neighbor discovery at all; or to validate which routers are permitted to act as default gateways.

SeND impacts the following areas of neighbor discovery:

- Neighbor solicitation (solicited-node multicast address; target address)
- Neighbor advertisement (solicited; unsolicited)
- Router solicitation
- Router advertisement
- Redirect messages

Figure 8 **Neighbor discovery with and without SeND**



When SeND is enabled on a node, basic neighbor discovery messaging is changed as illustrated in Figure 8. In the example, PE-A wants to find the MAC address of PE-B.

1. PE-A sends an NS message to the solicited node multicast address for PE-B's address with the CGA option, RSA signature option, timestamp option, and nonce option.
2. PE-B processes the NS message, and as it is configured for SeND operation, processes the NS. PE-B will validate the source address of the packet to ensure it is a valid CGA; then validate the cryptographic signature embedded in the NS message.

3. PE-B generates a NA message which is sent back to PE-A with the solicited bit, router bit set. The source address is that of PE-B, while the destination address is that of PE-A from the NS message. The timestamp is generated from PE-B, while the nonce is copied from PE-A's NS message
4. PE-A receives the NA and completes similar checks as PE-B did.

If all steps process correctly, then both nodes will install each other’s addresses into their neighbor cache database.

2.2.8.5 SeND Persistent CGAs

Persistent CGAs is an enhancement of the SeND feature.

Previously, all generated CGAs on SeND-enabled interfaces remained unchanged after a CPM switchover, but after a reboot from a saved configuration file, all CGAs were regenerated.

To keep the same CGAs after a reboot from a saved configuration file:

1. Save the RSA key pair used for SeND.
2. Save the modifiers used during the CGA generation.

To make the CGAs persistent:

1. Import an online or offline generated RSA key pair for SeND.
2. Make sure that the CompactFlash (CF) file(s) containing an RSA key pair that is used for SeND, is (are) synchronized to the standby CPM by making use of the HA infrastructure used for certificates.
3. Make sure the configuration file is saved when one or more CGAs are generated.

2.2.8.5.1 Persistent RSA Key Pair

The RSA key pair is stored in a file on the CF.

Generate an RSA Key Pair

To generate an RSA key pair, use the **admin certificate gen-keypair** command:

admin certificate gen-keypair *local-url* **[type rsa] size 1024**

For example

```
admin certificate gen-keypair cf1:\myDir\myRsaKeyPair type rsa size 1024
```

This generates a der formatted file.

Import an online/offline generated RSA key pair

To import a generated RSA key pair, use the **admin certificate secure-nd-import** command:

admin certificate secure-nd-import *local-url* **format {der | pem | pkcs12} [password <***password***>] [key-rollover]**

For example

```
admin certificate secure-nd-import cf1:\myDir\myRsaKeyPair format der
```

- Since SeND only uses RSA key pairs, the command is refused if the imported key type is not RSA.
- Since SeND only supports key size 1024, the command is refused if the imported key size is not 1024.
- The password has to be specified when an offline generated file in pkcs12 format has to be imported.
- **key-rollover** keyword: see the *RSA key pair rollover mechanism* section that follows.
- Creates the file cfx:\system-pki\secureNdKey (fixed directory and file name) and saves the imported key in that file in encrypted der format (same as the **admin certificate import** command).
- The RSA key pair is uploaded in the memory of SeND.

RSA key pair rollover mechanism

To trigger a key rollover, use the **admin certificate secure-nd-import** command described in the previous section Import an online/offline generated RSA key pair.

For example

```
admin certificate secure-nd-import cf1:\myDir\myOtherRsaKeyPair format der key-
rollover
```

- If CGAs exist that are generated based on an auto-generated or previously imported RSA key pair and the **key-rollover** keyword is not specified, the **secure-nd-import** command is refused.
- If a **secure-nd-import** with **key-rollover** is requested while a previous key rollover is still being handled, the new command is refused.

- If the **secure-nd-import** command is accepted, the imported RSA key pair is written to the file cfx:\system-pki\secureNdKey and loaded to SeND. Existing CGAs if any will be regenerated.
- While handling a key rollover, SeND keeps track of which interface uses which RSA key pair. Hence temporarily SeND can have two RSA key pairs in use. At all times only the latest RSA key pair is stored in the file cfx:\system-pki\secureNdKey. When the rollover is finished, the RSA key pair that is no longer referred to, is deleted from SeND's memory.

Auto-generation of RSA key pair

The first time an interface becomes SeND enabled, SeND needs an RSA key pair to generate or check a modifier and to generate a CGA.

If the operator did not import an RSA key pair for SeND, an auto-generated RSA key pair will be used as a fallback.

The auto-generated RSA key pair is synced to the standby CPM as it is done in the previous release, but it will not be written to the CF. Therefore, all CGAs generated via an auto-generated RSA key pair, are not persistent. A warning will be given whenever a non-persistent CGA is generated.

The **admin certificate secure-nd-import** command without the **key-rollover** keyword will be refused if CGAs exist that made use of the auto-generated RSA key pair. Specifying the **key-rollover** keyword will result in regeneration of the CGAs.

See the section Making non-persistent CGAs persistent for more information on the procedure to make non-persistent CGAs persistent,

HA

For the synchronization of the RSA key pair file in cfx:\system-pki\ used by SeND, the following commands for automatic and manual certificate synchronization are used:

- manual: **admin redundancy synchronize cert**
- automatic: **configure redundancy cert-sync**

SeND also synchronizes the RSA key pair to the standby CPM as it is done in the previous release.

2.2.8.5.2 Persistent CGA Modifier

The modifier used during the CGA generation will be saved in the configuration file. The CGA itself is not stored.

Based on the stored modifier and RSA key pair, the same CGA can be regenerated.

The modifier is needed to be sent out in ND messages.

By storing the modifier in the configuration file, the operator can also configure an offline generated modifier (possibly with a security parameter > 1).

Example 1: Configure a SeND interface without modifiers.

```
configure router interface itf1
    address 10.10.10.1
    port 1/1/1
    ipv6
         secure-nd
              no shutdown
```

=> A modifier is generated based on the actual RSA key pair (that is, imported or auto-generated). The modifier is used to generate a link-local CGA.

=> The modifier is saved in the interface configuration file.

```
         exit
         address 2000:1::/64
```

=> A modifier is generated based on the actual RSA key pair. The modifier is used to generate the global CGA.

=> The modifier is stored in the interface configuration file.

Example 2: Configure a SeND interface with modifiers.

```
configure router interface itf2
    address 10.10.10.2
    port 1/1/2
    ipv6
         secure-nd
              link-local-modifier 0xABCD
```

=> The offline generated modifier is used to generate the link-local CGA.

```
              no shutdown
         exit
         address 3000:1::/64
```

=> A modifier is generated based on the actual RSA key pair. The modifier is used to generate the global CGA.

=> The modifier is stored in the interface configuration file.

```
         address 3000:2::/64 modifier 0xABCD
```

=> The same offline generated modifier as the link-local address above is used for the generation of a global address.

```
address 3000:3::/64 modifier 0xABCD
```

=> Another offline generated modifier (*) is used for the generation of a global address.

=> For an offline generated modifier, a check is done to see if it is generated with the actual RSA key pair and the security parameter applicable for the interface. If this check fails, the command is refused, unless the command is triggered in the context of an exec of a config file: in this case, the modifier will be replaced by a new one that is generated based on the actual RSA key pair.

2.2.8.5.3 Making non-persistent CGAs persistent

CGAs can be non-persistent because:

- The operator forgot to configure an RSA key pair for SeND and hence the CGAs were generated based on an auto-generated RSA key pair.
- The operator forgot to synchronize an RSA key pair file to the stand-by CPM and a switch-over happens.
- The CGAs were generated by a software version not having persistent CGAs (such as, ISSU).
- The system was booted from a configuration file generated by a software version not having persistent CGAs.

Key rollover

You can import a new RSA key pair for SeND with the **key-rollover** keyword. This will result in the regeneration of all CGAs on all interfaces.

Exporting the SeND RSA key pair

Another method that does not result in the regeneration of the CGAs, is to export the RSA key pair that is currently in use by SeND to the system-pki directory via an admin command:

admin certificate secure-nd-export

This command will write the RSA key pair to the file cfx:\system-pki\secureNdKey in encrypted der format.

2.2.8.5.4 Booting from a saved configuration file

Configuration saved by a software version with persistent CGAs

The file cfx:\system-pki\secureNdKey should exist. This file will be automatically uploaded by SeND during initialization.

The configuration file should contain a modifier for each address on a SeND enabled interface.

Modifiers in the configuration file are checked against the current RSA key pair. If the check fails, a new modifier and CGA is generated and a warning is given to the operator that a new CGA is generated.

If a modifier is missing in the configuration file for an IPv6 /64 prefix on a SeND enabled interface, a new modifier and CGA will be generated based on the active RSA key pair.

Configuration saved by a software version having non-persistent CGAs

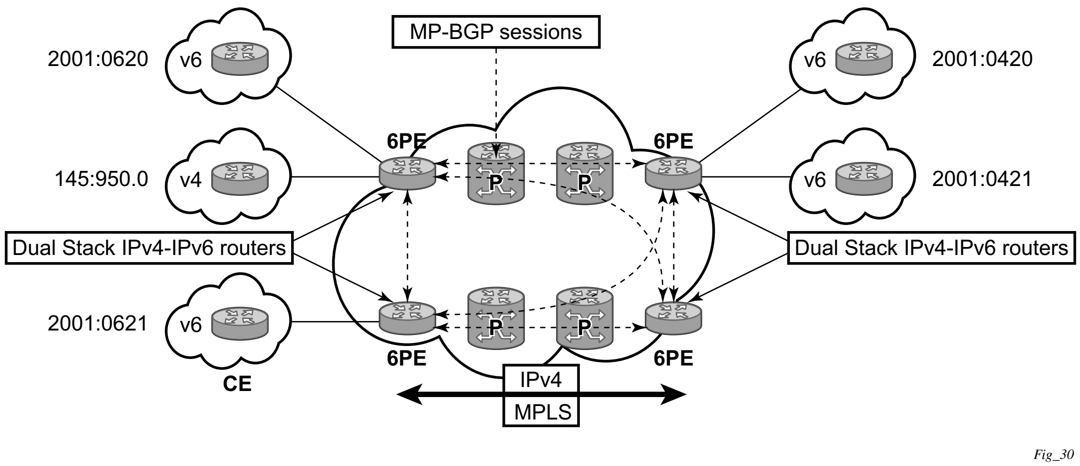
The file cfx:\system-pki\secureNdKey does not exist nor does the configuration file contain a modifier for any of the IPv6 /64 prefixes on secure-nd enabled interfaces.

New CGAs have to be generated (from the CLI context). Follow one of the procedures described in section Making non-persistent CGAs persistent to make the non-persistent CGA's persistent.

2.2.8.6 IPv6 Provider Edge Router over MPLS (6PE)

6PE allows IPv6 domains to communicate with each other over an IPv4 MPLS core network. This architecture requires no backbone infrastructure upgrades and no re-configuration of core routers, because forwarding is purely based on MPLS labels. 6PE is a cost effective solution for IPv6 deployment.

Figure 9 **Example of a 6PE Topology within One AS**



2.2.8.6.1 6PE Control Plane Support

The 6PE MP-BGP routers support:

- IPv4/IPv6 dual-stack
- MP-BGP can be used between 6PE routers to exchange IPv6 reachability information.
  - The 6PE routers exchange IPv6 prefixes over MP-BGP sessions running over IPv4 transport. The MP-BGP AFI used is IPv6 (value 2).
  - An IPv4 address of the 6PE router is encoded as an IPv4-mapped IPv6 address in the BGP next-hop field of the IPv6 NLRI. By default, the IPv4 address that is used for peering is used. It is configurable through the route policies.
  - The 6PE router binds MPLS labels to the IPv6 prefixes it advertises. The SAFI used in MP-BGP is the SAFI (value 4) label. The router uses the IPv6 explicit null (value 2) label for all the IPv6 prefixes that it advertises and can accept an arbitrary label from its peers.
- LDP is used to create the MPLS full mesh between the 6PE routers and the IPv4 addresses that are embedded in the next-hop field are reachable by LDP LSPs. The ingress 6PE router uses the LDP LSPs to reach remote 6PE routers.

2.2.8.6.2 6PE Data Plane Support

The ingress 6PE router can push two MPLS labels to send the packets to the egress 6PE router. The top label is an LDP label used to reach the egress 6PE router. The bottom label is advertised in MP-BGP by the remote 6PE router. Typically, the IPv6 explicit null (value 2) label is used but an arbitrary value can be used when the remote 6PE router is from a vendor other than Nokia.

The egress 6PE router pops the top LDP tunnel label. It sees the IPv6 explicit null label, which indicates an IPv6 packet is encapsulated. It also pops the IPv6 explicit null label and performs an IPv6 route lookup to find out the next hop for the IPv6 packet.

2.2.9 Static Route Resolution Using Tunnels

The user can forward packets of a static route to an indirect next-hop over a tunnel programmed in TTM by configuring the following static route tunnel binding command:

```
config>router>static-route-entry {ip-prefix/prefix-length} [mcast] indirect {ip-
address}
    tunnel-next-hop
        resolution {any|disabled|filter}
        resolution-filter
            [no] ldp
            [no] rsvp-te
                [no] lsp <name1>
                [no] lsp <name2>
                .
                .
                [no] lsp <namen>
            exit
            [no] sr-isis
            [no] sr-ospf
            [no] sr-te
                [no] lsp <name1>
                [no] lsp <name2>
                .
                .
                [no] lsp <namen>
            exit
        [no] disallow-igp
        exit
    exit
```

If **tunnel-next-hop** context is configured and **resolution** is set to **disabled**, the binding to tunnel is removed and resolution resumes in RTM to IP next-hops.

If **resolution** is set to **any**, any supported tunnel type in static route context will be selected following TTM preference.

The following tunnel types are supported in a static route context: RSVP-TE, LDP, Segment Routing (SR) Shortest Path, and Segment Routing Traffic Engineering (SR-TE).

- LDP

  The **ldp** value instructs the code to search for an LDP LSP with a FEC prefix corresponding to the address of the indirect next-hop. Both LDP IPv4 FEC and LDP IPv6 FEC can be used as the tunnel next-hop. However, only an indirect next-hop of the same family (IPv4 or IPv6) as the prefix of the route can use an LDP FEC as the tunnel next-hop. In other words, an IPv4 (IPv6) prefix can only be resolved to an LDP IPv4 (IPv6) FEC.

- RSVP-TE

  The **rsvp-te** value instructs the code to search for the set of lowest metric RSVP-TE LSPs to the address of the indirect next-hop. The LSP metric is provided by MPLS in the tunnel table. The static route treats a set of RSVP-TE LSPs with the same lowest metric as an ECMP set.

  The user has the option of configuring a list of RSVP-TE LSP names to be used exclusively instead of searching in the tunnel table. In that case, all LSPs must have the same LSP metric in order for the static route to use them as an ECMP set. Otherwise, only the LSPs with the lowest common metric value are selected.

  A P2P auto-lsp that is instantiated via an LSP template can be selected in TTM when **resolution** is set to **any**. However, it is not recommended to configure an auto-lsp name explicitly under the **rsvp-te** node as the auto-generated name can change if the node reboots, which will blackhole the traffic of the static route.

- SR Shortest Path

  When the **sr-isis** or **sr-ospf** value is enabled, an SR tunnel to the indirect next-hop is selected in the TTM from the lowest preference ISIS or OSPF instance, and if many instances have the same lowest preference, it is selected from the lowest numbered IS-IS or OSPF instance. Both SR-ISIS IPv4 and SR-ISIS IPv6 tunnels can be used as tunnel next-hops. However, only an indirect next-hop of the same family (IPv4 or IPv6) as the prefix of the route can use an SR-ISIS tunnel as a tunnel next-hop. In other words, an IPv4 (IPv6) prefix can only be resolved to a SR-ISIS IPv4 (IPv6).

- SR-TE

  The **sr-te** value instructs the code to search for the set of lowest metric SR-TE LSPs to the address of the indirect next-hop. The LSP metric is provided by MPLS in the tunnel table. The static route treats a set of SR-TE LSPs with the same lowest metric as an ECMP set.

The user has the option of configuring a list of SR-TE LSP names to be used exclusively instead of searching in the tunnel table. In that case, all LSPs must have the same LSP metric in order for the static route to use them as an ECMP set. Otherwise, only the LSPs with the lowest common metric value are selected.

If one or more explicit tunnel types are specified using the **resolution-filter** option, then only these tunnel types will be selected again following the TTM preference.

The user must set **resolution** to **filter** to activate the list of tunnel-types configured under resolution-filter.

If **disallow-igp** is enabled, the static route will not be activated using IP next-hops in RTM if no tunnel next-hops are found in TTM.

2.2.9.1 Static Route ECMP Support

The following is the ECMP behavior of a static route:

- ECMP is supported when resolving in RTM multiple static routes of the same prefix with multiple user-entered indirect IP next-hops. The system picks as many direct next-hops as available in RTM beginning from the first indirect next-hop and up to the value of the **ecmp** option in the system.
- ECMP is also supported when resolving in TTM a static route to a single indirect next-hop using a LDP tunnel when LDP has multiple direct next-hops.
- ECMP is supported when resolving in TTM a static route to a single indirect next-hop using a RSVP-TE tunnel type when there is more than one RSVP LSP with the same lowest metric to the indirect next-hop.
- ECMP is supported when resolving in TTM a static route to a single indirect next-hop using a list of user configured RSVP-TE LSP names when these LSPs have the same metric to the indirect next-hop.
- ECMP is supported when resolving in TTM multiple static routes of the same prefix with multiple user-entered indirect next-hops each binding to a tunnel type. The system picks as many tunnel next-hops as available in TTM beginning from the first indirect next-hop and up to the value of the **ecmp** option in the system. The spraying of flow packets is performed over the entire set of resolved next-hops which correspond to the selected indirect next-hops.
- ECMP is supported when resolving concurrently in RTM and TTM multiple static routes of the same prefix with multiple user entered indirect tunnel next-hops. There is no support for mixing IP and tunnel next-hops for the same prefix using different indirect next-hops. Tunnel next-hops preferred over IP next-hops.

2.3 Weighted Load-Balancing over MPLS LSP

The weighted load-balanced, or weighted-ecmp, feature sprays packets of IGP, BGP, and static route prefixes resolved to a set of ECMP tunnel next-hops proportionally to the weights configured for each MPLS LSP in the ECMP set.

Weighted load-balancing is supported in the following forwarding contexts:

- IGP prefix resolved to IGP shortcuts in RTM (**rsvp-shortcut** or **advertise-tunnel-link** enabled in the IGP instance).
- BGP prefix with the BGP next-hop resolved to IGP shortcuts in RTM (**rsvp-shortcut** enabled in the IGP instance).
- Static route prefix resolved to an indirect next-hop which itself is resolved to a set of equal-metric MPLS LSPs in TTM. The user can allow automatic selection or specify the names of the equal-metric MPLS LSPs in TTM to be used in the ECMP set.
- Static route prefix resolved to an indirect next-hop which itself is resolved to IGP shortcuts in RTM.
- BGP prefix with a BGP next-hop resolved to a static route which itself resolves to set of tunnel next-hops towards an indirect next-hop in RTM or TTM.
- BGP prefix resolving to another BGP prefix which next-hop is resolved to set of ECMP tunnel next-hops with a static route in RTM or TTM or to IGP shortcuts in RTM.

This feature does not modify the route calculation, thus the same set of ECMP next-hops is computed for a prefix. It also does not change the hash routine, but only the spraying of the flows over the tunnel next-hops is modified to reflect the normalized weight of each tunnel next-hop.

As part of this feature, static route implementation has been enhanced to support ECMP over a set of equal-cost MPLS LSPs. The user can allow automatic selection or specify the names of the equal-metric MPLS LSPs in TTM to be used in the ECMP set. For more information see Static Route Resolution Using Tunnels.

2.3.1 Weighted Load Balancing IGP, BGP, and Static Route Prefix Packets over IGP Shortcut

2.3.1.1 Feature Configuration

The user must have IGP shortcut or forwarding adjacency feature enabled in one or more IGP instances:

`config>router>ospf(isis)>rsvp-shortcut`

`config>router>ospf(isis)>advertise-tunnel-link`

The user can also disable specific MPLS LSPs from being used in IGP shortcut or forwarding adjacency by configuring the following:

`config>router>mpls>lsp>no igp-shortcut`

The user enables the weighted load balancing feature using the following new router level command:

`config>router>weighted-ecmp`

When this command is enabled, packets of IGP, BGP, and static route prefixes resolved to a set of ECMP tunnel next-hops are sprayed proportionally to the weights configured for each MPLS LSP in the ECMP set.

The user can configure a weight for each LSP using the following command:

`config>router>mpls>lsp>load-balancing-weight` *<32-bit-integer>*

For an auto-LSP signaled via an LSP template, the weight is configured using the following command:

`config>router>mpls>lsp-template>load-balancing-weight` *<32-bit-integer>*

There is no default weight value for an LSP. If one or more LSP in the ECMP set of a prefix does not have a weight configured, the regular ECMP spraying for the prefix will be performed. The user entered weight is normalized to the closest integer value which represents the number of entries in the ingress prefix hash table assigned to the LSP for the purpose of spraying packets of all prefixes resolved to this LSP. The higher the normalized weight, the more entries will be assigned to the LSP, the more packets will be sent to this LSP.

2.3.1.2 Feature Behavior

This section describes the details of the behavior of the weighted load-balancing feature for IGP, BGP, and static route prefixes resolved in RTM to IGP shortcuts.

When an IGP, BGP, or a static route prefix is resolved in RTM to a set of ECMP tunnel next-hops of type RSVP-TE and the router level **weighted-ecmp** option is enabled, the ingress hash table for the next-hop selection is populated with a number of tunnel next-hop entries for each LSP equal to the normalized LSP weight value. All prefixes resolving to the same set of ECMP tunnel next-hops use the same table.

This feature follows the following procedures:

1. MPLS populates the user configured LSP weight in TTM. When the global command **weighted-ecmp** is enabled, and if one or more LSPs in the ECMP set of a prefix does not have a weight configured, the regular ECMP spraying for the prefix will be performed.
2. IGP computes the normalized weight for each prefix tunnel next-hop. The minimum value of the normalized weight is 1 and the maximum if 64. IGP updates the route in RTM with the set of tunnel next-hops and normalized weights. RTM downloads the information to IOM for inclusion in the FIB.
3. The normalized weights of route tunnel next-hops are updated in the following cases:
   – When the main SPF is run following a trigger, e.g., network failure, and updates a given route with a modified set of tunnel next-hops. This will trigger a route re-download to the IOM and all users of RTM are notified.
   – The user adds or changes the weight of one or more LSPs. In this case, RTM will perform a route download to IOM but other users of RTM should not be notified since the route resolution did not change.
4. The weighted load balancing feature is only applied to a prefix when all the tunnel next-hops in the ECMP set have the same endpoint. If an IGP prefix resolves in RTM to a set of ECMP tunnel next-hops which do not terminate on the same endpoint, the regular ECMP spraying is performed. If BGP performs BGP ECMP to a set of BGP ECMP next-hops for a prefix [weighted-bgp-ecmp-prd], regular ECMP spraying is performed towards a given BGP next-hop if the subset of its tunnel next-hops does not terminate on the same endpoint.
5. Regular ECMP spraying is also applied if a prefix is resolved in RTM to an ECMP set which consists of a mix of IP and tunnel next-hops.
6. This feature is not supported in the following contexts:
   – Packets of BGP prefix with the BGP next-hop resolved in TTM to RSVP LSP (BGP shortcut).

– CPM generated packets, including OAM packets, which are looked-up in RTM and which are forwarded over tunnel next-hops. These will continue to be forwarded using either regular ECMP or by selecting one next-hop from the set as in existing implementation.

2.3.1.3 ECMP Considerations

The weight assigned to an LSP impacts only the forwarding decision, not the routing decision. In other words, it does not change the selection of the set of ECMP tunnel next-hops of a prefix when more next-hops exist than the value of the router **ecmp** option. This selection continues to follow the algorithm used in the IGP shortcut feature.

Once the set of tunnel next-hops is selected, the LSP weight is used to modulate the amount of packets forwarded over each next-hop.

2.3.1.4 Weighted Load Balancing Static Route Packets over MPLS LSP

2.3.1.4.1 Feature Configuration

The configuration of the resolution of a static route prefix to set of MPLS LSPs is covered in detail in Static Route Resolution Using Tunnels which also provides the selection rules among multiple LSP types: RSVP-TE, SR-TE, LDP, SR-ISIS, and SR-OSPF. A given static route of a prefix can only be resolved to a set of tunnel next-hops of the same type though for each indirect next-hop.

In order to perform ECMP over a set of configured MPLS LSPs the user must enter two or more LSP names to be used as tunnel next-hops. If automatic selection is performed, ECMP is performed if two or more MPLS LSPs are found in TTM to the indirect next-hop of the static route. All LSPs however must have the same LSP metric otherwise only the tunnel next-hops with the same lowest metric will be activated for the static route.

The user can force the metric of an LSP to a constant value using the following command:

CLI Syntax: `config>router>mpls>lsp>metric`

If the user enters for the same static route more LSP names with the same LSP metric than the value of the router level **ecmp** option, only the first configured LSPs which number equals the **ecmp** value will be selected. The remaining tunnel next-hops for the route will not be activated. When automatic MPLS LSP selection is performed in TTM, the lower tunnel-id is used as a tie-breaker among the same lowest metric LSPs.

In order to perform weighted load-balancing over the set of MPLS LSPs, either when the LSP names are provided or when auto-selection in TTM is performed, the user must also enable the weighted ECMP globally like for a static, IGP and BGP prefixes resolving to IGP shortcuts:

CLI Syntax: `config>router>weighted-ecmp`

2.3.1.4.2 Feature Behavior

The behavior of this feature in terms of RTM and IOM is exactly the same as in the case of BGP, IGP, and static route prefixes resolving to IGP shortcuts. See Feature Behavior for the details. In this case, the static route module computes the normalized weight for each prefix tunnel next-hop of the static route indirect next-hop. The minimum value of the normalized weight is 1 and the maximum if 64. The static route module updates the route in RTM with the set of tunnel next-hops and normalized weights. RTM downloads the information to IOM for inclusion in the FIB.

If one or more LSP in the ECMP set of a prefix static route does not have a weight configured, the regular ECMP spraying for the prefix will be performed.

ECMP is also supported when resolving in TTM the same static route with multiple user-entered indirect next-hops each binding to the same or different tunnel types. The system picks as many tunnel next-hops as available in RTM beginning from the first indirect next-hop and up to the value of the **ecmp** option in the system. In this case, the weighted load-balancing will be applied directly using the weights of the selected set of tunnel next-hops. If one or more LSP in the ECMP set of a prefix static route does not have a weight configured, or if one or more of the indirect next-hops binds to an LDP LSP, the regular ECMP spraying for the prefix will be performed.

If the same prefix is resolved via both a static route and an IGP shortcut route, then the RTM default protocol preference will install the static route only. As a result, the set of ECMP tunnel next-hops and the weighted load balancing behavior will be determined by the static route configuration and not of the IGP shortcut configuration.

2.3.2 Bi-directional Forwarding Detection

Bi-directional Forwarding Detection (BFD) is a light-weight, low-overhead, short-duration detection of failures in the path between two systems. If a system stops receiving BFD messages for a long enough period (based on configuration) it is assumed that a failure along the path has occurred and the associated protocol or service is notified of the failure.

BFD can provide a mechanism used for liveness detection over any media, at any protocol layer, with a wide range of detection times and overhead, to avoid a proliferation of different methods.

SR OS supports asynchronous and on demand modes of BFD in which BFD messages are set to test the path between systems.

If multiple protocols are running between the same two BFD endpoints then only a single BFD session is established, and all associated protocols will share the single BFD session.

In addition to the typical asynchronous mode, there is also an echo function defined within RFC 5880, *Bi-directional Forwarding Detection*, that allows either of the two systems to send a sequence of BFD echo packets to the other system, which loops them back within that system’s forwarding plane. If a number of these echo packets are lost then the BFD session is declared down.

2.3.2.1 BFD Control Packet

The base BFD specification does not specify the encapsulation type to be used for sending BFD control packets. Instead it is left to the implementers to use the appropriate encapsulation type for the medium and network. The encapsulation for BFD over IPv4 and IPv6 networks is specified in draft-ietf-bfd-v4v6-1hop-04.txt, *BFD for IPv4 and IPv6 (Single Hop)*. This specification requires that BFD control packets be sent over UDP with a destination port number of 3784 and the source port number must be within the range 49152 to 65535.

In addition, the TTL of all transmitted BFD packets must have an IP TTL of 255. All BFD packets received must have an IP TTL of 255 if authentication is not enabled. If authentication is enabled, the IP TTL should be 255 but can still be processed if it is not (assuming the packet passes the enabled authentication mechanism).

If multiple BFD sessions exist between two nodes, the BFD discriminator is used to de-multiplex the BFD control packet to the appropriate BFD session.

2.3.2.2 Control Packet Format

The BFD control packet has 2 sections, a mandatory section and an optional authentication section.

Figure 10 **Mandatory Frame Format**

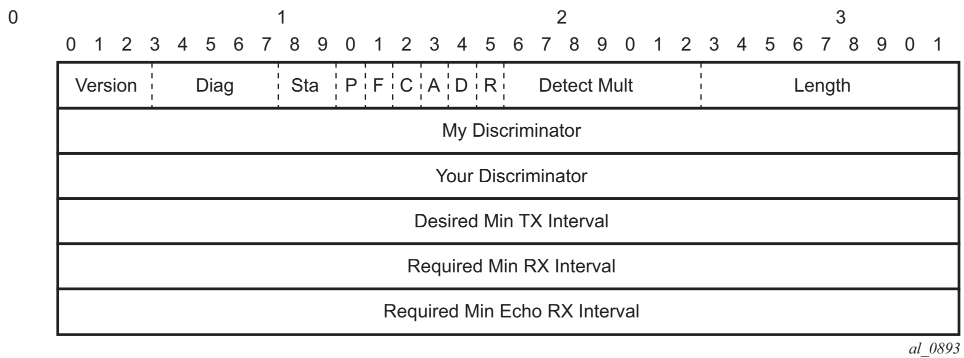


Table 5 **BFD Control Packet Field Descriptions**

Field	Description
Vers	The version number of the protocol. The initial protocol version is 0.
Diag	A diagnostic code specifying the local system’s reason for the last transition of the session from Up to some other state. Possible values are: 0-No diagnostic 1-Control detection time expired 2-Echo function failed 3-Neighbor signaled session down 4-Forwarding plane reset 5-Path down 6-Concatenated path down 7-Administratively down
D Bit	The “demand mode” bit. (Not supported)
P Bit	The poll bit. If set, the transmitting system is requesting verification of connectivity, or of a parameter change.
F Bit	The final bit. If set, the transmitting system is responding to a received BFD control packet that had the poll (P) bit set.
Rsvd	Reserved bits. These bits must be zero on transmit and ignored on receipt.

Table 5 **BFD Control Packet Field Descriptions (Continued)**

Field	Description
Length	Length of the BFD control packet, in bytes.
My Discriminator	A unique, nonzero discriminator value generated by the transmitting system, used to demultiplex multiple BFD sessions between the same pair of systems.
Your Discriminator	The discriminator received from the corresponding remote system. This field reflects back the received value of my discriminator, or is zero if that value is unknown.
Desired Min TX Interval	This is the minimum interval, in microseconds, that the local system would like to use when transmitting BFD control packets.
Required Min RX Interval	This is the minimum interval, in microseconds, between received BFD control packets that this system is capable of supporting.
Required Min Echo RX Interval	This is the minimum interval, in microseconds, between received BFD echo packets that this system is capable of supporting. If this value is zero, the transmitting system does not support the receipt of BFD echo packets.

2.3.2.3 BFD for RSVP-TE

BFD will notify RSVP-TE if the BFD session goes down, in addition to notifying other configured BFD enabled protocols (for example, OSPF, IS-IS and PIM). This notification will then be used by RSVP-TE to begin the reconvergence process. This greatly accelerates the overall RSVP-TE response to network failures.

All encapsulation types supporting IPv4 and IPv6 is supported as all BFD packets are carried in IPv4 and IPv6 packets; this includes Frame Relay and ATM.

BFD is supported on the following interfaces:

- Ethernet (Null, Dot1Q & QinQ)
- Spoke SDPs
- LAG interfaces

The following interfaces are supported only on the 7750 SR and 7450 ESS:

- VSM interfaces
- POS interfaces (including APS)
- Channelized interfaces (PPP, HDLC, FR and ATM) on ASAP (priority 1) and channelized MDAs (Priority 2) including link bundles and IMA

2.3.2.4 Echo Support

Echo support for BFD calls for the support of the echo function within BFD. By supporting BFD echo, the router loops back received BFD echo messages to the original sender based on the destination IP address in the packet.

The echo function is useful when the local router does not have sufficient CPU power to handle a periodic polling rate at a high frequency. As a result, it relies on the echo sender to send a high rate of BFD echo messages through the receiver node, which is only processed by the receiver's forwarding path. This allows the echo sender to send BFD echo packets at any rate.

The SR OS does not support the sending of echo requests, only the response to echo requests.

2.3.2.5 BFD Support for BGP

This feature enhancement allows BGP peers to be associated with the BFD session. If the BFD session failed, then BGP peering will also be torn down.

2.3.2.6 Centralized BFD

The following applications of centralized BFD require BFD to run on the SF/CPM.

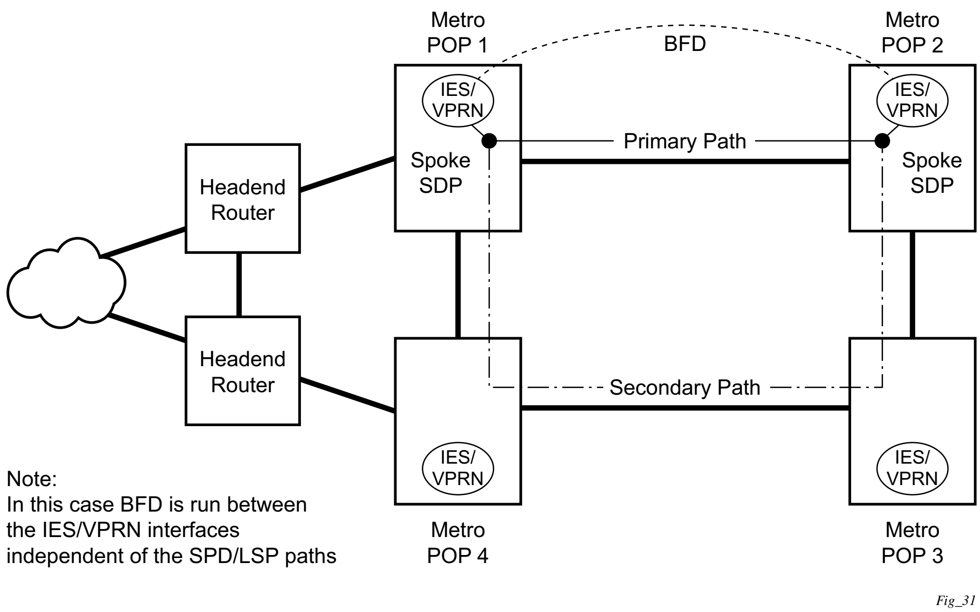
- IES Over Spoke SDP
- BFD Over LAG and VSM Interfaces

2.3.2.6.1 IES Over Spoke SDP

One application for a central BFD implementation is so BFD can be supported over spoke SDPs used to inter-connection IES or VPRN interfaces. When there are spoke SDPs for inter-connections over an MPLS network between two routers, BFD is used to speed up failure detections between nodes so re-convergence of unicast and multicast routing information can begin as quickly as possible.

The MPLS LSP associated with the spoke SDP can enter or egress from multiple interfaces on the box. BFD for these types of interfaces can not exist on the IOMXCM itself.

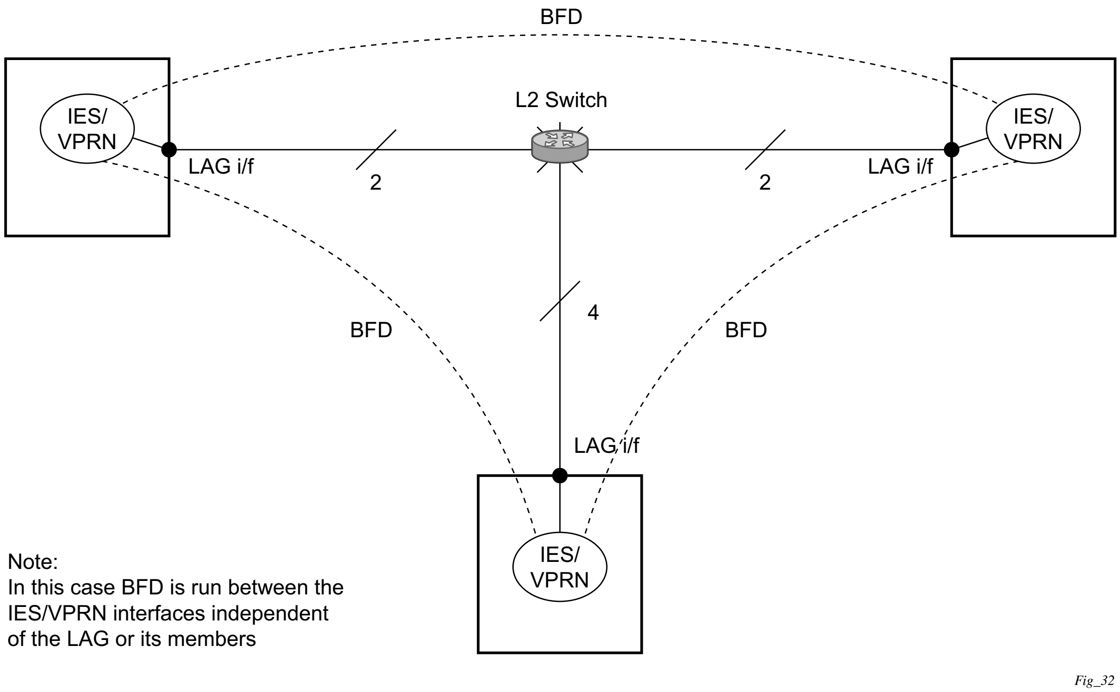
Figure 11 **BFD for IES/VPRN over Spoke SDP**



2.3.2.6.2 BFD Over LAG and VSM Interfaces

A second application for a central BFD implementation is so BFD can be supported over LAG or VSM interface. This is useful where BFD is not used for link failure detection but instead for node failure detection. In this application, the BFD session can run between the IP interfaces associated with the LAG or VSM interface, but there is only one session between the two nodes. There is no requirement for the message flow to across a certain link, or VSM, to get to the remote node.

Figure 12 **BFD Over LAG and VSM Interfaces**



2.3.2.7 Aggregate Next Hop

This feature adds the ability to configure an indirect next-hop for aggregate routes. The indirect next-hop specifies where packets will be forwarded if they match the aggregate route but not a more-specific route in the IP forwarding table.

2.3.2.8 Invalidate Next-Hop Based on ARP/Neighbor Cache State

This feature invalidates next-hop entries for static routes when the next-hop is no longer reachable on directly connected interfaces. This invalidation is based on ARP and Neighbor Cache state information.

When a next-hop is detected as no longer reachable due to ARP/Neighbor Cache expiry, the route's next-hop is set as unreachable to prevent the SR from sending continuous ARPs/Neighbor Solicitations triggered by traffic destined for the static route prefix. When the next-hop is detected as reachable via ARP or Neighbor Advertisements, the state of the next-hop is set back to valid.

2.3.2.8.1 Invalidate Next-Hop Based on IPV4 ARP

This feature invalidates a static route based on the reachability of the next-hop in the ARP cache when the **validate-next-hop** command is enabled within the **static-route-entry**>**next-hop** context for an IPv4 static route.

In this case, when the ARP entry for the next-hop is INVALID or not populated, the static route must remain invalid/inactive. When an ARP entry for the next-hop is populated based on a gratuitous ARP received or periodic traffic destined for it and the normal ARP who-has procedure, the static route becomes valid/active and is installed.

2.3.2.8.2 Invalidate Next-Hop Based on Neighbor Cache State

This feature invalidates a static route based on the reachability of the next-hop in the neighbor cache when the **validate-next-hop** command is enabled within the **static-route-entry**>**next-hop** context for an IPv6 static route.

In this case, when the Neighbor Cache entry for next-hop is INVALID or not populated, the static route must remain invalid/inactive. When an NC entry for next-hop is populated based on a neighbor advertisement received, or periodic traffic destined for it and the normal NS/NA procedure, the static route becomes valid/active and is installed.

2.3.2.9 LDP Shortcut for IGP Route Resolution

This feature enables you to forward user IP packets and specified control IP packets using LDP shortcuts over all network interfaces in the system that participate in the IS-IS and OSPF routing protocols. The default is to disable the LDP shortcut across all interfaces in the system.

config>router>ldp-shortcut [ipv4] [ipv6]

2.3.2.9.1 IGP Route Resolution

When LDP shortcut is enabled, LDP populates the RTM with next-hop entries corresponding to all prefixes for which it activated an LDP FEC. For a given prefix, two route entries are populated in RTM. One corresponds to the LDP shortcut next-hop and has an owner of LDP. The other one is the regular IP next-hop. The LDP shortcut next-hop always has preference over the regular IP next-hop for forwarding user packets and specified control packets over a given outgoing interface to the route next-hop.

The prior activation of the FEC by LDP is done by performing an exact match with an IGP route prefix in RTM. It can also be done by performing a longest prefix-match with an IGP route in RTM if the aggregate-prefix-match option is enabled globally in LDP *ldp-interarea-prd*.

The LDP next-hop entry is not exported to LDP control plane or to any other control plane protocols except OSPF, IS-IS, and specific OAM control plane as specified in Handling of Control Packets.

This feature is not restricted to /32 IPv4 prefixes or /128 IPv6 FEC prefixes. However only /32 IPv4 and /128 IPv6 FEC prefixes will be populated in the Tunnel Table for use as a tunnel by services.

All user and specified control packets for which the longest prefix match in RTM yields the FEC prefix will be forwarded over the LDP LSP. The following is an example of the resolution process.

Assume the egress LER advertised a FEC for some /24 prefix using the fec-originate command. At the ingress LER, LDP resolves the FEC by checking in RTM that an exact match exists for this prefix. Once LDP activated the FEC, it programs the NHLFE in the egress data path and the LDP tunnel information in the ingress data path tunnel table.

Next, LDP provides the shortcut route to RTM which will associate it with the same /24 prefix. There will be two entries for this /24 prefix, the LDP shortcut next-hop and the regular IP next-hop. The latter was used by LDP to validate and activate the FEC. RTM then resolves all user prefixes which succeed a longest prefix match against the /24 route entry to use the LDP LSP.

Assume now the aggregate-prefix-match was enabled and that LDP found a /16 prefix in RTM to activate the FEC for the /24 FEC prefix. In this case, RTM adds a new more specific route entry of /24 and has the next-hop as the LDP LSP but it will still not have a specific /24 IP route entry. RTM then resolves all user prefixes which succeed a longest prefix match against the /24 route entry to use the LDP LSP while all other prefixes which succeed a longest prefix-match against the /16 route entry will use the IP next-hop. LDP shortcut will also work when using RIP for routing.

2.3.2.9.2 LDP-IGP Synchronization

See the *SR OS MPLS Guide* for details of the LDP-IGP Synchronization.

2.3.2.9.3 LDP Shortcut Forwarding Plane

Once LDP activated a FEC for a given prefix and programmed RTM, it also programs the ingress Tunnel Table in IOM or on linecards with the LDP tunnel information.

When an IPv4 packet is received on an ingress network interface, a subscriber IES interface, or a regular IES interface, the lookup of the packet by the ingress IOM or linecard will result in the packet being sent labeled with the label stack corresponding to the NHLFE of the LDP LSP when the preferred RTM entry corresponds to an LDP shortcut.

If the preferred RTM entry corresponds to an IP next-hop, the IPv4 packet is forwarded unlabeled.

The switching from the LDP shortcut next-hop to the regular IP next-hop when the LDP FEC becomes unavailable depends on whether the next-hop is still available. If it is (for example, the LDP FEC was withdrawn due to LDP control plane issues) the switchover should be faster. If the next-hop determination requires IGP to re-converge, this will take longer. However no target is set.

The switching from a regular IP next-hop to an LDP shortcut next-hop will normally occur only when both are available. However, the programming of the NHLFE by LDP and the programming of the LDP tunnel information in the ingress IOM or linecards tunnel table are asynchronous. If Tunnel Table is configured first, it is possible that traffic will be black holed for some time.

2.3.2.9.4 ECMP Considerations

When ECMP is enabled and multiple equal-cost next-hops exit for the IGP route, the ingress IOM or linecard will spray the packets for this route based on hashing routine currently supported for IPv4 packets.

When the preferred RTM entry corresponds to an LDP shortcut route, spraying will be performed across the multiple next-hops for the LDP FEC. The FEC next-hops can either be direct link LDP neighbors or T-LDP neighbors reachable over RSVP LSPs in the case of LDP-over-RSVP but not both. This is as per ECMP for LDP in existing implementation.

When the preferred RTM entry corresponds to a regular IP route, spraying will be performed across regular IP next-hops for the prefix.

Spraying across regular IP next-hops and LDP-shortcut next-hops concurrently is not supported.

2.3.2.9.5 Handling of Control Packets

All control plane packets will not see the LDP shortcut route entry in RTM with the exception of the following control packets which will be forwarded over an LDP shortcut when enabled:

- A locally generated or in transit ICMP Ping and trace route of an IGP route. The transit message appears as a user packet to the ingress LER node.
- A locally generated response to a received ICMP ping or trace route message.

All other control plane packets that require an RTM lookup and knowledge of which destination is reachable over the LDP shortcut will continue to be forwarded over the IP next-hop route in RTM.

2.3.2.9.6 Handling of Multicast Packets

Multicast packets cannot be forwarded or received from an LDP LSP. This is because there is no support for the configuration of such an LSP as a tunnel interfaces in PIM. Only an RSVP P2MP LSP is currently allowed.

If a multicast packet is received over the physical interface, the RPF check will not resolve to the LDP shortcut as the LDP shortcut route in RTM is not made available to multicast application.

2.3.2.9.7 Interaction with BGP Route Resolution to an LDP FEC

There is no interaction between an LDP shortcut for BGP next-hop resolution and the LDP shortcut for IGP route resolution. BGP will continue to resolve a BGP next-hop to an LDP shortcut if the user enabled the following option in BGP:

```
config>router>bgp>next-hop-res>shortcut-tunnel
        family ipv4
            resolution-filter ldp
```

2.3.2.9.8 Interaction with Static Route Resolution to an LDP FEC

A static route will continue to be resolved by searching an LDP LSP which FEC prefix matches the specified indirect next-hop for the route. In contrast, the LDP shortcut for IGP route resolution uses the LDP LSP as a route. The most specific route for a prefix will be selected and if both a static and IGP routes exist, the RTM route type preference will be used to select one.

2.3.2.9.9 LDP Control Plane

In order for the LDP shortcut to be usable, an SR OS must originate a <FEC, label> binding for each IGP route it learns of even if it did not receive a binding from the next-hop for that route. In other words, it must assume it is an egress LER for the FEC until the route disappears from the routing table or the next-hop advertised a binding for the FEC prefix. In the latter case, the SR OS becomes a transit LSR for the FEC.

An SR OS will originate a <FEC, label> binding for its system interface address only by default. The only way to originate a binding for local interfaces and routes which are not local to the system is by using the fec-originate capability.

You must use the **fec-originate** command to generate bindings for all non-local routes for which this node acts as an egress LER for the corresponding LDP FEC. Specifically, this feature must support the FEC origination of IGP learned routes and subscriber/host routes statically configured or dynamically learned over subscriber IES interfaces.

An LDP LSP used as a shortcut by IPv4 packets may also be tunneled using the LDP-over-RSVP feature.

2.4 Weighted Load-Balancing over Interface Next-hops

When the **weighted-ecmp** command is configured in the base router context (**config>router**) or a VPRN (**config>service>vprn**), the associated IS-IS instances are allowed to program IPv4 and IPv6 ECMP routes to use weighted load-balancing across interface next-hops. The following conditions must be true:

- all ECMP next-hops must be interface next-hops
- all ECMP next-hops must be associated with the same neighbor IS-IS router

- all ECMP next-hop interfaces must have a non-zero **load-balancing-weight** value configured in the **config>router>isis>interface** context

  By default, IS-IS interfaces have a zero weight (**no load-balancing-weight**); non-zero values must be configured explicitly. Values cannot be auto-derived. The **config>router>isis>interface>load-balancing-weight** command accepts a value between 0 and 4294967295,

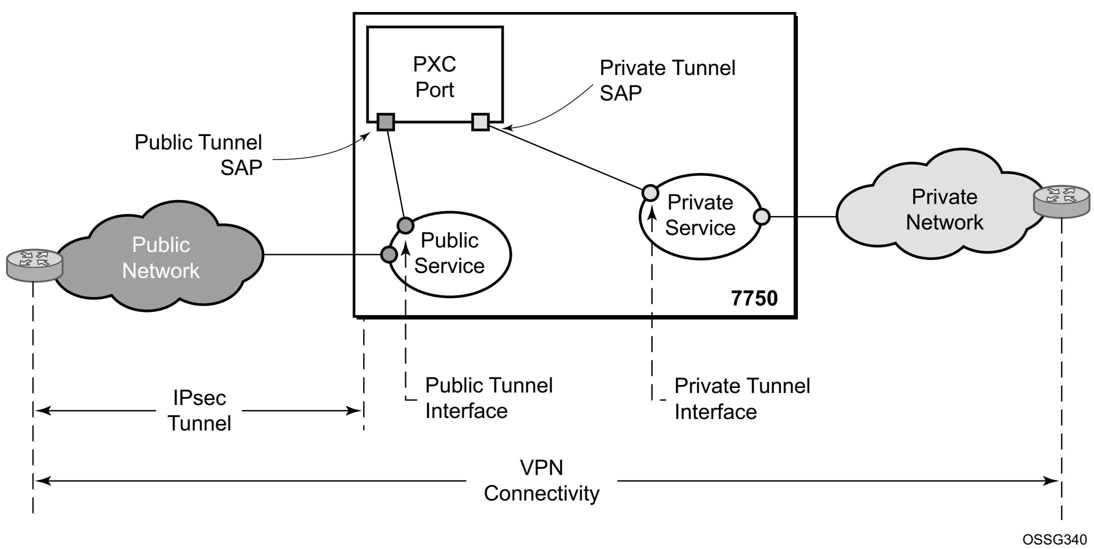
If a base router IPv4 or IPv6 BGP route has a BGP next-hop resolved by an ECMP IS-IS route and **ibgp-multipath** is configured under BGP, then traffic forwarded to the BGP next-hop is sprayed according to the load-balancing weights of the interface next-hops.

2.5 GRE Tunnel Overview

This section describes the GRE tunneling feature supported through the use of a Port Cross Connect (PXC) port. In this application, the PXC port functions as a resource module for the system, providing the necessary resources for the GRE encapsulation function. The GRE encapsulation function described here is similar to the GRE tunnel functionality supported through the use of the MS-ISA. In this use case, the MS-ISA is not required.

Figure 13 shows an example of a GRE deployment supported inside a 7750 SR router using the PXC element.

Figure 13 **Sample GRE Deployment Using a PXC Port**



In Figure 13, the public network is typically an unsecured network, such as public Internet, over which packets belonging to the private network in the diagram cannot be transmitted natively. Inside the 7750 SR, a public service instance (IES or VPRN) connects to the public network, and a private service instance (typically a VPRN) connects to the private network.

For GRE tunnels using PXC ports, the public and private services must be two different services, and the PXC is the connection between the two services. Traffic from the public network may require authentication and encryption inside an IPSec tunnel to reach the private network. In this way, the authenticity, confidentiality, and integrity of private network access can be enforced. If authentication and confidentiality are not required, then access to the private network may be provided through GRE or IP-IP tunnels.

Traffic flows through PXC-based tunnels in the following ways:

- In the upstream direction (public to private), the encapsulated traffic is forwarded to a public tunnel interface if the destination address matches the local or gateway address of a GRE tunnel. As the traffic passes through the PXC port, the tunnel header is removed, the payload IP packet is delivered to the private service, and from there, the traffic is forwarded again based on the destination address of the payload IP packet.
- In the downstream direction (private to public), unencapsulated traffic belonging to the private service is forwarded into the tunnel by matching a route with the GRE tunnel as next-hop. The route can be configured statically, learned by running OSPF on the private tunnel interface or by running BGP over the tunnel. After clear traffic is forwarded to the PXC port, it is encapsulated in the GRE header and passed to the public service, and from there, the traffic is forwarded again based on the destination address of the GRE header.

2.5.1 Sample GRE Tunnel Configurations

Public interface example:

```
config > service > ies 100
    interface "int-gre-tunnel-public" create
        address 192.110.1.1/30
        sap pxc-1.b:100 create //Public interface
            description "Public Tunnel PXC SAP"
            exit
        exit
    no shutdown
```

Private interface example:

```
config > service > vprn 200 customer 200 create
    route-distinguisher 64496:1
    vrf-target target:64496:1
    interface "int-gre-tunnel-private" tunnel create // Private if
        address 10.1.1.1/30
        ip-mtu 1476
        sap pxc-1.a:200 create
            ip-tunnel "gre-tunnel-1" create
                source 192.110.1.2
                remote-ip 192.120.1.1
                backup-remote-ip 192.120.1.2
                delivery-service 100
                gre-header send-key 123 receive-key 123
                no shutdown
                exit
            exit
        exit
    static-route 172.16.1.1/24 next-hop 10.1.1.2
... [additional SAPs and or SDP configuration]
```

2.6 Process Overview

The following items are components to configure basic router parameters.

- Interface — A logical IP routing interface. Once created, attributes like an IP address, port, link aggregation group or the system can be associated with the IP interface.
- Address — The address associates the device’s system name with the IP system address. An IP address must be assigned to each IP interface.
- System interface — This creates an association between the logical IP interface and the system (loopback) address. The system interface address is the circuitless address (loopback) and is used by default as the router ID for protocols such as OSPF and BGP.
- Router ID — (Optional) The router ID specifies the router's IP address.
- Autonomous system — (Optional) An autonomous system (AS) is a collection of networks that are subdivided into smaller, more manageable areas.
- Confederation — (Optional) Creates confederation autonomous systems within an AS to reduce the number of IBGP sessions required within an AS.

2.7 Configuration Notes

The following information describes router configuration caveats.

- A system interface and associated IP address should be specified.
- Boot options file (BOF) parameters must be configured prior to configuring router parameters.
- Confederations can be configured before protocol connections (such as BGP) and peering parameters are configured.
- IPv6 interfaces and associated routing protocols may only be configured on the following systems:
  - 7950 XRS systems.
  - 7750 SR chassis systems in chassis mode c or d.
  - 7750 SR-a chassis systems.
  - 7750 SR-e chassis systems.
  - 7450 ESS systems running in mixed-mode with IPv6 functionality limited to those interfaces on slots with 7750 IOM3-XPs/IMMs (or later) line cards.
  - 7750 SR-c4/12.
- An iom2-20g and a SFM2 card are required to enable the IPv6 CPM filter and per-peer queuing functionality.

2.8 Configuring an IP Router with CLI

This section provides information to configure an IP router.

Topics in this section include:

2.9 Router Configuration Overview

In a Nokia router, an interface is a logical named entity. An interface is created by specifying an interface name under the configure>router context. This is the global router configuration context where objects like static routes are defined. An IP interface name can be up to 32 alphanumeric characters long, must start with a letter, and is case-sensitive; for example, the interface name “1.1.1.1” is not allowed, but “int-1.1.1.1” is allowed.

To create an interface, the basic configuration tasks that must be performed are:

- Assign a name to the interface.
- Associate an IP address with the interface.
- Associate the interface with a network interface or the system interface.
- Configure appropriate routing protocols.

A system interface and network interface should be configured.

2.9.1 System Interface

The system interface is associated with the network entity (such as a specific Nokia router), not a specific interface. The system interface is also referred to as the loopback address. The system interface is associated during the configuration of the following entities:

- The termination point of service tunnels
- The hops when configuring MPLS paths and LSPs
- The addresses on a target router for BGP and LDP peering

The system interface is used to preserve connectivity (when routing reconvergence is possible) when an interface fails or is removed. The system interface is used as the router identifier. A system interface must have an IP address with a 32-bit subnet mask.

2.9.2 Network Interface

A network interface can be configured on one of the following entities a physical port or LAG:

- A physical or logical port
- A SONET/SDH channel

For the 7950 XRS, a network interface can be configured on either a physical port or Ethernet LAG interface.

2.10 Basic Configuration

Refer to each specific chapter for specific routing protocol information and command syntax to configure protocols such as OSPF and BGP.

The most basic router configuration must have the following:

- System name
- System address

The following example displays a router configuration for the 7750 SR and 7450 ESS:

```
A:ALA-A> config# info
. . .
#------------------------------------------
# Router Configuration
#------------------------------------------
    router
        interface "system"
            address 10.10.10.103/32
        exit
        interface "to-104"
            address 10.0.0.103/24
            port 1/1/1
            exit
        exit
        autonomous-system 100
        confederation 1000 members 100 200 300
   router-id 10.10.10.103
...
    exit
    isis
    exit
...
#------------------------------------------
A:ALA-A> config#
```

2.11 Common Configuration Tasks

The following sections describe basic system tasks.

2.11.1 Configuring a System Name

Use the system command to configure a name for the device. The name is used in the prompt string. Only one system name can be configured. If multiple system names are configured, the last one configured will overwrite the previous entry.

If special characters are included in the system name string, such as spaces, #, or ?, the entire string must be enclosed in double quotes. Use the following CLI syntax to configure the system name:

CLI Syntax:

```
config# system
name system-name
```

Example:

```
config# system
config>system# name ALA-A
ALA-A>config>system# exit all
ALA-A#
```

The following example displays the system name output.

```
A:ALA-A>config>system# info
#------------------------------------------
# System Configuration
#------------------------------------------
        name "ALA-A"
        location "Mt.View, CA, NE corner of FERG 1 Building"
        coordinates "37.390, -122.05500 degrees lat."
        snmp
        exit
```

2.11.2 Configuring Interfaces

The following command sequences create a system and a logical IP interface. The system interface assigns an IP address to the interface, and then associates the IP interface with a physical port. The logical interface can associate attributes like an IP address or port.

The system interface cannot be deleted.

2.11.2.1 Configuring a System Interface

To configure a system interface:

CLI Syntax:
```
config>router
     interface interface-name
          address {ip-address/mask | ip-address
             [netmask]} [broadcast {all-ones | host-ones]
          secondary {[address/mask | ip-address]
             [netmask]} [broadcast {all-ones | host-
             ones}] [igp-inhibit]
```

2.11.2.2 Configuring a Network Interface

To configure a network interface for the 7450 ESS:

CLI Syntax:
```
config>router
     interface interface-name
          address ip-addr{/mask-length | mask}
             [broadcast {all-ones | host-ones}]
          cflowd {acl | interface}
          egress
               filter ip ip-filter-id
          ingress
               filter ip ip-filter-id
          port port-name
```

To configure a network interface for the 7750 SR:

CLI Syntax:
```
config>router
     interface interface-name
          address ip-addr{/mask-length | mask}
             [broadcast {all-ones | host-ones}]
          cflowd {acl | interface}
```

```
egress
     filter ip ip-filter-id
     filter ipv6 ipv6-filter-id
ingress
     filter ip ip-filter-id
     filter ipv6 ipv6-filter-id
port port-name
```

To configure a network interface on the 7950 XRS:

CLI Syntax:

```
config>router
     interface interface-name
          address ip-addr{/mask-length | mask}
             [broadcast {all-ones | host-ones}]
          egress
               filter ip ip-filter-id
               filter ipv6 ipv6-filter-id
          ingress
               filter ip ip-filter-id
               filter ipv6 ipv6-filter-id
          port port-name
```

The following displays an IP configuration output showing interface information.

```
A:ALA-A>config>router# info
#------------------------------------------
# IP Configuration
#------------------------------------------
        interface "system"
            address 10.10.0.4/32
        exit
        interface "to-ALA-2"
            address 10.10.24.4/24
            port 1/1/1
            egress
                filter ip 10
            exit
        exit
...
#------------------------------------------
A:ALA-A>config>router#
```

To enable CPU protection:

CLI Syntax:

```
config>router
     interface interface-name
          cpu-protection policy-id
```

CPU protection policies are configured in the **config>sys>security>cpu-protection** context. See the *7450 ESS, 7750 SR, and 7950 XRS System Management Guide*.

2.11.2.3 Configuring IPv6 Parameters

IPv6 interfaces and associated routing protocols may only be configured on the following systems:

- 7950 XRS systems.
- 7750 SR chassis systems in chassis mode c or d.
- 7750 SR-a chassis systems.
- 7750 SR-e chassis systems.
- 7450 ESS chassis running in mixed-mode, with IPv6 functionality limited to those interfaces on slots with 7750 IOM3-XPs/IMMs (or later) line card.
- 7750 SR-c4/12.

The following displays the interface configuration showing the IPv6 default configuration when IPv6 is enabled on the interface.

```
A:ALA-49>config>router>if>ipv6# info detail
----------------------------------------------
 ` port 1/2/37
   ipv6
      packet-too-big 100 10
      param-problem 100 10
      redirects 100 10
      time-exceeded 100 10
      unreachables 100 10
   exit
----------------------------------------------
A:ALA-49>config>router>if>ipv6# exit all
```

Use the following CLI syntax to configure IPv6 parameters on a router interface.

CLI Syntax:
```
config>router# interface interface-name
port port-name
ipv6
      address {ipv6-address/prefix-length} [eui-64]
      icmp6
            packet-too-big [number seconds]
            param-problem [number seconds]
            redirects [number seconds]
            time-exceeded [number seconds]
            unreachables [number seconds]
      neighbor ipv6-address mac-address
```

The following displays a configuration example showing interface information.

```
A:ALA-49>config>router>if# info
----------------------------------------------
            address 10.11.10.1/24
```

```
            port 1/2/37
            ipv6
                address 10::1/24
            exit
----------------------------------------------
A:ALA-49>config>router>if#
```

2.11.2.4 Configuring IPv6 Over IPv4 Parameters

This section provides several examples of the features that must be configured in order to implement IPv6 over IPv4 relay services for the 7750 SR OS.

- Tunnel Ingress Node
  - Learning the Tunnel Endpoint IPv4 System Address
  - Configuring an IPv4 BGP Peer
  - An Example of a IPv6 Over IPv4 Tunnel Configuration
- Tunnel Egress Node
  - Learning the Tunnel Endpoint IPv4 System Address
  - Configuring an IPv4 BGP Peer
  - An Example of a IPv6 Over IPv4 Tunnel Configuration

2.11.2.5 Tunnel Ingress Node

This configuration shows how the interface through which the IPv6 over IPv4 traffic leaves the node. This must be configured on a network interface.

CLI Syntax:

```
config>router
      static-route-entry::C8C8:C802/128
            indirect 200.200.200.2
                  interface ip-int-name
                        address {ip-address/mask | ip-address
                              netmask} [broadcast {all-ones |
                              host-ones}]
                        port port-name
```

The following displays configuration output showing interface configuration.

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        interface "ip-1.1.1.1"
            address 1.1.1.1/30
            port 1/1/1
```

```
        exit
...
----------------------------------------------
A:ALA-49>configure>router#
```

Both the IPv4 and IPv6 system addresses must to configured.

CLI Syntax:
```
config>router
      interface ip-int-name
            address {ip-address/mask | ip-address netmask}
               [broadcast {all-ones | host-ones}]
            ipv6
                  address ipv6-address/prefix-length [eui-
                     64]
```

The following displays configuration output showing interface information.

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        interface "system"
            address 200.200.200.1/32
            ipv6
                address 3FFE::C8C8:C801/128
            exit
        exit
...
----------------------------------------------
A:ALA-49>configure>router#
```

2.11.2.5.1 Learning the Tunnel Endpoint IPv4 System Address

This configuration displays the OSPF configuration to learn the IPv4 system address of the tunnel endpoint.

CLI Syntax:
```
config>router
ospf
      area area-id
            interface ip-int-name
```

The following displays a configuration showing OSPF output.

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        ospf
            area 0.0.0.0
                interface "system"
                exit
```

```
                interface "ip-1.1.1.1"
                exit
            exit
        exit
----------------------------------------------
A:ALA-49>configure>router#
```

2.11.2.5.2 Configuring an IPv4 BGP Peer

This configuration display the commands to configure an IPv4 BGP peer with (IPv4 and) IPv6 protocol families.

CLI Syntax:
```
config>router
bgp
      export policy-name [policy-name...(upto 5 max)]
      router-id ip-address
      group name
            family [ipv4] [vpn-ipv4] [ipv6] [mcast-ipv4]
            type {internal | external}
            neighbor ip-address
                  local-as as-number [private]
                  peer-as as-number
```

The following displays a configuration showing BGP output.

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        bgp
            export "ospf3"
            router-id 200.200.200.1
            group "main"
                family ipv4 ipv6
                type internal
                neighbor 200.200.200.2
                    local-as 1
                    peer-as 1
                exit
            exit
        exit
...
----------------------------------------------
A:ALA-49>configure>router#
```

2.11.2.5.3 An Example of a IPv6 Over IPv4 Tunnel Configuration

The IPv6 address is the next-hop as it is received through BGP. The IPv4 address is the system address of the tunnel's endpoint.

This configuration displays an example to configure a policy to export IPv6 routes into BGP.

CLI Syntax:
```
config>router
bgp
      export policy-name [policy-name...(upto 5 max)]
      router-id ip-address
      group name
            family [ipv4] [vpn-ipv4] [ipv6] [mcast-ipv4]
            type {internal | external}
            neighbor ip-address
                  local-as as-number [private]
                  peer-as as-number
```

The following displays the configuration output.

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        policy-options
            policy-statement "ospf3"
                description "Plcy Stmnt For 'From ospf3 To bgp'"
                entry 10
                    description "Entry From Protocol ospf3 To bgp"
                    from
                        protocol ospf3
                    exit
                    to
                        protocol bgp
                    exit
                    action accept
                    exit
                exit
            exit
        exit
...
----------------------------------------------
A:ALA-49>configure>router#
```

2.11.2.6 Tunnel Egress Node

This configuration shows how the interface through which the IPv6 over IPv4 traffic leaves the node. It must be configured on a network interface. Both the IPv4 and IPv6 system addresses must be configured.

CLI Syntax:
```
config>router
      static-route ::C8C8:C801/128
            indirect 200.200.200.1
                  interface ip-int-name
```

```
address {ip-address/mask> | ip-
     address netmask} [broadcast
     {all-ones | host-ones}]
ipv6
address ipv6-address/prefix-length
     [eui-64]
port port-name
```

The following displays interface configuration.

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        interface "ip-1.1.1.2"
            address 1.1.1.2/30
            port 1/1/1
        exit
        interface "system"
            address 200.200.200.2/32
            ipv6
                address 3FFE::C8C8:C802/128
            exit
        exit
----------------------------------------------
```

2.11.2.6.1 Learning the Tunnel Endpoint IPv4 System Address

This configuration displays the OSPF configuration to learn the IPv4 system address of the tunnel endpoint.

CLI Syntax:
```
config>router
ospf
     area area-id
          interface ip-int-name
```

The following displays OSPF configuration information.

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        ospf
            area 0.0.0.0
                interface "system"
                exit
                interface "ip-1.1.1.2"
                exit
            exit
        exit
----------------------------------------------
A:ALA-49>configure>router#
```

2.11.2.6.2 Configuring an IPv4 BGP Peer

This configuration display the commands to configure an IPv4 BGP peer with (IPv4 and) IPv6 protocol families.

CLI Syntax:
```
config>router
bgp
     export policy-name [policy-name...(upto 5 max)]
     router-id ip-address
     group name
          family [ipv4] [vpn-ipv4] [ipv6] [mcast-ipv4]
          type {internal | external}
          neighbor ip-address
               local-as as-number [private]
               peer-as as-number
```

The following displays the IPv4 BGP peer configuration example.

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        bgp
            export "ospf3"
            router-id 200.200.200.2
            group "main"
                family ipv4 ipv6
                type internal
                neighbor 200.200.200.1
                    local-as 1
                    peer-as 1
                exit
            exit
        exit
...
----------------------------------------------
A:ALA-49>configure>router#
```

2.11.2.6.3 An Example of a IPv6 Over IPv4 Tunnel Configuration

The IPv6 address is the next-hop as it is received through BGP. The IPv4 address is the system address of the tunnel's endpoint.

This configuration displays an example to configure a policy to export IPv6 routes into BGP.

CLI Syntax:
```
config>router
bgp
     export policy-name [policy-name...(upto 5 max)]
     router-id ip-address
```

```
group name
     family [ipv4] [vpn-ipv4] [ipv6] [mcast-ipv4]
     type {internal | external}
     neighbor ip-address
          local-as as-number [private]
          peer-as as-number
```

The following displays an IPv6 over IPv4 tunnel configuration

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        policy-options
            policy-statement "ospf3"
                description "Plcy Stmnt For 'From ospf3 To bgp'"
                entry 10
                    description "Entry From Protocol ospf3 To bgp"
                    from
                        protocol ospf3
                    exit
                    to
                        protocol bgp
                    exit
                    action accept
                    exit
                exit
            exit
        exit
----------------------------------------------
A:ALA-49>configure>router#
```

2.11.2.7 Router Advertisement

To configure the router to originate router advertisement messages on an interface, the interface must be configured under the router-advertisement context and be enabled (no shutdown). All other router advertisement configuration parameters are optional.

Router advertisement can be configured under the **config>router>router-advertisement** context or under the **config>service>vprn>router-advertisement** context. Use the following examples of CLI syntax to enable router advertisement and configure router advertisement parameters.

To configure router advertisement on the 7750 SR:

CLI Syntax:

```
config>router# router-advertisement
dns-options
     rdnss-lifetime seconds
     dns-servers ipv6-address
```

```
interface ip-int-name
     current-hop-limit number
     dns-options
          rdnss-lifetime {seconds | infinite}
          dns-servers ipv6-address
     include-dns
     managed-configuration
     max-advertisement-interval seconds
     min-advertisement-interval seconds
     mtu mtu-bytes
     other-stateful-configuration
     prefix ipv6-prefix/prefix-length
          autonomous
          on-link
          preferred-lifetime {seconds | infinite}
          valid-lifetime {seconds | infinite}
     reachable-time milliseconds
     retransmit-time milliseconds
     router-lifetime seconds
     no shutdown
     use-virtual-mac
```

To configure router advertisement for the 7450 ESS:

CLI Syntax:

```
config>router# router-advertisement
dns-options
     rdnss-lifetime seconds
interface ip-int-name
     current-hop-limit number
     dns-options
          rdnss-lifetime {seconds | infinite}
     include-dns
     managed-configuration
     max-advertisement-interval seconds
     min-advertisement-interval seconds
     mtu mtu-bytes
     other-stateful-configuration
          autonomous
          on-link
          preferred-lifetime {seconds | infinite}
          valid-lifetime {seconds | infinite}
     reachable-time milliseconds
     retransmit-time milliseconds
     router-lifetime seconds
     no shutdown
     use-virtual-mac
```

The following displays a router advertisement configuration example.

```
*A:sim131>config>router>router-advert# info
----------------------------------------------
            interface "n1"
                prefix 2001:db8:3::/64
                exit
                use-virtual-mac
                no shutdown
            exit
----------------------------------------------
*A:sim131>config>router>router-advert# interface n1
*A:sim131>config>router>router-advert>if# prefix 2001:db8:3::/64
----------------------------------------------
                    autonomous
                    on-link
                    preferred-lifetime 604800
                    valid-lifetime 2592000
----------------------------------------------
*A:tahi>config>router>router-advert>if>prefix#
```

2.11.2.8 Configuring IPv6 Parameters

The following displays the interface configuration showing the IPv6 default configuration when IPv6 is enabled on the interface.

```
A:ALA-49>config>router>if>ipv6# info detail
----------------------------------------------
  port 1/3/37
   ipv6
      packet-too-big 100 10
      param-problem 100 10
      redirects 100 10
      time-exceeded 100 10
      unreachables 100 10
   exit
----------------------------------------------
A:ALA-49>config>router>if>ipv6# exit all
```

The following displays an IPv6 configuration example.

```
A:ALA-49>config>router>if# info
----------------------------------------------
            address 10.11.10.1/24
            port 1/3/37
            ipv6
                address 10::1/24
            exit
----------------------------------------------
A:ALA-49>config>router>if#
```

2.11.2.8.1 An Example of a IPv6 Over IPv4 Tunnel Configuration

The IPv6 address is the next-hop as it is received through BGP. The IPv4 address is the system address of the tunnel's endpoint.

This configuration displays an example to configure a policy to export IPv6 routes into BGP.

CLI Syntax:
```
config>router
bgp
     export policy-name [policy-name...(upto 5 max)]
     router-id ip-address
     group name
          family [ipv4] [vpn-ipv4] [ipv6] [mcast-ipv4]
          type {internal | external}
          neighbor ip-address
               local-as as-number [private]
               peer-as as-number
```

The following displays the configuration showing the policy output.

```
A:ALA-49>configure>router# info
----------------------------------------------
...
        policy-options
            policy-statement "ospf3"
                description "Plcy Stmnt For 'From ospf3 To bgp'"
                entry 10
                    description "Entry From Protocol ospf3 To bgp"
                    from
                        protocol ospf3
                    exit
                    to
                        protocol bgp
                    exit
                    action accept
                    exit
                exit
            exit
        exit
----------------------------------------------
A:ALA-49>configure>router#
```

2.11.2.9 Configuring Proxy ARP

To configure proxy ARP, you can configure:

- A prefix list in the **config>router>policy-options>prefix-list** context.

- A route policy statement in the **config>router>policy-options>policy-statement** context and apply the specified prefix list.
  - In the policy statement **entry>to** context, specify the host source address(es) for which ARP requests can or cannot be forwarded to non-local networks, depending on the specified action.
  - In the policy statement **entry>from** context, specify network prefixes that ARP requests will or will not be forwarded to depending on the action if a match is found. For more information about route policies, refer to the Unicast Routing Protocols Guide.
- Apply the policy statement to the **proxy-arp** configuration in the **config>router>interface** context.

CLI Syntax:
```
config>router# policy-options
begin
commit
prefix-list name
     prefix ip-prefix/mask [exact | longer | through
        length | prefix-length-range length1-length2]
```

Use the following CLI syntax to configure the policy statement specified in the **proxy-arp-policy** *policy-statement* command.

CLI Syntax:
```
config>router# policy-options
begin
commit
policy-statement name
     default-action {accept | next-entry | next-policy |
        reject}
     entry entry-id
          action {accept | next-entry | next-policy |
             reject}
          to
               prefix-list name [name...(upto 5 max)]
          from
               prefix-list name [name...(upto 5 max)]
```

The following displays prefix list and policy statement configuration examples:

```
A:ALA-49>config>router>policy-options# info
----------------------------------------------
            prefix-list "prefixlist1"
                    prefix 10.20.30.0/24 through 32
            exit
            prefix-list "prefixlist2"
                    prefix 10.10.10.0/24 through 32
            exit
...
            policy-statement "ProxyARPpolicy"
```

```
                entry 10
                    from
                        prefix-list "prefixlist1"
                    exit
                    to
                        prefix-list "prefixlist2"
                    exit
                    action reject
                exit
                default-action accept
                exit
            exit
...
----------------------------------------------
A:ALA-49>config>router>policy-options#
```

Use the following CLI to configure proxy ARP:

CLI Syntax: `config>router>interface` *`interface-name`*
`local-proxy-arp`
`proxy-arp-policy` *`policy-name`* `[`*`policy-name`*`...(upto 5 max)]`
`remote-proxy-arp`

The following displays a proxy ARP configuration example:

```
A:ALA-49>config>router>if# info
----------------------------------------------
            address 128.251.10.59/24
            local-proxy-arp
            proxy-arp
                policy-statement "ProxyARPpolicy"
            exit
----------------------------------------------
A:ALA-49>config>router>if#
```

2.11.2.10 Creating an IP Address Range

An IP address range can be reserved for exclusive use for services by defining the config>router>service-prefix command. When the service is configured, the IP address must be in the range specified as a service prefix. If no service prefix command is configured, then no limitation exists.

The no service-prefix ip-prefix/mask command removes all address reservations. A service prefix cannot be removed while one or more services use address(es) in the range to be removed.

CLI Syntax: `config>router`

```
service-prefix ip-prefix/mask [exclusive]
```

2.11.3 Deriving the Router ID

The router ID defaults to the address specified in the system interface command. If the system interface is not configured with an IP address, then the router ID inherits the last four bytes of the MAC address. The router ID can also be manually configured in the config>router router-id context. On the BGP protocol level, a BGP router ID can be defined in the config>router>bgp router-id context and is only used within BGP.

If a new router ID is configured, protocols are not automatically restarted with the new router ID. The next time a protocol is initialized the new router ID is used. An interim period of time can occur when different protocols use different router IDs. To force the new router ID, issue the shutdown and no shutdown commands for each protocol that uses the router ID, or restart the entire router.

It is possible to configure an SR OS to operate with an IPv6 only BOF and no IPv4 system interface address. When configured in this manner, the operator must explicitly define IPv4 router IDs for protocols such as OSPF and BGP as there is no mechanism to derive the router ID from an IPv6 system interface address.

Use the following CLI syntax to configure the router ID:

CLI Syntax:
```
config>router
router-id router-id
interface ip-int-name
          address {ip-address/mask | ip-address netmask}
             [broadcast {all-ones | host-ones}]
```

The following example displays a router ID configuration:

```
A:ALA-4>config>router# info
#------------------------------------------
# IP Configuration
#------------------------------------------
        interface "system"
            address 10.10.0.4/32
        exit
    . . .
        router-id 10.10.0.4
#------------------------------------------
A:ALA-4>config>router#
```

2.11.4 Configuring a Confederation

Configuring a confederation is optional. The AS and confederation topology design should be carefully planned. Autonomous system (AS), confederation, and BGP connection and peering parameters must be explicitly created on each participating router. Identify AS numbers, confederation numbers, and members participating in the confederation.

Refer to the BGP section for CLI syntax and command descriptions.

Use the following CLI syntax to configure a confederation:

CLI Syntax: `config>router`
`confederation` *`confed-as-num`* `members` *`member-as-num`*

The following example displays the commands to configure the confederation topology diagram displayed in Confederation Configuration.

Note:

- Confederations can be preconfigured prior to configuring BGP connections and peering.
- Each confederation can have up to 15 members.

The following displays a confederation example.

```
A:ALA-B>config>router# info
#------------------------------------------
# IP Configuration
#------------------------------------------
        interface "system"
            address 10.10.10.103/32
        exit
        interface "to-104"
            shutdown
            address 10.0.0.103/24
            port 1/1/1
        exit
        autonomous-system 100
        confederation 2002 members 200 300 400
        router-id 10.10.10.103

#------------------------------------------
A:ALA-B>config>router#
```

2.11.5 Configuring an Autonomous System

Configuring an autonomous system is optional. Use the following CLI syntax to configure an autonomous system:

CLI Syntax:
```
config>router
      autonomous-system as-number
```

The following displays an autonomous system configuration example:

```
A;ALA-A>config>router# info
#------------------------------------------
# IP Configuration
#------------------------------------------
        interface "system"
            address 10.10.10.103/32
        exit
   interface "to-104"
            address 10.0.0.103/24
            port 1/1/1
            exit
        exit
        autonomous-system 100
        router-id 10.10.10.103
#------------------------------------------
A:ALA-A>config>router#
```

2.11.6 Configuring Overload State on a Single SFM

A 7450 ESS or 7750 SR with a single SFM installed has a system multicast throughput that is only a half of a system with dual SFMs installed. For example, in a mixed environment in which IOM1s, IOM2s, and IOM3s are installed in the same system (chassis mode B or C), system multicast throughput doubles when redundant SFMs are used instead of a single SFM. If the required system multicast throughput is between 16G and 32G (which means both SFMs are being actively used), when there is an SFM failure, multicast traffic needs to be rerouted around the node.

Some scenarios include:

- There is only one SFM installed in the system
- One SFM (active or standby) failed in a dual SFM configuration
- The system is in the ISSU process

You can use an overload state in IGP to trigger the traffic reroute by setting the overload bit in IS-IS or setting the metric to maximum in OSPF. Since PIM uses IGP to find out the upstream router, a next-hop change in IGP will cause PIM to join the new path and prune the old path, which effectively reroutes the multicast traffic downstream. When the problem is resolved, the overload condition is cleared, which will cause the traffic to be routed back to the router.

2.12 Service Management Tasks

This section discusses the following service management tasks:

- Changing the System Name
- Modifying Interface Parameters
- Deleting a Logical IP Interface

2.12.1 Changing the System Name

The system command sets the name of the device and is used in the prompt string. Only one system name can be configured. If multiple system names are configured, the last one configured will overwrite the previous entry.

Use the following CLI syntax to change the system name:

CLI Syntax:
```
config# system
name system-name
```

The following example displays the command usage to change the system name:

Example:
```
A:ALA-A>config>system# name tgif
A:TGIF>config>system#
```

The following example displays the system name change:

```
A:ALA-A>config>system# name TGIF
A:TGIF>config>system# info
#------------------------------------------
# System Configuration
#------------------------------------------
        name "TGIF"
    location "Mt.View, CA, NE corner of FERG 1 Building"
    coordinates "37.390, -122.05500 degrees lat."
    synchronize
    snmp
```

```
        exit
        security
            snmp
                community "private" rwa version both
            exit
        exit
        . . .
----------------------------------------------
A:TGIF>config>system#
```

2.12.2 Modifying Interface Parameters

Starting at the config>router level, navigate down to the router interface context.

To modify an IP address, perform the following steps:

CLI Syntax:
```
A:ALA-A>config>router# interface “to-sr1”
A:ALA-A>config>router>if# shutdown
A:ALA-A>config>router>if# no address
A:ALA-A>config>router>if# address 10.0.0.25/24
A:ALA-A>config>router>if# no shutdown
```

To modify a port, perform the following steps:

CLI Syntax:
```
A:ALA-A>config>router# interface “to-sr1”
A:ALA-A>config>router>if# shutdown
A:ALA-A>config>router>if# no port
A:ALA-A>config>router>if# port 1/1/2
A:ALA-A>config>router>if# no shutdown
```

The following example displays the interface configuration:

```
A:ALA-A>config>router# info
#-----------------------------------------
# IP Configuration
#-----------------------------------------
        interface "system"
            address 10.0.0.103/32
        exit
        interface "to-sr1"
            address 10.0.0.25/24
            port 1/1/2
        exit
        router-id 10.10.0.3
#-----------------------------------------
A:ALA-A>config>router#
```

2.12.3 Deleting a Logical IP Interface

The no form of the interface command typically removes the entry, but all entity associations must be shut down and/or deleted before an interface can be deleted.

Step 1. Before an IP interface can be deleted, it must first be administratively disabled with the shutdown command.

Step 2. After the interface has been shut down, it can then be deleted with the **no interface** command.

CLI Syntax:

```
config>router
no interface ip-int-name
```

Example:

```
config>router# interface test-interface
config>router>if# shutdown
config>router>if# exit
config>router# no interface test-interface
config>router#
```

2.13 IP Router Configuration Command Reference

2.13.1 Command Hierarchies

- Router Commands
- Router BFD commands
- Router L2TP Commands
- Router Interface Commands
- Router Interface IPv6 Commands
- Router Advertisement Commands

2.13.1.1 Router Commands

config
- — **router** [*router-instance*] [**create**]
- — **no router** [*router-instance*]
  - — **aggregate** *ip-prefix/ip-prefix-length* [**summary-only**] [**as-set**] [**aggregator** *as-number:ip-address*] [**black-hole**] [**community** *comm-id*] [**description** *description*]
  - — **aggregate** *ip-prefix/ip-prefix-length* [**summary-only**] [**as-set**] [**aggregator** *as-number:ip-address*] [**community** *comm-id*] [**indirect** *ip-address*] [**description** *description*]
  - — **no aggregate** *ip-prefix/ip-prefix-length*
  - — **autonomous-system** *autonomous-system*
  - — **no autonomous-system**
  - — **confederation** *confed-as-num* **members** *as-number* [*as-number...*(**up to 15 max**)]
  - — **no confederation** [*confed-as-num* **members** *as-number....*(**up to 15 max**)]
  - — **ecmp** *max-ecmp-routes*
  - — **no ecmp**
  - — **no entropy-label**
  - — **fib-priority** {**high** | **standard**}
  - — **flowspec**
    - — **ip-filter-max-size** {*value* | **default**}
    - — **ipv6-filter-max-size** {*value* | **default**}
  - — [**no**] **icmp-tunneling**
  - — [**no**] **ip-fast-reroute**
  - — [**no**] **ldp-shortcut**
  - — **mc-maximum-routes** *number* [**log-only**] [**threshold** *threshold*]
  - — **no mc-maximum-routes**
  - — **mpls-labels**
    - — **bgp-labels-hold-timer** *seconds*
    - — **no bgp-labels-hold-timer**
    - — **static-label-range** *static-range*
    - — **no static-label-range**
    - — **sr-labels** *start-value* **end** *end-value*
    - — **no sr-labels**
  - — **mss-adjust-group** *nat-group-id* **segment-size** *segment-size*
  - — **no mss-adjust-group**
  - — **multicast-info-policy** *policy-name*
  - — **no multicast-info-policy**

— **multicast-info-policy**
 — **description** *description-string*
 — **no description**
— **origin-validation**
 — [**no**] **rpki-session** *ip-address*
  — [**no**] **connect-retry***seconds*
  — [**no**] **description** *description-string*
  — [**no**] **local-address** *ip-address*
  — [**no**] **port** *port-id*
  — [**no**] **refresh-time** *seconds* **hold-time** *seconds*
  — [**no**] **shutdown**
  — [**no**] **stale-time** *seconds*
  — **static-entry** *ip-prefix/prefix-length* **upto** *prefix-length2* **origin-as** *as-number* [**valid** | **invalid**]
  — **no static-entry** *ip-prefix/prefix-length1-prefix-length2*
— **router-id** *ip-address*
— **no router-id**
— **service-prefix** {*ip-prefix***I***mask* | *ip-prefix netmask*} [**exclusive**]
— **no service-prefix** {*ip-prefix/mask* | *ip-prefix netmask*}
— **sgt-qos**
 — **application** *dscp-app-name* **dscp** {*dscp-value* | *dscp-name*}
 — **application** *dot1p-app-name* **dot1p** *dot1p-priority*
 — **no application** {*dscp-app-name* | *dot1p-app-name*}
 — **dscp** *dscp-name* **fc** *fc-name*
 — [**no**] **dscp** *dscp-name*
— **single-sfm-overload** [**holdoff-time** *holdoff-time*]
— **no single-sfm-overload**
— [**no**] **static-route-entry** {*ip-prefix/prefix-length* } [**mcast**]
 — [**no**] **black-hole**
  — [**no**] **community** *comm-id*
  — [**no**] **description** *description-string*
  — [**no**] **dynamic-bgp**
  — [**no**] **generate-icmp**
  — [**no**] **metric** *metric-value*
  — [**no**] **preference** *preference-value*
  — [**no**] **prefix-list** *name* {**all** | **none** | **any**}
  — [**no**] **shutdown**
  — [**no**] **tag** **tag-value**
 — [**no**] **indirect** *ip-address*
  — [**no**] **community** *comm-id*
  — [**no**] **cpe-check** *cpe-ip-address*
   — [**no**] **drop-count** *count*
   — [**no**] **interval** *seconds*
   — [**no**] **log**
   — [**no**] **padding-size** *padding-size*
  — [**no**] **description** *description-string*
  — [**no**] **destination-class** *dest-index*
  — [**no**] **forwarding-class** {*be* | *l2* | *af* | *l1* | *h2* | *ef* | *h1* | *nc*}
   — [**no**] **priority** {**low** | **high**}
  — [**no**] **metric** *metric-value*
  — [**no**] **preference** *preference-value*
  — [**no**] **prefix-list** *prefix-list-name* {**all** | **none** | **any**}
  — [**no**] **shutdown**
  — [**no**] **source-class** *source-index*

```
                    — [no] tag tag-value
                    — [no] tunnel-next-hop
                        — [no] disallow-igp
                        — [no] resolution
                        — [no] resolution-filter {any | disable | filter}
                            — [no] ldp
                            — [no] rsvp-te
                                — [no] lsp lsp-name
                            — [no] sr-isis
                            — [no] sr-ospf
                            — [no] sr-te
                                — [no] lsp lsp-name
                — [no] next-hop {ip-address | ip-int-name | ipv6 address}
                    — [no] bfd-enable
                    — [no] community comm-id
                    — [no] cpe-check cpe-ip-address
                        — [no] drop-count count
                        — [no] interval seconds
                        — [no] log
                        — [no] padding-size padding-size
                    — [no] description description-string
                    — [no] destination-class dest-index
                    — [no] forwarding-class {be | l2 | af | l1 | h2 | ef | h1 | nc}
                        — [no] priority {low | high}
                    — [no] ldp-sync
                    — [no] metric metric-value
                    — [no] preference preference-value
                    — [no] prefix-list name {all | none | any}
                    — [no] shutdown
                    — [no] source-class [source-index]
                    — [no] tag tag-value
                    — [no] validate-next-hop
            — [no] triggered-policy
            — ttl-propagate
                — label-route-local [none | all]
                — label-route-transit [none | all]
                — lsr-label-route [none | all]
                — vprn-local [none | vc-only | all]
                — vprn-transit [none | vc-only | all]
            — weighted-ecmp

config
    — router management
        — origin-validation
            — [no] rpki-session ip-address
                — [no] connect-retryseconds
                — [no] description description-string
                — [no] local-address ip-address
                — [no] port port-id
                — [no] refresh-time seconds hold-time seconds
                — [no] shutdown
                — [no] stale-time seconds
```

2.13.1.2 Router BFD commands

config
- — **router**
  - — **bfd**
  - — **bfd-template** *name* [**create**]
  - — **bfd-template** *name*
    - — **transmit-interval** *transmit-interval*
    - — **no transmit-interval**
    - — **receive-interval** *receive-interval*
    - — **no receive-interval**
    - — **echo-receive** *echo-interval*
    - — **no echo-receive**
    - — **multiplier** *multiplier*
    - — **no multiplier**
    - — [**no**] **type cpm-np**

2.13.1.3 Router L2TP Commands

The router L2TP commands apply only to the 7750 SR and 7450 ESS.

config
- — **router** [*router-name*]
  - — **l2tp**
    - — **calling-number-format** *ascii-spec*
    - — **no calling-number-format**
    - — **challenge** {**always**}
    - — **no challenge**
    - — **df-bit-lac** {**always** | **never**}
    - — **no df-bit-lac**
    - — **destruct-timeout** *destruct-timeout*
    - — **no destruct-timeout**
    - — **eth-tunnel**
      - — **reconnect-timeout** *seconds*
      - — **no reconnect-timeout**
    - — **exclude-avps** *calling-number*
    - — **no exclude-avps**
    - — **group** *tunnel-group-name* [**create**]
    - — **no group** *tunnel-group-name*
      - — **avp-hiding** {**sensitive** | **always**}
      - — **no avp-hiding**
      - — **challenge** [**always**]
      - — **no challenge**
      - — **description** *description-string*
      - — **no description**
      - — **df-bit-lac** {**always** | **never** | **default**}
      - — **no df-bit-lac**
      - — **destruct-timeout** *destruct-timeout*
      - — **no destruct-timeout**
      - — **hello-interval** *hello-interval*

- — **no hello-interval**
- — **idle-timeout** *idle-timeout*
- — **no idle-timeout**
- — **l2tpv3**
  - — **cookie-length** {**4** | **8** | **none**}
  - — **no cookie-length**
  - — **digest-type** {**md5** | **sha1** | **none**}
  - — **no digest-type**
  - — **nonce-length** {*length* | **none**}
  - — **no nonce-length**
  - — **pw-cap-list** {**ethernet** | **ethernet-vlan**}
  - — **no pw-cap-list**
  - — **rem-router** *ip-addr*
  - — **no rem-router**
  - — [**no**] **track-password-change**
  - — **transport-type ip**
  - — **no transport-type**
- — **lns-group** *lns-group-id*
- — **no lns-group**
- — **load-balance-method** {**per-session** | **per-tunnel**}
- — **no load-balance-method**
- — **local-address** *ip-address*
- — **no local-address**
- — **local-name** *host-name*
- — **no local-name**
- — **max-retries-estab** *max-retries*
- — **no max-retries-estab**
- — **max-retries-not-estab** *max-retries*
- — **no max-retries-not-estab**
- — **password** *password* [**hash** | **hash2**]
- — **no password**
- — **ppp**
  - — **authentication** {**chap** | **pap** | **pref-chap** | **pref-pap**}
  - — **authentication-policy** *auth-policy-name*
  - — **no authentication-policy**
  - — **default-group-interface** *ip-int-name* **service-id** *service-id*
  - — **no default-group-interface**
  - — **keepalive** *seconds* [**hold-up-multiplier** *multiplier*]
  - — **no keepalive**
  - — **mtu** *mtu-bytes*
  - — **no mtu**
  - — [**no**] **proxy-authentication**
  - — [**no**] **proxy-lcp**
  - — **user-db** *local-user-db-name*
  - — **no user-db**
- — **session-assign-method** {**existing-first** | **weighted** | **weighted-random**}
- — **no session-assign-method**
- — **session-limit** *session-limit*
- — **no session-limit**
- — **tunnel** *tunnel-name* [**create**]
- — **no tunnel** *tunnel-name*
  - — [**no**] **auto-establish**
  - — **avp-hiding** {**never** | **sensitive** | **always**}

— **no avp-hiding**
— **challenge** *challenge-mode*
— **no challenge**
— **description** *description-string*
— **no description**
— **df-bit-lac** {**always** | **never** | **default**}
— **no df-bit-lac**
— **destruct-timeout** *destruct-timeout*
— **no destruct-timeout**
— **hello-interval** *hello-interval*
— **hello-interval infinite**
— **no hello-interval**
— **idle-timeout** *idle-timeout*
— **idle-timeout infinite**
— **no idle-timeout**
— **load-balance-method** {**per-session** | **per-tunnel**}
— **no load-balance-method**
— **local-address** *ip-address*
— **no local-address**
— **local-name** *host-name*
— **no local-name**
— **max-retries-estab** *max-retries*
— **no max-retries-estab**
— **max-retries-not-estab** *max-retries*
— **no max-retries-not-estab**
— **password** *password* [**hash** | **hash2**]
— **no password**
— **peer** *ip-address*
— **no peer**
— **preference** *preference*
— **no preference**
— **remote-name** *host-name*
— **no remote-name**
— **session-limit** *session-limit*
— **no session-limit**
— [**no**] **shutdown**

— **l2tpv3**
— **cookie-length** {**4** | **8** | **none**}
— **no cookie-length**
— **digest-type** {**md5** | **sha1** | **none**}
— **no digest-type**
— **nonce-length** {*length* | **none**}
— **no nonce-length**
— **password** *password* [**hash** | **hash2**]
— **no password**
— **transport-type ip**
— **no transport-type**

— **next-attempt** {**same-preference-level** | **next-preference-level**}
— **no next-attempt**
— **replace-result-code** *code* [**code**...(upto 3 max)]
— **no replace-result-code**
— **peer-address-change-policy** {**accept** | **ignore** | **reject**}
— **receive-window-size**
— **no receive-window-size**

— [**no**] **shutdown**

configure
- — **router**
  - — **l2tp**
    - — **tunnel-selection-blacklist**
      - — **add-tunnel** **never**
      - — **add-tunnel** **on** *reason*>[*reason*...(**upto 8 max**)]
      - — **no** **add-tunnel**
      - — **add-tunnel**
      - — **max-list-length** *count*
      - — **no** **max-list-length**
      - — **max-time** *minutes*
      - — **no** **max-time**
      - — **timeout-action** *action*
      - — **no** **timeout-action**

2.13.1.4 Router Interface Commands

config
- — **router** [*router-name*]
  - — **if-attribute**
    - — **admin-group** *group-name* **value** *group-value*
    - — **no** **admin-group** *group-name*
    - — **srlg-group** *group-name* **value** *group-value* [**penalty-weight** *penalty-weight*]
    - — **no** **srlg-group** *group-name*
  - — [**no**] **interface** *ip-int-name* **gmpls-loopback**
  - — [**no**] **interface** *ip-int-name* [**unnumbered-mpls-tp**]
    - — **address** {*ip-address/mask* | *ip-address netmask*} [**broadcast all-ones** | **host-ones**] [**track-srrp** *srrp-instance*]
    - — **no** **address**
    - — [**no**] **allow-directed-broadcasts**
    - — **arp-limit** *limit* [*log-only*] [*threshold percent*]
    - — **no** **arp-limit**
    - — **arp-timeout** *seconds*
    - — **no** **arp-timeout**
    - — **bfd** *transmit-interval* [**receive** *receive-interval*] [**multiplier** *multiplier*] [**echo-receive echo-interval** [**type cpm-np**]
    - — **no** **bfd**
    - — **cflowd-parameters**
    - — **no** **cflowd-parameters**
      - — **sampling** {**unicast** | **multicast**} **type** {**acl** | **interface**} [**direction** {**ingress-only** | **egress-only** | **both**}]
      - — **no** **sampling** {**unicast** | **multicast**}
    - — **cpu-protection** *policy-id*
    - — **no** **cpu-protection**
    - — **description** *description-string*
    - — **no** **description**
    - — **dhcp**
      - — **description** *description-string*
      - — **no** **description**

- — **gi-address** *ip-address* [*src-ip-addr*]
- — **no gi-address**
- — [**no**] **option**
  - — **action** {**replace** | **drop** | **keep**}
  - — **no action**
  - — **circuit-id** [**ascii-tuple** | **ifindex** | **sap-id** | **vlan-ascii-tuple**]
  - — **no circuit-id**
  - — **remote-id** [**mac** | **string** *string*]
  - — [**no**] **vendor-specific-option**
    - — [**no**] **client-mac-address**
    - — [**no**] **pool-name**
    - — [**no**] **port-id**
    - — [**no**] **service-id**
    - — **string** *text*
    - — **no string**
    - — [**no**] **system-id**
  - — **python-policy** *policy-name*
  - — **no python-policy**
  - — [**no**] **relay-plain-bootp**
  - — **server** *server1* [*server2*...(**up to 8 max**)]
  - — **no server**
  - — [**no**] **shutdown**
  - — [**no**] **trusted**

- — **dist-cpu-protection** *policy-name*
- — **no dist-cpu-protection**
- — **egress**
  - — **filter ip** *ip-filter-id*
  - — **filter ipv6** *ipv6-filter-id*
  - — **no filter** [**ip** *ip-filter-id*] [**ipv6** *ipv6-filter-id*]
- — [**no**] **enable-ingress-stats**
- — [**no**] **enable-mac-accounting**
- — **hold-time**
  - — **up ip** *seconds*
  - — **no up ip**
  - — **up ipv6** *seconds*
  - — **no up ipv6**
  - — **down ip** *seconds* [**init-only**]
  - — **no down**
  - — **down ipv6** *seconds* [**init-only**]
  - — **no down ipv6**
- — **icmp**
  - — [**no**] **mask-reply**
  - — **redirects** [*number* **seconds**]
  - — **no redirects**
  - — **ttl-expired** [*number* **seconds**]
  - — **no ttl-expired**
  - — **unreachables** [*number* **seconds**]
  - — **no unreachables**
- — **if-attribute**
  - — [**no**] **admin-group** *group-name* [*group-name*...(**up to 5 max**)]
  - — **no admin-group**
  - — [**no**] **srlg-group** *group-name* [*group-name*...(**up to 5 max**)]
  - — **no srlg-group**
- — **ingress**

- — **filter ip** *ip-filter-id*
- — **filter ipv6** *ipv6-filter-id*
- — **no filter** [**ip** *ip-filter-id*] [**ipv6** *ipv6-filter-id*]

— **ip-mtu** *octets*
— **no ip-mtu**
— **lag-link-map-profile** *lnk-map-profile-id*
— **no lag-link-map-profile**
— **lag-per-link-hash class** {**1** | **2** | **3**} **weight** [**1..1024**]
— **no lag-per-link-hash**
— **ldp-sync-timer** *seconds* [**end-of-lib**]
— **no ldp-sync-timer**
— **load-balancing**

- — **egr-ip-load-balancing** {**source** | **destination** | **inner-ip**}
- — **no egr-ip-load-balancing**
- — **lsr-load-balancing** *hashing-algorithm*
- — **no lsr-load-balancing**
- — [**no**] **spi-load-balancing**
- — [**no**] **teid-load-balancing**

— [**no**] **local-proxy-arp**
— [**no**] **loopback**
— **mac** *ieee-mac-addr*
— **no mac**
— **network-domain** *network-domain-name*
— **no network-domain**
— [**no**] **ntp-broadcast**
— **port** *port-name*
— **no port**
— [**no**] **proxy-arp-policy**
— [**no**] **ptp-hw-assist**
— **qos-route-lookup** [**source** | **destination**]
— **no qos-route-lookup**
— **qos** *network-policy-id* [**egress-port-redirect-group** *queue-group-name*] [**egress-instance** *instance-id*]] [**ingress-fp-redirect-group** *queue-group-name* **ingress-instance** *instance-id*]
— **no qos**
— [**no**] **remote-proxy-arp**
— **secondary** {[*ip-addr/mask* | *ip-addr*] [*netmask*]} [**broadcast** {**all-ones** | **host-ones**}] [**igp-inhibit**]
— **no secondary** [*ip-addr/mask* | *ip-addr*] [*netmask*]
— [**no**] **shutdown**
— **static-arp** *ip-addr ieee-mac-addr* **unnumbered**
— **no static-arp unnumbered**
— [**no**] **strip-label**
— **tcp-mss** *mss-value*
— **no tcp-mss**
— **tos-marking-state** {**trusted** | **untrusted**}
— **no tos-marking-state**
— **unnumbered** [*ip-addr* | *ip-int-name*]
— **no unnumbered**
— [**no**] **urpf-check**

- — **mode** {**strict** | **loose** | **strict-no-ecmp**}
- — **no mode**

— **vas-if-type** {**to-from-access** | **to-from-network** | **to-from-both**}
— **no vas-if-type**

— **route-next-hop-policy**
  — [**no**] **template** *template-name*
    — **include-group** *group-name* [**pref** *pref*]
    — **no include-group** *group-name*
    — [**no**] **exclude-group** *group-name*
    — [**no**] **srlg-enable**
    — **protection-type** {**link** | **node**}
    — **no protection-type**
    — **nh-type** {**ip** | **tunnel**}
    — **no nh-type**

For router interface VRRP commands, see VRRP Configuration Command Reference.

2.13.1.5 Router Interface IPv6 Commands

config
— **router** [*router-name*]
  — [**no**] **interface** *ip-int-name*
    — [**no**] **ipv6**
      — **address** *ipv6-address***/***prefix-length* [**eui-64**]
      — **no address** *ipv6-address***/***prefix-length*
      — **bfd** *transmit-interval* [**receive** *receive-interval*] [**multiplier** *multiplier*] [**echo-receive echo-interval** [**type cpm-np**]
      — **no bfd**
      — [**no**] **dad-disable**
      — **icmp6**
        — **packet-too-big** [*number seconds*]
        — **no packet-too-big**
        — **param-problem** [*number seconds*]
        — **no param-problem**
        — **redirects** [*number seconds*]
        — **no redirects**
        — **time-exceeded** [*number seconds*]
        — **no time-exceeded**
        — **unreachables** [*number seconds*]
        — **no unreachables**
      — **link-local-address** *ipv6-address* [**preferred**]
      — [**no**] **local-proxy-nd**
      — **neighbor** *ipv6-address* [*mac-address*]
      — **no neighbor** *ipv6-address*
      — **neighbor-limit** *limit* [**log-only**] [**threshold** *percent*]
      — **no neighbor-limit**
      — **proxy-nd-policy** *policy-name* [*policy-name*...(up to 5 max)]
      — **no proxy-nd-policy**
      — [**no**] **qos-route-lookup**
      — [**no**] **secure-nd**
        — [**no**] **allow-unsecured-msgs**
        — **link-local-modifier** *modifier*
        — **no link-local-modifier**

— **public-key-min-bits** *bits*
— **no public-key-min-bits**
— **security-parameter** *sec*
— **no security-parameter**
— [**no**] **shutdown**
— **stale-time** *seconds*
— **no stale-time**
— **tcp-mss** *mss-value*
— **no tcp-mss**
— [**no**] **urpf-check**
— **mode** {**strict** | **loose** | **strict-no-ecmp**}
— **no mode**
— [**no**] **qos-route-lookup**
— [**no**] **urpf-check**
— **mode** {**strict** | **loose**}
— **no mode**

2.13.1.6 Router Advertisement Commands

config
— **router**
— [**no**] **router-advertisement**
— [**no**] **dns-options**
— **servers** *ipv6-address*
— **no servers**
— **rdnss-lifetime** *seconds*
— **no rdnss-lifetime**
— [**no**] **interface** *ip-int-name*
— **current-hop-limit** *number*
— **no current-hop-limit**
— [**no**] **dns-options**
— **servers** *ipv6-address*
— **no servers**
— **rdnss-lifetime** {*seconds* | **infinite**}
— **no rdnss-lifetime**
— [**no**] **include-dns**
— [**no**] **managed-configuration**
— **max-advertisement-interval** *seconds*
— **no max-advertisement-interval**
— **min-advertisement-interval** *seconds*
— **no min-advertisement-interval**
— **mtu** *mtu-bytes*
— **no mtu**
— [**no**] **other-stateful-configuration**
— **prefix** [*ipv6-prefix/prefix-length*]
— [**no**] **autonomous**
— [**no**] **on-link**
— **preferred-lifetime** {*seconds* | **infinite**}
— **no preferred-lifetime**
— **valid-lifetime** {*seconds* | **infinite**}
— **no valid-lifetime**

— **reachable-time** *milliseconds*
— **no reachable-time**
— **retransmit-time** *milliseconds*
— **no retransmit-time**
— **router-lifetime** *seconds*
— **no router-lifetime**
— [**no**] **shutdown**
— [**no**] **use-virtual-mac**

2.13.2 Command Descriptions

2.13.2.1 Generic Commands

shutdown

Syntax [**no**] **shutdown**

Context config>router>if

Description The **shutdown** command administratively disables the entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics. Many entities must be explicitly enabled using the **no shutdown** command.

The **shutdown** command administratively disables an entity. The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they may be deleted.

Unlike other commands and parameters where the default state is not indicated in the configuration file, **shutdown** and **no shutdown** are always indicated in system generated configuration files.

The **no** form of the command puts an entity into the administratively enabled state.

Default no shutdown

description

Syntax **description** *description-string*
no description

Context config>router>if
config>router>if>dhcp
config>router>if>vrrp
config>router>l2tp>group
config>router>l2tp>group>tunnel

Description This command creates a text description stored in the configuration file for a configuration context.

The **no** form of the command removes the description string from the context.

Default No description is associated with the configuration context.

Parameters *description-string* — The description character string. Allowed values are any string up to 80 characters long, composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

2.13.2.2 Router Global Commands

router

Syntax **router** [*router-instance*] [**create**]
no router [*router-instance*]

Context config

Description This command enables the context to configure router parameters including interfaces, route policies and protocols. This command is also used to create CPM router instances.

For CPM router instances, this command enters or creates a user-created CPM router instance. A CPM router instance is a not a VPRN router instance. VPRN router instances are configured under **configure service vprn**. CPM router instances are the only type of non-VPRN router instances that can be created by a user, and they have a user-defined name. CPM router instances only use CPM/CFM/CCM ethernet ports as interfaces.

Parameters *router-instance* — specifies the router name or CPM router instance

Values

router-instance : *router name*

router-name	Base **|** management **|** *cpm-vr-name*
cpm-vr-name	[32 characters maximum]

Default Base

aggregate

Syntax **aggregate** *ip-prefix/ip-prefix-length* [**summary-only**] [**as-set**] [**aggregator** *as-number:ip-address*] [**black-hole**] [**community** *comm-id*] [**description** *description*]
aggregate *ip-prefix/ip-prefix-length* [**summary-only**] [**as-set**] [**aggregator** *as-number:ip-address*] [**community** *comm-id*] [**indirect** *ip-address*] [**description** *description*]
no aggregate *ip-prefix/ip-prefix-length*

Context config>router

Description This command creates an aggregate route.

Use this command to automatically install an aggregate in the routing table when there are one or more component routes. A component route is any route used for forwarding that is a more-specific match of the aggregate.

The use of aggregate routes can reduce the number of routes that need to be advertised to neighbor routers, leading to smaller routing table sizes.

Overlapping aggregate routes may be configured; in this case a route becomes a component of only the one aggregate route with the longest prefix match. For example if one aggregate is configured as 10.0.0.0/16 and another as 10.0.0.0/24, then route 10.0.128/17 would be aggregated into 10.0.0.0/16, and route 10.0.0.128/25 would be aggregated into 10.0.0.0/24. If multiple entries are made with the same prefix and the same mask the previous entry is overwritten.

A standard 4-byte BGP community may be associated with an aggregate route in order to facilitate route policy matching.

By default aggregate routes are not installed in the forwarding table, however there are configuration options that allow an aggregate route to be installed with a black-hole next hop or with an indirect IP address as next hop.

The **no** form of the command removes the aggregate.

Default No aggregate routes are defined.

Parameters *ip-prefix* — The destination address of the aggregate route in dotted decimal notation.

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-prefix	a.b.c.d (host bits must be 0)	
ipv4-prefix-length	0 to 32	
ipv6-prefix	x:x:x:x:x:x:x:x (eight 16-bit pieces)	
	x:x:x:x:x:x:d.d.d.d	
	x:	[0 to FFFF]H
	d:	[0 to 255]D
ipv6-prefix-length	0 to 128	

Values The following values apply to the 7450 ESS:

ipv4-prefix	a.b.c.d (host bits must be 0)
ipv4-prefix-length	0 to 32

ip-prefix-length — The mask associated with the network address expressed as a mask length.

Values 0 to 32

summary-only — This optional parameter suppresses advertisement of more specific component routes for the aggregate.

To remove the **summary-only** option, enter the same aggregate command without the **summary-only** parameter.

as-set — This optional parameter is only applicable to BGP and creates an aggregate where the path advertised for this route will be an AS_SET consisting of all elements contained in all paths that are being summarized. Use this feature carefully as it can increase the amount of route churn due to best path changes.

aggregator *as-number***:***ip-address* **—** This optional parameter specifies the BGP aggregator path attribute to the aggregate route. When configuring the aggregator, a two-octet AS number used to form the aggregate route must be entered, followed by the IP address of the BGP system that created the aggregate route.

community *comm-id* **—** This configuration option associates a BGP community with the aggregate route. The community can be matched in route policies and is automatically added to BGP routes exported from the aggregate route.

Values

comm-id	asn:comm-val **|** well-known-comm
asn	0 to 65535
comm-val	0 to 65535
well-known-comm	no-advertise, no-export, no-export-subconfed

black-hole — This optional parameter installs the aggregate route, when activated, in the FIB with a black-hole next-hop; where packets matching this route are discarded.

indirect ip-address — This configuration option specifies that the aggregate route should be installed in the FIB with a next-hop taken from the route used to forward packets to ip-address.

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-prefix	a.b.c.d
ipv6-prefix	x:x:x:x:x:x:x:x
	x:x:x:x:x:x:d.d.d.d
	x: [0 to FFFF]H
	d: [0 to 255]D

Values The following values apply to the 7450 ESS:

ipv4-prefix: a.b.c.d

description *description-text* **—** specifies a text description stored in the configuration file for a configuration context

autonomous-system

Syntax **autonomous-system** *autonomous-system*
no autonomous-system

Context config>router

Description This command configures the autonomous system (AS) number for the router. A router can only belong to one AS. An AS number is a globally unique number with an AS. This number is used to exchange exterior routing information with neighboring ASs and as an identifier of the AS itself.

If the AS number is changed on a router with an active BGP instance, the new AS number is not used until the BGP instance is restarted either by administratively disabling/enabling (**shutdown**/**no shutdown**) the BGP instance or rebooting the system with the new configuration.

Default No autonomous system number is defined.

Parameters *autonomous-system* — The autonomous system number expressed as a decimal integer.

Values 1 to 4294967295

confederation

Syntax **confederation** *confed-as-num* **members** *as-number* [*as-number...***up to 15 max**]
no confederation [*confed-as-num* **members** *as-number...***up to 15 max**]

Context config>router

Description This command creates confederation autonomous systems within an AS.

This technique is used to reduce the number of IBGP sessions required within an AS. Route reflection is another technique that is commonly deployed to reduce the number of IBGP sessions.

The **no** form of the command deletes the specified member AS from the confederation.

When no members are specified in the **no** statement, the entire list is removed and **confederation** is disabled.

When the last member of the list is removed, **confederation** is disabled.

Default no confederation - no confederations are defined.

Parameters *confed-as-num* — The confederation AS number expressed as a decimal integer.

Values 1 to 65535

members *member-as-num* **—** The AS number(s) of members that are part of the confederation, expressed as a decimal integer. Up to 15 members per *confed-as-num* can be configured*.*

Values 1 to 65535

ecmp

Syntax **ecmp** *max-ecmp-routes*
no ecmp

Context config>router

Description This command enables ECMP and configures the number of routes for path sharing; for example, the value 2 means two equal cost routes will be used for cost sharing.

ECMP can only be used for routes learned with the same preference and same protocol.

When more ECMP routes are available at the best preference than configured in *max-ecmp-routes,* then the lowest next-hop IP address algorithm is used to select the number of routes configured in *max-ecmp-routes*.

The **no** form of the command disables ECMP path sharing. If ECMP is disabled and multiple routes are available at the best preference and equal cost, then the route with the lowest next-hop IP address is used.

Default no ecmp

Parameters *max-ecmp-routes* — The maximum number of equal cost routes allowed on this routing table instance, expressed as a decimal integer. Setting ECMP *max-ecmp-routes* to 1 yields the same result as entering **no ecmp**.

Values 0 to 32

entropy-label

Syntax **entropy-label**
no entropy-label

Context config>router

Description If **entropy-label** is configured, the Entropy label and Entropy Label Indicator is inserted on packets for which at least one LSP in the stack for the far-end of the LDP or RSVP tunnel used by an IGP or BGP shortcut has advertised entropy-label-capability. If the tunnel is of type RSVP, then **entropy-label** must also have been enabled under **config>router>mpls** or **config>router>mpls>lsp**.

This configuration will result in other traffic that is forwarded over an LDP or RSVP LSP for which this router is the LER, and for which there is no explicit service endpoint on this router, to have the EL/ELI enabled, subject to the LSP far-end advertising entropy-label-capability. An example of such traffic includes packets arriving on a stitched LDP LSP forwarded over an RSVP LSP.

Default no entropy-label

flowspec

Syntax **flowspec**

Context config>router

Description This command enables the context to configure flowspec-related parameters for the specified routing instance.

Default n/a

ip-filter-max-size

Syntax **ip-filter-max-size** {*value* **| default**}

Context config>router>flowspec

Description This command configures the maximum number of flowspec routes or rules that can be embedded into the auto-created embedded filter (fSpec-*X*). Flowspec filter entries embedded in a filter policy in this routing instance will use filter entries from the range between “embedding offset + 1” and “embedding offset + ip-filter-max-size”.

The sum of the **ip-filter-max-size** *value* parameter and the highest offset in any IPv4 filter that embeds IPv4 flowspec rules from this routing instance (excluding filters that embed at offset 65535) must not exceed 65535.exit

The **ip-filter-max-size** configuration can be adjusted up or down at any time. If the number of IPv4 flowspec rules that are currently installed is *M*, and the new limit is *N*, where *N*<*M*, then the last set of rules from *N* to *M* (by flowspec order) are immediately removed, but are retained in the BGP RIB. If the limit is increased, new rules are programmed only as they are received again in new BGP updates.

Default ip-filter-max-size default

Parameters *value* — The maximum number of flowspec routes or rules that can be embedded into an ingress IP filter policy

Values 0 — 65535

default — Keyword to configure the maximum size as 512

ipv6-filter-max-size

Syntax **ipv6-filter-max-size** {*value* | **default**}

Context config>router>flowspec

Description This command configures the maximum number of IPv6 flowspec routes or rules that can be embedded into the auto-created embedded filter (fSpec-*X*). Flowspec filter entries embedded in a filter policy in this routing instance will use filter entries from the range between “embedding offset + 1” and “embedding offset + ip-filter-max-size”.

The sum of the **ip-filter-max-size** *value* parameter and the highest offset in any IPv6 filter that embeds IPv6 flowspec rules from this routing instance (excluding filters that embed at offset 65535) must not exceed 65535.

The **ip-filter-max-size** configuration can be adjusted up or down at any time. If the number of IPv6 flowspec rules that are currently installed is *M*, and the new limit is *N*, where *N*<*M*, then the last set of rules from *N* to *M* (by flowspec order) are immediately removed, but are retained in the BGP RIB. If the limit is increased, new rules are programmed only as they are received again in new BGP updates.

Default ipv6-filter-max-size default

Parameters *value* — The maximum number of flowspec routes or rules that can be embedded into an ingress IP filter policy

Values 0 — 65535

default — Keyword to configure the maximum size as 512

weighted-ecmp

Syntax **weighted-ecmp**
no ecmp

Context config>router

Description This command enables the weighted load-balancing, or weighted ECMP, over MPLS LSP.

When this command is enabled, packets of IGP, BGP, and static route prefixes resolved to a set of ECMP tunnel next-hops are sprayed proportionally to the weights configured for each MPLS LSP in the ECMP set.

Weighted load-balancing over MPLS LSP is supported in the following forwarding contexts:

IGP prefix resolved to IGP shortcuts in RTM (**rsvp-shortcut** or **advertise-tunnel-link** enabled in the IGP instance).

BGP prefix with the BGP next-hop resolved to IGP shortcuts in RTM (**rsvp-shortcut** or **advertise-tunnel-link** enabled in the IGP instance).

Static route prefix resolved to an indirect next-hop which itself is resolved to a set of equal-metric MPLS LSPs in TTM. The user can allow automatic selection or specify the names of the equal-metric MPLS LSPs in TTM to be used in the ECMP set.

Static route prefix resolved to an indirect next-hop which itself is resolved to IGP shortcuts in RTM.

BGP prefix with a BGP next-hop resolved to a static route which itself resolves to set of tunnel next-hops towards an indirect next-hop in RTM or TTM.

BGP prefix resolving to another BGP prefix which next-hop is resolved to set of ECMP tunnel next-hops with a static route in RTM or TTM or to IGP shortcuts in RTM.

IGP computes the normalized weight for each prefix tunnel next-hop. IGP updates the route in RTM with the set of tunnel next-hops and normalized weights. RTM downloads the information to IOM for inclusion in the FIB.

If one or more LSPs in the ECMP set of a prefix do not have a weight configured, the regular ECMP spraying for the prefix will be performed.

The weight assigned to an LSP impacts only the forwarding decision, not the routing decision. In other words, it does not change the selection of the set of ECMP tunnel next-hops of a prefix when more next-hops exist than the value of the router **ecmp** option. Once the set of tunnel next-hops is selected, the LSP weight is used to modulate the amount of packets forwarded over each next-hop. It also does not change the hash routine, but only the spraying of the flows over the tunnel next-hops is modified to reflect the normalized weight of each tunnel next-hop.

The no version of the command resumes regular ECMP spraying of packets of IGP, BGP, and static route prefixes over MPLS LSP.

Default no weighted-ecmp

fib-priority

Syntax **fib-priority** {**high** | **standard**}

Context config>router

Description This command specifies the FIB priority for VPRN.

Default fib-priority standard

icmp-tunneling

Syntax **icmp-tunneling**
no icmp-tunneling

Context config>router

Description This command enables the tunneling of ICMP reply packets over MPLS LSP at a LSR node as per RFC 3032.

The LSR part of this feature consists of crafting the reply ICMP packet of type=11- 'time exceeded', with a source address set to a local address of the LSR node, and appending the IP header and leading payload octets of the original datagram. The system skips the lookup of the source address of the sender of the label TTL expiry packet, which becomes the destination address of the ICMP reply packet. Instead, CPM injects the ICMP reply packet in the forward direction of the MPLS LSP the label TTL expiry packet was received from. The TTL of pushed labels should be set to 255.

The source address of the ICMP reply packet is determined as follows. The LSR uses the address of the outgoing interface for the MPLS LSP. With LDP LSP or BGP LSP multiple ECMP next-hops can exist and in such a case the first outgoing interface is selected. If that interface does not have an address of the same family (IPv4 or IPv6) as the ICMP packet, then the system address of the same family is selected. If one is not configured, the packet is dropped.

When the packet is received by the egress LER, it performs a regular user packet lookup in the data path in the GRT context for BGP shortcut, 6PE, and BGP label route prefixes, or in VPRN context for VPRN and 6VPE prefixes. It then forwards it to the destination, which is the sender of the original packet which TTL expired at the LSR.

If the egress LER does not have a route to the destination of the ICMP packet, it drops the packets.

The rate of the tunneled ICMP replies at the LSR can be directly or indirectly controlled by the existing IOM level and CPM levels mechanisms. Specifically, the rate of the incoming UDP traceroute packets received with a label stack can be controlled at ingress IOM using the distributed CPU protection feature. The rate of the ICMP replies by CPM can also be directly controlled by configuring a system wide rate limit for packets ICMP replies to MPLS expired packets which are successfully forwarded to CPM using the command 'configure system security vprn-network-exceptions'. While this command's name refers to VPRN service, this feature rate limits ICMP replies for packets received with any label stack, including VPRN and shortcuts.

The 7450 ESS, 7750 SR, and 7950 XRS implementation supports appending to the ICMP reply of type Time Exceeded the MPLS label stack object defined in RFC 4950. It does not include it in the ICMP reply type of Destination unreachable.

The new MPLS Label Stack object permits an LSR to include label stack information including label value, EXP, and TTL field values, from the encapsulation header of the packet that expired at the LSR node. The ICMP message continues to include the IP header and leading payload octets of the original datagram.

In order to include the MPLS Label Stack object, the SR OS implementation adds support of RFC 4884 which defines extensions for a multi-part ICMPv4/v6 message of type Time Exceeded.

The **no** form of command disables the tunneling of ICMP reply packets over MPLS LSP at a LSR node.

Default no icmp-tunneling

ip-fast-reroute

Syntax [**no**] **ip-fast-reroute**

Context config>router

Description This command enables IP Fast-Reroute (FRR) feature on the system.

This feature provides for the use of a Loop-Free Alternate (LFA) backup next-hop for forwarding in-transit and CPM generated IP packets when the primary next-hop is not available. IP FRR is supported on IPv4 and IPv6 OSPF/IS-IS prefixes forwarded in the base router instance to a network IP interface or to an IES SAP interface or spoke interface. It is also supported for VPRN VPN-IPv4 OSPF prefixes and VPN-IPv6 OSPF prefixes forwarded to a VPRN SAP interface or spoke interface.

IP FRR also provides a LFA backup next-hop for the destination prefix of a GRE tunnel used in an SDP or in VPRN auto-bind.

When any of the following events occurs, IGP instructs in the fast path on the XMAs to enable the LFA backup next-hop:

- OSPF/IS-IS interface goes operationally down: physical or local admin shutdown.
- Timeout of a BFD session to a next-hop when BFD is enabled on the OSPF/IS-IS interface

When the SPF computation determines there is more than one primary next-hop for a prefix, it will not program any LFA next-hop in RTM. Thus, the IP prefix will resolve to the multiple equal-cost primary next-hops that provide the required protection.

The **no** form of this command disables the IP FRR feature on the system

Default no ip-fast-reroute

mc-maximum-routes

Syntax **mc-maximum-routes** *number* [**log-only**] [**threshold** *threshold*]
no mc-maximum-routes

Context config>router

Description This command specifies the maximum number of multicast routes that can be held within a VPN routing/forwarding (VRF) context. When this limit is reached, a log and SNMP trap are sent. If the **log-only** parameter is not specified and the maximum-routes value is set below the existing number of routes in a VRF, then no new joins will be processed.

The **no** form of the command disables the limit of multicast routes within a VRF context. Issue the **no** form of the command only when the VPRN instance is shutdown.

Default no mc-maximum-routes

Parameters *number* — specifies the maximum number of routes to be held in a VRF context

Values 1 to 2147483647

log-only — specifies that if the maximum limit is reached, only log the event. **log-only** does not disable the learning of new routes.

threshold *threshold* **—** The percentage at which a warning log message and SNMP trap should be sent.

Values 0 to 100

Default 10

mpls-labels

Syntax **mpls-labels**

Context config>router

Description This command creates a context for the configuration of global parameters related to MPLS labels.

Default n/a

static-label-range

Syntax **static-label-range** *static-range*
no static-label-range

Context config>router>mpls-labels

Description This command configures the range of MPLS static label values shared among static LSP, MPLS-TP LSP, and static service VC label. Once this range is configured, it is reserved and cannot be used by other protocols such as RSVP, LDP, BGP, or Segment Routing to assign a label dynamically.

Default static-label-range 18400

Parameters *static-range* — Size of the static label range in number of labels. The minimum label value in the range is 32. The maximum label value is thus computed as {32+ static-range-1}.

Values 0 to 131040 for chassis mode C

Values 0 to 262112 for chassis mode D

Default 18400

bgp-labels-hold-timer

Syntax **bgp-labels-hold-timer** *seconds*
[**no**] **bgp-labels-hold-timer**

Context config>router>mpls-labels

Description This command configures the BGP labels hold timer on the ingress router.

Default bgp-labels-hold-timer 0

Parameters *seconds* — specifies the seconds

Values 0 to 255

sr-labels

Syntax **sr-labels start** *start-value* **end** *end-value*
no sr-labels

Context config>router>mpls-labels

Description This command configures the range of the Segment Routing Global Block (SRGB). It is a label block which is used for assigning labels to segment routing prefix SIDs originated by this router. This range is carved from the system dynamic label range and is not instantiated by default.

This is a reserved label and once configured it cannot be used by other protocols such as RSVP, LDP, and BGP to assign a label dynamically.

Default no sr-labels

Parameters *start start-value* — start label value in the SRGB

Values 18432 to 524287

Default none

end end-value — end label value in the SRGB

Values 18432 to 524287

Default None

mss-adjust-group

Syntax **mss-adjust-group** *nat-group-id* **segment-size** *segment-size*
no mss-adjust-group

Context config>router
config>service>vprn

Description This command associates the MSS adjust group consisting of multiple ISAs with the routing context in which the application requiring TCP MSS adjust resides.

Default n/a

Parameters *nat-group-id* — specifies the NAT group used for TCP MSS adjust

segment-size — specifies the value to put into the TCP Maximum Segment Size (MSS) option if it is not already present, or if the present value is higher

multicast-info-policy

Syntax **multicast-info-policy** *policy-name*
no multicast-info-policy

Context config>router

Description This command configures multicast information policy.

Default no multicast-info-policy

Parameters *policy-name* — specifies the policy name

Values 32 chars max

network-domains

Syntax **network-domains**

Context config>router

Description This command opens context for defining network-domains. This command is applicable only in the base routing context.

Default n/a

description

Syntax [**no**] **description** *string*

Context config>router>network-domains>network-domain

Description This command creates a text description stored in the configuration file for a configuration context.

The **no** form of the command removes the description string from the context.

Default no description

Parameters *string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special character (#, $, space, etc.), the entire string must be enclosed within double quotes.

network-domain

Syntax **network-domain** *network-domain-name* [**create**]
no network-domain *network-domain-name*

Context config>router>network-domains

Description This command creates network-domains that can be associated with individual interfaces and SDPs.

Default **network-domain** “default”

Parameters *network-domain-name* — Network domain name character string.

rpki-session

Syntax **rpki-session** *ip-address*
no rpki-session *ip-address*

Context config>router>origin-validation

Description This command configures a session with an RPKI local cache server by using the RPKI-Router protocol. It is over these sessions that the router learns dynamic VRP entries expressing valid origin AS and prefix associations. SR OS supports the RPKI-Router protocol over TCP/IPv4 or TCP/IPv6 transport. The router can set up an RPKI-Router session using the base routing table (in-band) or the management router (out-of-band).

Default **no rpki-session**

Parameters *ip-address* — An IPv4 address or an IPv6 address. If the IPv6 address is link-local then the interface name must be appended to the IPv6 address after a hyphen (-).

connect-retry

Syntax **connect-retry** *seconds*
no connect-retry

Context config>router>origin-validation>rpki-session

Description This command configures the time in seconds to wait between one TCP connection attempt that fails and the next attempt. The default (with **no connect-retry**) is 120 seconds.

Default **no connect-retry**

Parameters *seconds* — specifies time in seconds

Values 1 to 65535

description

Syntax **description** *description-string*
no description

Context config>router>origin-validation>rpki-session

Description This command configures a description for an RPKI-Router session.

Default **no description**

Parameters *description-string* — specifies a text string up to 80 characters in length

local-address

Syntax **local-address** *ip-address*
no local-address

Context config>router>origin-validation>rpki-session

Description This command configures the local address to use for setting up the TCP connection used by an RPKI-Router session. The default local-address is the outgoing interface IPv4 or IPv6 address. The local-address cannot be changed without first shutting down the session.

Default **no local-address**

Parameters *ip-address* — specifies an IPv4 address or an IPv6 address

port

Syntax **port** *port-id*

no port

Context config>router>origin-validation>rpki-session

Description This command configures the destination port number to use when contacting the cache server. The default port number is 323. The port cannot be changed without first shutting down the session.

Default **no port**

Parameters *port-id* — specifies a port-id

Values 0 to 65535

refresh-time

Syntax **refresh-time** *seconds1* **hold-time** *seconds2*
no refresh-time

Context config>router>origin-validation>rpki-session

Description This command is used to configure the **refresh-time** and **hold-time** intervals that are used for liveness detection of the RPKI-Router session. The **refresh-time** defaults to 300 seconds and is reset whenever a Reset Query PDU or Serial Query PDU is sent to the cache server. When the timer expires, a new Serial Query PDU is sent with the last known serial number.

The **hold-time** specifies the length of time in seconds that the session is to be considered UP without any indication that the cache server is alive and reachable. The timer defaults to 600 seconds and must be at least 2x the refresh-time (otherwise the CLI command is not accepted). Reception of any PDU from the cache server resets the hold timer. When the **hold-time** expires, the session is considered to be DOWN and the stale timer is started.

Default **no refresh-time**

Parameters *seconds1* — specifies a time in seconds

Values 30 to 32767

seconds2 — specifies a time in seconds

Values 60 to 65535

shutdown

Syntax **shutdown**
no shutdown

Context config>router>origin-validation>rpki-session

Description This command administratively disables an RPKI-Router session. The no form of the command enables the RPKI-Router session.

Default **no shutdown**

stale-time

Syntax **stale-time** *seconds*
no stale-time

Context config>router>origin-validation>rpki-session

Description This command configures the maximum length of time that prefix origin validation records learned from the cache server remain usable after the RPKI-Router session goes down. The default stale-time is 3600 seconds (1 hour). When the timer expires all remaining stale entries associated with the session are deleted.

Default **no stale-time**

Parameters *seconds* — specifies a time in seconds

Values 60 to 3600

static-entry

Syntax **static-entry** *ip-prefix/ip-prefix-length* **upto** *prefix-length2* **origin-as** *as-number* [**valid** | **invalid**]
no static-entry *ip-prefix/ip-prefix-length* **upto** *prefix-length2* **origin-as** *as-number*

Context config>router>origin-validation

Description This command configures a static VRP entry indicating that a particular origin AS is either valid or invalid for a particular IP prefix range. Static VRP entries are stored along with dynamic VRP entries (learned from local cache servers using the RPKI-Router protocol) in the origin validation database of the router. This database is used for determining the **origin-validation** state of IPv4 and/or IPv6 BGP routes received over sessions with the **enable-origin-validatio**n command configured.

Static entries can only be configured under the **config>router>origin-validation** context of the base router.

Default **no static entries**

Parameters *ip-prefix/ip-prefix-length* — specifies an IPv4 or IPv6 address with a minimum prefix length value

Values 60 to 3600

prefix-length2 — specifies the maximum prefix length

as-number — specifies as-number

Values 0 to 4294967295

valid — specifies a keyword meaning the static entry expresses a valid combination of origin AS and prefix range

invalid — specifies a keyword meaning the static entry expresses an invalid combination of origin AS and prefix range

router-id

Syntax **router-id** *ip-address*
no router-id

Context config>router

Description This command configures the router ID for the router instance.

The router ID is used by both OSPF and BGP routing protocols in this instance of the routing table manager. IS-IS uses the router ID value as its system ID.

When configuring a new router ID, protocols are not automatically restarted with the new router ID. The next time a protocol is initialized, the new router ID is used. This can result in an interim period of time when different protocols use different router IDs.

It is possible to configure an SR OS to operate with an IPv6 only BOF and no IPv4 system interface address. When configured in this manner, the operator must explicitly define IPv4 router IDs for protocols such as OSPF and BGP as there is no mechanism to derive the router ID from an IPv6 system interface address.

To force the new router ID to be used, issue the **shutdown** and **no shutdown** commands for each protocol that uses the router ID, or restart the entire router.

The **no** form of the command to reverts to the default value.

Default The system uses the system interface address (which is also the loopback address).

If a system interface address is not configured, use the last 32 bits of the chassis MAC address.

Parameters *router-id* — The 32 bit router ID expressed in dotted decimal notation or as a decimal value.

service-prefix

Syntax **service-prefix** *ip-prefix/mask* **|** *ip-prefix netmask* [**exclusive**]
no service-prefix *ip-prefix/mask* **|** *ip-prefix netmask*

Context config>router

Description This command creates an IP address range reserved for IES or VPLS services.

The purpose of reserving IP addresses using **service-prefix** is to provide a mechanism to reserve one or more address ranges for services.

When services are defined, the address must be in the range specified as a service prefix. If a service prefix is defined, then IP addresses assigned for services must be within one of the ranges defined in the **service-prefix** command. If the **service-prefix** command is not configured, then no limitations exist.

Addresses in the range of a service prefix can be allocated to a network port unless the exclusive parameter is used. Then, the address range is exclusively reserved for services.

When a range that is a superset of a previously defined service prefix is defined, the subset is replaced with the superset definition; for example, if a service prefix exists for 10.10.10.0/24, and a service prefix is configured as 10.10.0.0/16, then 10.10.10.0/24 is replaced by the new 10.10.0.0/16 configuration.

When a range that is a subset of a previously defined service prefix is defined, the subset replaces the existing superset, providing addresses used by services are not affected; for example, if a service prefix exists for 10.10.0.0/16, and a service prefix is configured as 10.10.10.0/24, then the 10.10.0.0/16 entry is removed as long as no services are configured that use 10.10.x.x addresses other than 10.10.10.x.

The **no** form of the command removes all address reservations. A service prefix cannot be removed while one or more service uses an address or addresses in the range.

Default no service-prefix - no IP addresses are reserved for services.

Parameters *ip-prefix/mask* — The IP address prefix to include in the service prefix allocation in dotted decimal notation.

Values

ipv4-prefix:	a.b.c.d (host bits must be 0)	
ipv4-prefix-length:	0 to 32	
ipv6-prefix:	x:x:x:x:x:x:x:x (eight 16-bit pieces)	
	x:x:x:x:x:x:d.d.d.d	
	x:	[0 to FFFF]H
	d:	[0 to 255]D
ipv6-prefix-length:	0 to 128	

Values exclusive

When this option is specified, the addresses configured are exclusively used for services and cannot be assigned to network ports.

sgt-qos

Syntax **sgt-qos**

Context config>router

Description This command configures DSCP/Dot1p re-marking for self-generated traffic.

Default n/a

application

Syntax **application** *dscp-app-name* **dscp** {*dscp-value* |*dscp-name*}
application *dot1p-app-name* **dot1p** *dot1p-priority*
no application {*dscp-app-name* **|** *dot1p-app-name*}

Context config>router>sgt-qos

Description This command configures DSCP/Dot1p re-marking for applications.

Parameters *dscp-app-name* — specifies the DSCP application name

Values bgp, cflowd, dhcp, diameter, dns, ftp, ftp, gtp, icmp, igmp, igmp-reporter, l2tp, ldp, mld, msdp, ndis, ntp, ospf, pcep, pim, ptp, radius, rip, rsvp, sflow, snmp, snmp-notification, srrp, ssh, syslog, tacplus, telnet, tftp, traceroute, vrrp

dscp-value — specifies the DSCP value

Values 0 to 63

dscp-name — specifies the DSCP name

none, be, ef, cp1, cp2, cp3, cp4, cp5, cp6, cp7, cp9, cs1, cs2, cs3, cs4, cs5, nc1, nc2, af11, af12, af13, af21, af22, af23, af31, af32, af33, af41, af42, af43, cp11, cp13, cp15, cp17, cp19, cp21, cp23, cp25, cp27, cp29, cp31, cp33, cp35, cp37, cp39, cp41, cp42, cp43, cp44, cp45, cp47, cp49, cp50, cp51, cp52, cp53, cp54, cp55, cp57, cp58, cp59, cp60, cp61, cp62, cp63

dot1p-priority — specifies the Dot1p priority

Values none, 0 to 7

dot1p-app-name — specifies the Dot1p application name

Values arp, isis, pppoe

dscp

Syntax **dscp** *dscp-name* **fc** *fc-name*
no dscp *dscp-name*

Context config>router>sgt-qos

Description This command configures DSCP name to FC mapping.

Parameters *dscp-name* — specifies the DSCP name

Values be, ef, cp1, cp2, cp3, cp4, cp5, cp6, cp7, cp9, cs1, cs2, cs3, cs4, cs5, nc1, nc2, af11, af12, af13, af21, af22, af23, af31, af32, af33, af41, af42, af43, cp11, cp13, cp15, cp17, cp19, cp21, cp23, cp25, cp27, cp29, cp31, cp33, cp35, cp37, cp39, cp41, cp42, cp43, cp44, cp45, cp47, cp49, cp50, cp51, cp52, cp53, cp54, cp55, cp57, cp58, cp59, cp60, cp61, cp62, cp63

fc-name — specifies the forward class name

Values be, l2, af, l1, h2, ef, h1, nc

bfd-template

Syntax **bfd-template** *name* [**create**]
no bfd-template *name*

Context config>router>bfd

Description This command creates or edits a BFD template. A BFD template defines the set of configurable parameters used by a BFD session. These include the transmit and receive timers used for BFD CC packets, the transmit timer interval used when the session is providing a CV function, the multiplier value, the echo-receive interval, and whether the BFD session terminates in the CPM network processor.

Default no bfd-template

Parameters *name* — specifies a text string name for the template up to 32 characters in printable 7-bit ASCII, enclosed in double quotes

transmit-interval

Syntax **transmit-interval** *transmit-interval*
no transmit-interval

Context config>router>bfd>bfd-template

Description This command specifies the transmit timer used for BFD packets. If the template is used for a BFD session on an MPLS-TP LSP, then this timer is used for CC packets.

Default transmit-interval 100

Parameters *transmit-interval* — specifies the transmit interval. The minimum interval that can be configured is hardware dependent.

Values 10 ms to 100,000 ms in 1 ms intervals

Default 10 ms for CPM3 or higher; 1 second for other hardware

receive-interval

Syntax **receive-interval** *receive-interval*
no receive-interval

Context config>router>bfd>bfd-template

Description This command specifies the receive timer used for BFD packets. If the template is used for a BFD session on an MPLS-TP LSP, then this timer is used for CC packets.

Default receive-interval 100

Parameters *receive-interval* — specifies the receive interval. The minimum interval that can be configured is hardware dependent.

Values 10 ms to 100,000 ms in 1 ms intervals

Default 10 ms for CPM3 or higher; 1 second for other hardware

echo-receive

Syntax **echo-receive** *echo-interval*
no echo-receive

Context config>router>bfd>bfd-template

Description This command sets the minimum echo receive interval, in milliseconds, for a session. This is not used by a BFD session for MPLS-TP.

Default echo-receive 100

Parameters *echo-interval* — specifies the echo receive interval

Values 100 ms to 100,000 ms in 1 ms increments

Default 100

multiplier

Syntax **multiplier** *multiplier*
no multiplier

Context config>router>bfd>bfd-template

Description This command specifies the detect multiplier used for a BFD session. If a BFD control packet is not received for a period of *multiplier* x *receive-interval*, then the session is declared down.

Default multiplier 3

Parameters *multiplier* — specifies the multiplier

Values 3 to 20, integers

Default 3

type

Syntax [**no**] **type cpm-np**

Context config>router>bfd>bfd-template

Description This command selects the CPM network processor as the local termination point for the BFD session. This is enabled by default.

Default no type

single-sfm-overload

Syntax **single-sfm-overload** [**holdoff-time** *holdoff-time*]
no single-sfm-overload

Context config>router

Description This command configures OSPF, OSPFv3 and IS-IS to set overload when the router has fewer than the full set of SFMs functioning, which reduces forwarding capacity. Setting overload enables a router to still participate in exchanging routing information, but routes all traffic away from it.

The conditions to set overload are as follows:

- 7750 SR-12/SR-7/SR-c12 and 7450 ESS-12/ESS-7/ESS-6 platforms: protocol sets overload if one of the SF/CPMs fails
- 7950 XRS and 7750 SR-12e platforms: protocol sets overload if two SFMs fail

The **no** form of this command configures the router to not set overload if an SFM fails.

Default no single-sfm-overload

Parameters *holdoff-time* — This parameter specifies the delay between detecting SFM failures and setting overload.

Values 1to 600 seconds

Default 0 seconds

static-route-entry

Syntax **static-route-entry** {*ip-prefix***/***prefix-length*} [**mcast**]

Context config>router

Description This command creates a static route entry for both the network and access routes. A prefix and netmask must be specified.

Once the static route context for the specified prefix and netmask has been created, additional parameters associated with the static route(s) may be specified through the inclusion of additional static route parameter commands

The **no** form of the command deletes the static route entry. If a static route needs to be removed when multiple static routes exist to the same destination, then as many parameters to uniquely identify the static route must be entered

IPv6 static routes are not supported on the 7450 ESS except in mixed mode.

Default No static routes are defined.

Parameters *ip-prefix/prefix-length* — The destination address of the static route.

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-prefix	a.b.c.d (host bits must be 0)	
ipv4-prefix-length	0 to 32	
ipv6-prefix	x:x:x:x:x:x:x:x (eight 16-bit pieces)	
	x:x:x:x:x:x:d.d.d.d	
	x	[0 to FFFF]H
	d	[0 to 255]D
ipv6-prefix-length	0 to 128	

Values The following values apply to the 7450 ESS:

ipv4-prefix	a.b.c.d (host bits must be 0)
ipv4-prefix-length	0 to 32

ip-address — The IP address of the IP interface. The *ip-addr* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation.

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-address	a.b.c.d (host bits must be 0)
ipv6-address	x:x:x:x:x:x:x:x[-interface]
	x:x:x:x:x:x:d.d.d.d[-interface]
	x: [0..FFFF]H
	d: [0..255]D
	interface: 32 characters maximum, mandatory for link local addresses

Values The following value applies to the 7450 ESS:

ipv4-address	a.b.c.d (host bits must be 0)

next-hop

Syntax **next-hop** {*ip-address* | *ip-int-name* | *ipv6 address*}

Context config>router>static-route-entry

Description This command specifies the directly connected next hop IP address or interface used to reach the destination. If the next hop is over an unnumbered interface or a point-to-point interface, the **ip-int-name** of the unnumbered or point-to-point interface (on this node) can be configured.

If the next hop is over an unnumbered interface in the 7450 ESS router, the *ip-int-name* of the unnumbered interface (on this node) can be configured.

The configured *ip-address* can be either on the network side or the access side on this node. The address must be associated with a network directly connected to a network configured on this node.

Default no next-hop

Parameters *ip-address* | *ip-int-name* | *ipv6-address* — the IPv4/IPv6 address or interface of the next hop

Values The following values apply to the 7750 SR, 7450 ESS, and 7950 XRS:

ip-int-name	32 characters max
ipv4-address	a.b.c.d
ipv6-address	x:x:x:x:x:x:x:x-[interface]
	x:x:x:x:x:x:d.d.d.d[-interface]
	x: [0..FFFF]H
	d: [0..255]D

interface: 32 characters maximum, mandatory for link local addresses

IPv6 static routes are not supported on the 7450 ESS except in mixed mode

indirect

Syntax [**no**] **indirect** *ip-address*

Context config>router>static-route-entry

Description This command specifies that the route is indirect and specifies the next hop IP address used to reach the destination.

The configured *ip-addr*ess is not directly connected to a network configured on this node. The destination can be reached via multiple paths. The indirect address can only resolved from dynamic routing protocol. Another static route cannot be used to resolve the indirect address.

The *ip-address* configured here can be either on the network side or the access side and is typically at least one hop away from this node.

Default no indirect

Parameters *ip-address* — The IP address of the IP interface.

Values

ipv4-address	a.b.c.d
ipv6-address	x:x:x:x:x:x:x:x-[interface]

black-hole

Syntax [**no**] **black-hole**

Context config>router>static-route-entry

Description This command specifies that the route is a black hole route. If the destination address on a packet matches this static route, it will be silently discarded.

Default no black-hole

bfd-enable

Syntax [**no**] **bfd-enable**

Context config>router>static-route-entry>next-hop

Description This command associates the static route state to a BFD session between the local system and the configured nexthop.

The remote end of the BFD session must also be configured to originate or accept the BFD session controlling the static route state.

The **no** form of this command removes the association of the static route state to that of the BFD session.

Default no bfd-enable

community

Syntax [**no**] **community** *comm-id*

Context config>router>static-route-entry>next-hop
config>router>static-route-entry>indirect

Description This configuration option associates a BGP community with the static route. The community can be matched in route policies and is automatically added to BGP routes exported from the static route.

The **no** form of this command removes the community association.

Default no community

Parameters *comm-id* — Speifies the community identifier.

Values

comm-id	asn:comm-val, well-known-comm
asn	0 to 65535
comm-val	0 to 65535
well-known-comm	no-advertise, no-export, no-export-subconfed

cpe-check

Syntax [**no**] **cpe-check** *cpe-ip-address*

Context config>router>static-route-entry>next-hop
config>router>static-route-entry>indirect

Description This command enables CPE-check and specifies the IP address of the target CPE device.

This option initiates a background ICMP ping test to the configured target IP address. The IP address can either be an IPv4 address for IPv4 static routes or an IPv6 address for IPv6 static routes. The target-ip-address cannot be in the same subnet as the static route subnet itself to avoid possible circular references. This option is mutually exclusive with BFD support on a given static route.

The **no** form of this command disables the **cpe-check** option.

Default no cpe-check

Parameters *cpe-ip-address* — Speifies the IP address of the CPE device.

drop-count

Syntax [**no**] **drop-count** *count*

Context config>router>static-route-entry>next-hop>cpe-check
config>router>static-route-entry>indirect>cpe-check

Description This optional parameter specifies the number of consecutive ping-replies that must be missed to declare the CPE down and to deactivate the associated static route.

Default drop-count 3

Parameters *count* — An integer count value.

Values 1 to 255

interval

Syntax [**no**] **interval** *seconds*

Context config>router>static-route-entry>next-hop>cpe-check
config>router>static-route-entry>indirect>cpe-check

Description This optional parameter specifies the interval between ICMP pings to the target IP address.

Default interval 1

Parameters *seconds* — An integer interval value.

Values 1 to 255

padding-size

Syntax [**no**] **padding-size** *padding-size*

Context config>router>static-route-entry>next-hop>cpe-check config>router>static-route-entry>indirect>cpe-check

Description This optional parameter specifies the amount of padding to add to the ICMP packet in bytes. The parameter is only applicable when the **cpe-check** option is used with the associated static route.

Default padding-size 56

Parameters *padding-size* — An integer value.

Values 0 to 16384 bytes

log

Syntax [**no**] **log**

Context config>router>static-route-entry>next-hop>cpe-check
config>router>static-route-entry>indirect>cpe-check

Description This optional parameter enables the ability to log transitions between active and in-active based on the CPE connectivity check. Events will be sent to the system log, syslog and SNMP traps.

Default no log

description

Syntax [**no**] **description** *description-string*

Context config>router>static-route-entry>next-hop
config>router>static-route-entry>indirect
config>router>static-route-entry>black-hole

Description This command creates a text description stored in the configuration file for a configuration context.

The **no** form of the command removes the description string from the context

Default no description

Parameters *description-string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

destination-class

Syntax [**no**] **destination-class** *dest-index*

Context config>router>static-route-entry>next-hop
config>router>static-route-entry>indirect
config>router>static-route-entry>black-hole

Description This command configures the policy accounting destination-class index to be used when incrementing accounting statistic for traffic matching the associated static route.

The **no** form of the command removes the associated destination-class from the associated static route nexthop.

Default no destination-class

Parameters *dest-index* — The destination index integer value.

Values 1 to 255

dynamic-bgp

Syntax [**no**] **dynamic-bgp**

Context config>router>static-route-entry>black-hole

Description This optional command controls the behavior of the associated static route so that if a matching BGP route to the same exact prefix is present in BGP, the static route's nexthop is set to the BGP's nexthop value. If there is no matching active BGP route, the static route's nexthop is set to be a black-hole nexthop.

Default no dynamic-bgp

generate-icmp

Syntax [**no**] **generate-icmp**

Context config>router>static-route-entry>black-hole

Description This optional command causes the ICMP unreachable messages to be sent when received packets match the associated static route. By default, the ICMP unreachable messages for those types of static routes are not generated.

This command can only be associated with a static route that has a blackhole next-hop

The **no** form of this command removes the black-hole nexthop from the static route configuration.

Default no generate-icmp

forwarding-class

Syntax [**no**] **forwarding-class** {**be** | **l2** | **af** | **l1** | **h2** | **ef** | **h1** | **nc**}

Context config>router>static-route-entry>next-hop
config>router>static-route-entry>indirect
config>router>static-route-entry>next-hop

Description This command specifies the enqueuing forwarding class that should be associated with traffic matching the associate static route. If this parameter is not specified, the packet will use the forwarding-class association based on default classification or other QoS Policy associations.

Default no forwarding-class

Parameters **be | l2 | af | l1 | h2 | ef | h1 | nc —** specifies the forwarding class

Values be **|** l2 **|** af **|** l1 **|** h2 **|** ef **|** h1 **|** nc

ldp-sync

Syntax [**no**] **ldp-sync**

Context config>router>static-route-entry>next-hop
config>router>static-route-entry>indirect
config>router>static-route-entry>next-hop

Description This command extends the LDP synchronization feature to a static route. When an interface comes back up, it is possible that a preferred static route using the interface as next-hop for a given prefix is enabled before the LDP adjacency to the peer LSR comes up on this interface. In this case, traffic on an SDP that uses the static route for the far-end address would be black-holed until the LDP session comes up and the FECs exchanged.

This option when enabled delays the activation of the static route until the LDP session comes up over the interface and the ldp-sync-timer configured on that interface has expired

Default no ldp-sync

metric

Syntax [**no**] **metric** *metric-value*

Context config>router>static-route-entry>next-hop
config>router>static-route-entry>indirect

Description This command specifies the cost metric for the static route, expressed as a decimal integer. This value is used when importing the static route into other protocols such as OSPF. When the metric is configured as 0 then the metric configured in OSPF, default-import-metric, applies. When modifying the metric of an existing static route, the preference will not change unless specified. This value is also used to determine which static route to install in the forwarding table.

If there are multiple static routes with the same preference but different metrics then the lower cost (metric) route will be installed.

The **no** form of this command returns the metric to the default value

Default metric 1

Parameters *metric-value* — specifies the cost metric value

Values 0 to 65535

preference

Syntax [**no**] **preference** *preference-value*

Context config>router>static-route-entry>next-hop
config>router>static-route-entry>indirect
config>router>static-route-entry>black-hole

Description This command specifies the route preference to be assigned to the associated static route. The lower the preference value the more preferred the route is considered.

Table 6 shows the default route preference based on the route source.

Table 6 **Default Route Preference**

Label	Preference	Configurable
Direct attached	0	No
Static route	5	Yes
OSPF Internal routes	10	Yes
IS-IS level 1 internal	15	Yes
IS-IS level 2 internal	18	Yes
OSPF external	150	Yes
IS-IS level 1 external	160	Yes
IS-IS level 2 external	165	Yes
BGP	170	Yes

The **no** form of this command returns the returns the associated static route preference to its default value.

Default preference 5

Parameters *preference-value* — specifies the route preference value

Values 1 to 255

prefix-list

Syntax [**no**] **prefix-list** *name* {**all** | **none** | **any**}

Context config>router>static-route-entry>next-hop
config>router>static-route-entry>indirect
config>router>static-route-entry>black-hole

Description This command associates a new constraint to the associated static route such that the static route is only active if **any**, **none**, or **all** of the routes in the prefix list are present and active in the route-table.

Default no prefix-list

Parameters *name* — specifies the name of a currently configured prefix-list

all — specifies that the static route condition is met if all prefixes in the prefix-list must be present in the active route-table

none — specifies that the static route condition is met if none of the prefixes in the named prefix-list can be present in the active route-table

any — specifies that the static route condition is met if any prefixes in the prefix-list are present in the active route-table

priority

Syntax [**no**] **priority** {**low** | **high**}

Context config>router>static-route-entry>next-hop>forwarding-class
config>router>static-route-entry>indirect>forwarding-class

Description This optional command associates an enqueuing priority with the static route. The options are either high or low, with low being the default. This parameter has the ability to affect the likelihood that a packet will be enqueued at SAP ingress in the face of ingress congestion.

Once a packet is enqueued into an ingress buffer, the significance of this parameter is lost.

Default priority low

Parameters **low** — Setting the enqueuing parameter for a packet to **low** decreases the likelihood of enqueuing the packet when the ingress queue is congested. Ingress enqueuing priority only affects ingress SAP queuing. Once the packet is placed in a buffer on the ingress queue, the significance of the enqueuing priority is lost.

high — Setting the enqueuing parameter for a packet to **high** increases the likelihood of enqueuing the packet when the ingress queue is congested. Ingress enqueuing priority only affects ingress SAP queuing. Once the packet is placed in a buffer on the ingress queue, the significance of the enqueuing priority is lost..

shutdown

Syntax [**no**] **shutdown**

Context config>router>static-route-entry>black-hole
config>router>static-route-entry>indirect
config>router>static-route-entry>next-hop

Description This command causes the static route to be placed in an administratively down state and removed from the active route-table

Default no shutdown

source-class

Syntax [**no**] **source-class** *source-index*

Context config>router>static-route-entry>indirect
config>router>static-route-entry>next-hop

Description This command configures the policy accounting source-class index to be used when incrementing accounting statistic for traffic matching the associated static route.

If source route policy accounting is enabled and a source-class index is configured, traffic with a source IP address matches the associated static route, the source accounting statistics for the specified class will be incremented.

The **no** form of the command removes the associated destination-class from the associated static route nexthop.

Default no source-class

Parameters *source-index* — specifies an integer value for the accounting source class index

Values 1 to 255

tag

Syntax [**no**] **tag** *tag-value*

Context config>router>static-route-entry>indirect
config>router>static-route-entry>next-hop

Description This command adds a 32-bit integer tag to the associated static route.

The tag value can be used in route policies to control distribution of the route into other protocols.

Default no tag

Parameters *tag-value* — specifies an integer tag value

Values 32 bit integer

tunnel-next-hop

Syntax [**no**] **tunnel-next-hop**

Context config>router>static-route-entry>indirect

Description This command enables the static route's nexthop to be resolved to an indirect tunnel next-hop.

The command within the **tunnel-next-hop** context controls the resolution to tunnel next-hops in TTM. As such, the user must first configure the prefix with the existing command and the **indirect** option, and then enter the new command with the **indirect** option and with the new **static-route-entry** command.

Default no tunnel-next-hop

disallow-igp

Syntax [**no**] **disallow-igp**

Context config>router>static-route-entry>indirect>tunnel-next-hop

Description This optional command determines if the associated static route can be resolved via an IGP next-hop in the RTM if no tunnel next-hops are found in TTM.

When configured, the associated static route will not be resolved to an available IGP route in the RTM.

The **no** form of the command returns the behavior to the default, which does allow for the static route to be resolved via an IGP route in the RTM if no tunnel next-hop can be found in the TTM.

Default no disallow-igp

resolution

Syntax **resolution** {**any** | **disabled** | **filter**}
no resolution

Context config>router>static-route-entry>indirect>tunnel-next-hop

Description This command determines how the associated static route can be resolved to a tunnel next-hop.

Default resolution any

Parameters **any** — Allows the associated static route to be resolved to any active entry in the TTM, following the TTM preference order.

disabled — Disables the associated static route to be resolved to any active entry in the TTM. As a result, the static route can only be resolved via IP RTM resolution of the static route's nexthop.

filter — Allows the associated static route to be resolved to active tunnels in the TTM using the resolution-filter restrictions.

resolution-filter

Syntax [**no**] **resolution-filter**

Context config>router>static-route-entry>indirect>tunnel-next-hop

Description This command creates the context to specify the tunnel next-hop resolution options.

If one or more tunnel filter criteria are specified, the static route nexthop will be resolved to an available tunnel from one of those LSP sources. The tunnel types will be selected following the TTM preference.

Default no resolution-filter

ldp

Syntax [**no**] **ldp**

Context config>router>static-route-entry>indirect>tunnel-next-hop>resolution-filter

Description This command enables the use of LDP sourced tunnel entries in the TTM to resolve the associated static route next-hop.

Default no ldp

rsvp-te

Syntax [**no**] **rsvp-te**

Context config>router>static-route-entry>indirect>tunnel-next-hop>resolution-filter

Description This command enables the use of RSVP-TE sourced tunnel entries in the TTM to resolve the associated static route next-hop.

The rsvp-te value instructs the code to search for the set of lowest metric RSVP-TE LSPs to the address of the indirect next-hop. The LSP metric is provided by MPLS in the tunnel table. The static route treats a set of RSVP-TE LSPs with the same lowest metric as an ECMP set. The user has the option of configuring a list of RSVP-TE LSP names to be used exclusively instead of searching in the tunnel table. In that case, all LSPs must have the same LSP metric in order for the static route to use them as an ECMP set. Otherwise, only the LSPs with the lowest common metric value will be selected.

A P2P auto-lsp that is instantiated via an LSP template can be selected in TTM when resolution is set to any. However, it is not recommended to configure an auto-lsp name explicitly under the rsvp-te node as the auto-generated name can change if the node reboots, which will blackhole the traffic of the static route.

Default no rsvp-te

lsp

Syntax [**no**] **lsp** *name*

Context config>router>static-route-entry>indirect>tunnel-next-hop>resolution-filter>rsvp-te
config>router>static-route-entry>indirect>tunnel-next-hop>resolution-filter>sr-te

Description This command restricts the search for a resolving LSP to a specific set of named LSPs. Only those LSPs named in the associated name list will be searched for a match to resolve the associated static route.

Default n/a

Parameters *name* — specifies the name of the LSP(s) to be searched for a valid resolving tunnel for the static route's next-hop

sr-ospf

Syntax [**no**] **sr-ospf**

Context config>router>static-route-entry>indirect>tunnel-next-hop>resolution-filter

Description This command enables the use of sr-ospf sourced tunnel entries in the TTM to resolve the associated static route next-hop.

Default no sr-ospf

sr-isis

Syntax [**no**] **sr-isis**

Context config>router>static-route-entry>indirect>tunnel-next-hop>resolution-filter

Description This command enables the use of sr-isis sourced tunnel entries in the TTM to resolve the associated static route next-hop.

Default no sr-isis

sr-te

Syntax [**no**] **sr-te**

Context config>router>static-route-entry>indirect>tunnel-next-hop>resolution-filter

Description The sr-te value instructs the code to search for the set of lowest metric SR-TE LSPs to the address of the indirect next-hop. The LSP metric is provided by MPLS in the tunnel table. The static route treats a set of SR-TE LSPs with the same lowest metric as an ECMP set. The user has the option of configuring a list of SR-TE LSP names to be used exclusively instead of searching in the tunnel table. In that case, all LSPs must have the same LSP metric in order for the static route to use them as an ECMP set. Otherwise, only the LSPs with the lowest common metric value are selected.

Default no sr-te

validate-next-hop

Syntax [**no**] **validate-next-hop**

Context config>router>static-route-entry>next-hop

Description This optional command tracks the state of the next-hop in the IPv4 ARP cache or IPv6 Neighbor Cache. When the next-hop is not reachable and is removed from the ARP or Neighbor Cache, the next-hop will no longer be considered valid and the associated static-route state removed from the active route-table.

When the next-hop is reachable again and present in the ARP/Neighbor Cache, the static route will be considered valid and is subject to being placed into the active route-table.

Default no validate-next-hop

disallow-igp

Syntax **disallow-igp**
no disallow-igp

Context config>router>static-route-entry>tunnel-next-hop

Description This command is for indirect static routes using tunnel next-hops. When enabled, the static route will not be activated using IGP next-hops in RTM if no tunnel next-hops are found in TTM.

Default no disallow-igp

triggered-policy

Syntax **triggered-policy**
no triggered-policy

Context config>router

Description This command triggers route policy re-evaluation.

By default, when a change is made to a policy in the **config router policy options** context and then committed, the change is effective immediately. There may be circumstances when the changes should or must be delayed; for example, if a policy change is implemented that would affect every BGP peer on a router, the consequences could be dramatic. It would be more effective to control changes on a peer-by-peer basis.

If the **triggered-policy** command is enabled, and a given peer is established, and you want the peer to remain up, in order for a change to a route policy to take effect, a **clear** command with the *soft* or *soft inbound* option must be used; for example, **clear router bgp neighbor x.x.x.x soft**. This keeps the peer up, and the change made to a route policy is applied only to that peer or group of peers.

Default no triggered-policy

ttl-propagate

Syntax **ttl-propagate**

Context config>router

Description This command enables the context to configure TTL propagation for transit and locally generated packets in the Global Routing Table (GRT) and VPRN routing contexts

Default n/a

label-route-local

Syntax **label-route-local** [**all** | **none**]

Context config>router>ttl-propagate

Description This command configures the TTL propagation for locally generated packets which are forwarded over a BGP label route in the Global Routing Table (GRT) context.

For IPv4 and IPv6 packets forwarded using a RFC 3107 label route in the global routing instance, including 6PE, the all value of the command enables TTL propagation from the IP header into all labels in the transport label stack. The none value reverts to the default mode which disables TTL propagation from the IP header to the labels in the transport label stack. This command does not have a no version.

The TTL of the IP packet is always propagated into the RFC 3107 label itself, and this command only controls the propagation into the transport labels, for example, labels of the RSVP or LDP LSP to which the BGP label route resolves and which are pushed on top of the BGP label.

If the BGP peer advertised the implicit-null label value for the BGP label route, the TTL propagation will not follow the configuration described, but will follow the configuration to which the BGP label route resolves:

RSVP LSP shortcut:

- configure router mpls shortcut-local-ttl-propagate

LDP LSP shortcut:

- configure router ldp shortcut-local-ttl-propagate

This feature does not impact packets forwarded over BGP shortcuts. The ingress LER operates in uniform mode by default and can be changed into pipe mode using the configuration of TTL propagation for RSVP or LDP LSP shortcut listed.

Default label-route-local none

Parameters *none* — The TTL of the IP packet is not propagated into the transport label stack.

all — The TTL of the IP packet is propagated into all labels of the transport label stack.

label-route-transit

Syntax **label-route-transit** [**all** | **none**]

Context cconfig>router>ttl-propagate

Description This command configures the TTL propagation for transit packets which are forwarded over a BGP label route in the Global Routing Table (GRT) context.

For IPv4 and IPv6 packets forwarded using a RFC 3107 label route in the global routing instance, including 6PE, the all value of the command enables TTL propagation from the IP header into all labels in the transport label stack. The none value reverts to the default mode which disables TTL propagation from the IP header to the labels in the transport label stack. This command does not have a no version.

The TTL of the IP packet is always propagated into the RFC 3107 label itself, and this command only controls the propagation into the transport labels, for example, labels of the RSVP or LDP LSP to which the BGP label route resolves and which are pushed on top of the BGP label.

If the BGP peer advertised the implicit-null label value for the BGP label route, the TTL propagation will not follow the configuration described, but will follow the configuration to which the BGP label route resolves.

RSVP LSP shortcut:

- configure router mpls shortcut-transit-ttl-propagate

LDP LSP shortcut:

- configure router ldp shortcut-transit-ttl-propagate

This feature does not impact packets forwarded over BGP shortcuts. The ingress LER operates in uniform mode by default and can be changed into pipe mode using the configuration of TTL propagation for the listed RSVP or LDP LSP shortcut.

Default label-route-transit none

Parameters *none* — The TTL of the IP packet is not propagated into the transport label stack.

all — The TTL of the IP packet is propagated into all labels of the transport label stack.

lsr-label-route

Syntax **lsr-label-route** [**all** | **none**]

Context config>router>ttl-propagate

Description This command configures the TTL propagation for transit packets at a router acting as an LSR for a BGP label route.

When an LSR swaps the BGP label for a ipv4 prefix packet, thus acting as a ABR, ASBR, or data-path Route-Reflector (RR) in the base routing instance, or swaps the BGP label for a vpn-ipv4 or vpn-ipv6 prefix packet, thus acting as an inter-AS Option B VPRN ASBR or VPRN data path Route-Reflector (RR), the all value of this command enables TTL propagation of the decremented TTL of the swapped BGP label into all outgoing LDP or RSVP transport labels.

When an LSR swaps a label or stitches a label, it always writes the decremented TTL value into the outgoing swapped or stitched label. What this feature controls is whether this decremented TTL value is also propagated to the transport label stack pushed on top of the swapped or stitched label.

The none value reverts to the default mode which disables TTL propagation. This changes the existing default behavior which propagates the TTL to the transport label stack. When a customer upgrades, the new default becomes in effect. This command does not have a no version.

This feature also controls the TTL propagation at an LDP-BGP stitching LSR in the LDP to BGP stitching direction. It also controls the TTL propagation in Carrier Supporting Carrier (CsC) VPRN at both the CsC CE and CsC PE.

SR OS does not support ASBR or data path RR functionality for labeled IPv6 routes in the global routing instance (6PE). As such the CLI command of this feature has no impact on prefix packets forwarded in this context.

Default lsr-label-route none

Parameters *none* — The TTL of the swapped label is not propagated into the transport label stack.

all — The TTL of the swapped label is propagated into all labels of the transport label stack.

vprn-local

Syntax **vprn-local** [**all** | **vc-only** | **none**]

Context config>router>ttl-propagate

Description This command configures the TTL propagation for locally generated packets which are forwarded over a MPLS LSPs in all VPRN service contexts.

For vpn-ipv4 and vpn-ipv6 packets forwarded in the context of all VPRN services in the system, including 6VPE packets, the all value of the command enables TTL propagation from the IP header into all labels in the stack:

The user can enable the TTL propagation behavior separately for locally generated packets by CPM (vprn-local) and for user and control packets in transit at the node (vprn-transit).

The vc-only value reverts to the default behavior by which the IP TTL is propagated into the VC label but not to the transport labels in the stack. The user can explicitly set the default behavior by configuring the vc-only value. This command does not have a no version.

The value none allows the user to disable the propagation of the IP TTL to all labels in the stack, including the VC label. This is needed for a transparent operation of UDP traceroute in VPRN inter-AS option B such that the ingress and egress ASBR nodes are not traced.

The user can override the global configuration within each VPRN instance using the following commands:

- config service vprn ttl-propagate local [inherit | none | vc-only | all]
- config service vprn ttl-propagate transit [inherit | none | vc-only | all]

The default behavior for a given VPRN instance is to inherit the global configuration for the same command. The user can explicitly set the default behavior by configuring the inherit value.

When a packet is received in a VPRN context but is looked up in the Global Routing Table (GRT), for example, leaking to GRT is enabled, the behavior of the TTL propagation is governed by the RSVP or LDP shortcut configuration when the matching routing is a LSP shortcut route. It is governed by the BGP label route configuration when the matching route is a RFC 3107 label route or a 6PE route.

When a packet is received on one VPRN instance and is redirected using Policy Based Routing (PBR) to be forwarded in another VPRN instance, the TTL propagation is governed by the configuration of the outgoing VPRN instance.

Default vprn-local vc-only

Parameters *none* — The TTL of the IP packet is not propagated into the VC label or labels in the transport label stack

vc-only — The TTL of the IP packet is propagated into the VC label and not into the labels in the transport label stack.

all — The TTL of the IP packet is propagated into the VC label and all labels in the transport label stack.

vprn-transit

Syntax **vprn-transit** [**all** | **vc-only** | **none**]

Context config>router>ttl-propagate

Description This command configures the TTL propagation for in transit packets which are forwarded over a MPLS LSPs in all VPRN service contexts. For vpn-ipv4 and vpn-ipv6 packets forwarded in the context of all VPRN services in the system, including 6VPE packets, the all value of the command enables TTL propagation from the IP header into all labels in the stack:

The user can enable the TTL propagation behavior separately for locally generated packets by CPM (vprn-local) and for user and control packets in transit at the node (vprn-transit).

The vc-only value reverts to the default behavior by which the IP TTL is propagated into the VC label but not to the transport labels in the stack. The user can explicitly set the default behavior by configuring the vc-only value. This command does not have a no version.

The value none allows the user to disable the propagation of the IP TTL to all labels in the stack, including the VC label. This is needed for a transparent operation of UDP trace-route in VPRN inter-AS option B such that the ingress and egress ASBR nodes are not traced.

The user can override the global configuration within each VPRN service instance using the following commands:

- config service vprn ttl-propagate local [inherit | none | vc-only | all]
- config service vprn ttl-propagate transit [inherit | none | vc-only | all]

The default behavior for a given VPRN instance is to inherit the global configuration for the same command. The user can explicitly set the default behavior by configuring the inherit value.

When a packet is received in a VPRN context but is looked up in the Global Routing Table (GRT), for example, leaking to GRT is enabled, the behavior of the TTL propagation is governed by the RSVP or LDP shortcut configuration when the matching routing is a LSP shortcut route. It is governed by the BGP label route configuration when the matching route is a RFC 3107 label route or a 6PE route.

When a packet is received on one VPRN instance and is redirected using Policy Based Routing (PBR) to be forwarded in another VPRN instance, the TTL propagation is governed by the configuration of the outgoing VPRN instance

Default vprn-transit vc-only

Parameters *none* — The TTL of the IP packet is not propagated into the VC label or labels in the transport label stack

vc-only — The TTL of the IP packet is propagated into the VC label and not into the labels in the transport label stack.

all — The TTL of the IP packet is propagated into the VC label and all labels in the transport label stack.

2.13.2.3 Router L2TP Commands

Router L2TP commands only apply to the 7750 SR and 7450 ESS.

l2tp

Syntax **l2tp**

Context config>router

Description This command enables the context to configure L2TP parameters. L2TP extends the PPP model by allowing Layer 2 and PPP endpoints to reside on different devices interconnected by a packet-switched network.

Default n/a

calling-number-format

Syntax **calling-number-format** *ascii-spec*
no calling-number-format

Context config>router>l2tp

Description This command what string to put in the Calling Number AVP, for L2TP control messages related to a session in this L2TP protocol instance.

Default calling-number-format "%S %s"

Parameters *ascii-spec* — specifies the L2TP calling number AVP

Values

ascii-spec	char-specification ascii-spec		
	char-specification	ascii-char **|** char-origin	
	ascii-char	a printable ASCII character	
	char-origin	%origin	
	origin	S **|** c **|** r **|** s **|** l	
		S	system name, the value of TIMETRA-CHASSIS-MIB::tmnxChassisName
		c	Agent Circuit Id
		r	Agent Remote Id
		s	SAP ID, formatted as a character string
		l	Logical Line ID

eth-tunnel

Syntax **eth-tunnel**

Context config>router>l2tp

Description This command enables the context to configure Ethernet tunnel client parameters.

Default N/A

reconnect-timeout

Syntax **reconnect-timeout** *seconds*
no reconnect-timeout

Context config>router>l2tp>eth-tunnel

Description This command configures the number of seconds that the Ethernet tunnel client of L2TPv3 waits before attempting to re-establish a new session after a session setup fails or a session closes.

The no form of the command returns **reconnect-timeout** to an infinite timeout value, meaning that reconnection will not be attempted by the local client.

Default no reconnect-timeout (infinite timeout)

Parameters *seconds* — Specifies the number of seconds before a session reconnection is attempted after a previous session or session setup fails

Values 10 to 3600

exclude-avps

Syntax **exclude-avps** *calling-number*
no exclude-avps

Context config>router>l2tp

Description This command configures the L2TP AVPs to exclude.

Default no exclude-avps

l2tpv3

Syntax **l2tpv3**

Context config>router>l2tp
config>router>l2tp>group

Description This command enables the context to configure L2TPv3 parameters.

Default n/a

cookie-length

Syntax **cookie-length** {**4** | **8** | **none**}
no cookie-length

Context config>router>l2tp>l2tpv3
config>router>l2tp>group>l2tpv3

Description This command configures the length of the optional cookie field.

The **no** form of the command returns the **cookie-length** to a default of **none**.

Default no cookie-length

Parameters **4 —** Specifies the cookie length as 4 bytes

8 — Specifies the cookie length as 8 bytes

none — Specifies that no cookie field should be included

digest-type

Syntax **digest-type** {**none** | **md5** | **sha1**}
no digest-type

Context config>router>l2tp>l2tpv3
config>router>l2tp>group>l2tpv3

Description This command configures the hashing algorithm used to calculate the message digest.

The **no** form of the command returns the **digest-type** to **none**.

Default no digest-type

Parameters **none —** Specifies that no digest should be used

md5 — Specifies that the MD5 algorithm should be used

sha1 — Specifies that the SHA1 algorithm should be used

nonce-length

Syntax **nonce-length** {*length* | **none**}
no nonce-length

Context config>router>l2tp>l2tpv3
config>router>l2tp>group>l2tpv3

Description This command configures the length for the local L2TPv3 nonce (random number) value used in the Nonce AVP.

The **no** form of the command returns the **nonce-length** to a default of **none**.

Default no nonce-length

Parameters *length* — Specifies the length of the Nonce AVP value

Values 16 to 64

none — Specifies that no Nonce AVP is included

rem-router

Syntax **rem-router-id** *ip-addr*
no rem-router-id

Context config>router>l2tp>group>l2tpv3

Description This command configures the IP address that should be used within the Remote Router-ID AVP.

The **no** form of this command removes the configured IP address.

Default no rem-router-id

Parameters *ip-addr* — Specifies an IP address to be used within the Remote Router-ID AVP

pw-cap-list

Syntax **pw-cap-list** {**ethernet | ethernet-vlan**}
no pw-cap-list

Context config>router>l2tp>group>l2tpv3

Description This command configures the allowable pseudowire capability list that is advertised to the far end. An empty list results in both pseudowire capabilities being advertised.

The **no** form of this command removes the list and advertises both pseudowire capabilities to the far end.

Default no pw-cap-list

Parameters **ethernet —** Specifies that the Ethernet pseudo-wire type is advertised

ethernet-vlan — Specifies that the Ethernet-VLAN pseudo-wire type is advertised. This parameter is only supported in SR OS Release 14.0 R4 or later.

track-password-change

Syntax [**no**] **track-password-change**

Context config>router>l2tp>group>l2tpv3

Description This command enables tracking of password changes, allowing password tunnel passwords to be changed without bringing down active tunnels or sessions. This is only supported with L2TPv3.

The **no** form of the command disables password change tracking.

Default no track-password-change

transport-type

Syntax **transport-type ip**
no transport-type

Context config>router>l2tp>l2tpv3
config>router>l2tp>group>l2tpv3

Description This command configures the transport type to be used to carry the L2TPv3 tunnel. Currently, only IP transport is supported.

The **no** form of this command returns the **transport-type** to the default value.

Default no transport-type

Parameters **ip —** Specifies that IP should be used as the transport type for the L2TPv3 tunnel

next-attempt

Syntax **next-attempt** {**same-preference-level** | **next-preference-level**}
no next-attempt

Context config>router>l2tp
config>service>vprn>l2tp

Description This command enables tunnel selection algorithm based on the tunnel preference level.

Default n/a

Parameters **same-preference-level —** In case that the tunnel-spec selection algorithm evaluates into a tunnel that is currently unavailable (for example tunnel in a blacklist) then the next elected tunnel, if available, will be chosen within the same preference-level as the last attempted tunnel. Only when all tunnels within the same preference level are exhausted, the tunnel selection algorithm will move to the next preference level.

In case that a new session setup request is received while all tunnels on the same preference level are blacklisted, the L2TP session will try to be established on blacklisted tunnels before the tunnel selection moves to the next preference level.

next-preference-level — In case that the tunnel-spec selection algorithm evaluates into a tunnel that is currently unavailable (for example tunnel in a blacklist) then the selection algorithm will try to select the tunnel from the next preference level, even though the tunnels on the same preference level might be available for selection.

Default next-preference-level

replace-result-code

Syntax **replace-result-code** *code* [**code...**(**upto 3 max**)]
no replace-result-code

Context config>router>l2tp
config>service>vprn>l2tp

Description This command will replace CDN Result-Code 4, 5 and 6 on LNS with the Result Code 2. This is needed for interoperability with some implementation of LAC which only take action based on CDN Result-Code 2, while ignore CDN Result-Code 4, 5 and 6.

Default no replace-result-code

Parameters *code* — specifies the L2TP Result codes that need to be replaced

Values cdn-tmp-no-facilities — CDN Result-Code 4 on LNS will be replaced with the result code 2 before it is sent to LAC.

cdn-prem-no-facilities — CDN Result-Code 5 on LNS will be replaced with the result code 2 before it is sent to LAC.

cdn-inv-dest — CDN Result-Code 6 on LNS will be replaced with the result code 2 before it is sent to LAC.

tunnel-selection-blacklist

Syntax **tunnel-selection-blacklist**

Context config>router>l2tp

Description This command enables the context to configure L2TP Tunnel Selection Blacklist parameters.

Default n/a

add-tunnel

Syntax **add-tunnel never**
add-tunnel on *reason* [*reason***...**(**upto 8 max**)]
no add-tunnel

Context config>router>l2tp>tunnel-selection-blacklist config>service>vprn>l2tp>tunnel-selection-blacklist

Description This command will force the tunnel to the blacklist and render it unavailable for new sessions for the duration of preconfigured time. Peers are always forced to the black list in case that they time out (failure to receive response to control packets). In addition to time outs, certain events can be used to trigger placement of the tunnel on the black list.

Default add-tunnel never

Parameters *reason* — specifies the return codes or events that determine which tunnels are added to the blacklist

Table 7 **Return codes**

Return code	Tunnels added to blacklist
cdn-err-code	A tunnel will be forced to the blacklist in case that CDN message with the Result Code 2 (Call disconnected for the reasons indicated in error code) is received.
cdn-inv-dest	A tunnel will be forced to the blacklist in case that CDN message with the Result Codes 6 (Invalid destination) is received.
cdn-tmp-no-facilities	A tunnel will be forced to the blacklist in case that CDN message with the Result Code 4 is received (Call failed due to lack of appropriate facilities being available - temporary condition) is received.
cdn-perm-no-facilities	A tunnel will be forced to the blacklist in case that CDN message with the Result Codes 5 (Call failed due to lack of appropriate facilities being available - permanent condition) is received.
tx-cdn-not-established-in-time	A tunnel will be forced to the blacklist in case that CDN message with the Result Code 10 (Call was not established within time allotted by LAC) is sent from the LAC to the LNS.
stop-ccn-err-code	A tunnel will be forced to the blacklist in case that StopCCN message with the Result Code 2 (General error – Error Code indicates the problem) is sent or received.

Table 7 **Return codes (Continued)**

Return code	Tunnels added to blacklist
stop-ccn-other	A tunnel will be forced to the blacklist in case that StopCCN message with the following Result Codes is received: (1) General request to clear control connection (4) Requester is not authorized to establish a control channel (5) Protocol version not supported (6) Requester is being shutdown Or in the case that the StopCCN with the following result codes is transmitted: (4) Requester is not authorized to establish a control channel. (5) Protocol version not supported The receipt of the following Result Codes will NEVER blacklist a tunnel: (0) Reserved (3) Control channel already exist (7) Finite state machine error (8) Undefined Transmission of the following Result Codes will NEVER blacklist a tunnel: (1) General request to clear control connection (3) Control channel already exist (6) Requester is being shutdown (7) Finite state machine error
addr-change-timeout	A timed-out tunnel for which the peer IP address has changed mid-session (from the one that is provided initially during configuration) will be forced to the blacklist. In absence of this configuration option, only the configured peer for the tunnel will be blacklisted, but not the tunnel itself which now has a different peer address than the one initially configured.

never — When specified, no tunnels will be placed on blacklist under any circumstance. This parameter will available to preserve backward compatibility.

max-list-length

Syntax **max-list-length unlimited**
max-list-length *count*
no max-list-length

Context config>router>l2tp>tunnel-selection-blacklist config>service>vprn>l2tp>tunnel-selection-blacklist

Description This command configured the maximum length of the peer/tunnel blacklist.

This command specifies how many items (tunnels or peers) can be in the tunnel-selection-blacklist. If a tunnel or peer needs to be added to the tunnel-selection-blacklist and the tunnel-selection-blacklist is full, the system will remove the item (tunnel or peer) from the blacklist that was in this blacklist for the longest time.

Default max-list-length unlimited

Parameters **unlimited —** specifies there is no limit

count — specifies how many items (tunnels or peers) can be in the tunnel-selection-blacklist

Values 1 to 65635

max-time

Syntax **max-time** *minutes*
no max-time

Context config>router>l2tp>tunnel-selection-blacklist
config>service>vprn>l2tp>tunnel-selection-blacklist

Description This command configures time for which an entity (peer or a tunnel) are kept in the blacklist.

Default max-time 5

Parameters *minutes* — specifies the maximum time a tunnel or peer may remain in the blacklist

Values 1 to 60

timeout-action

Syntax **timeout-action** *action*
no timeout-action

Context config>router>l2tp>tunnel-selection-blacklist
config>service>vprn>l2tp>tunnel-selection-blacklist

Description This command defines an action that will be executed on the entity (peer/tunnel) in the blacklist once the entity becomes eligible for selection again.

Default timeout-action remove-from-blacklist

Parameters *action* — specifies the Action to be taken when a tunnel or peer has been in the blacklist for the max-period of time

Values remove-from-blacklist — The peer or tunnel in the blacklist will be removed completely from the blacklist and made eligible for the selection process once the max-time expires. In this mode of operation, multiple new sessions can be mapped into the same, newly released tunnel from the blacklist. The first such session will try to setup the tunnel, while the other will be buffered until the tunnel establishment process is completed. In case that the tunnel remains unavailable, it will be placed in the blacklist again. Consequently all new sessions will have be renegotiated over an alternate tunnel.

try-one-session — Once the max-time expired, the peer or tunnel in the blacklist is made available for selection only to a single new session request. Only upon successful tunnel establishment will the incoming new sessions be eligible to be mapped into this tunnel. This behavior will avoid session establishment delays in case that the tunnel just removed from the blacklist is still unavailable.

peer-address-change-policy

Syntax **peer-address-change-policy** {**accept** | **ignore** | **reject**}

Context config>router>l2tp

Description This command specifies what to do in case the system receives a L2TP response from another address than the one the request was sent to.

Default peer-address-change-policy reject

Parameters **accept —** specifies that this system accepts any source IP address change of received L2TP control messages related to a locally originated tunnel in the state waitReply and rejects any peer address change for other tunnels; in case the new peer IP address is accepted, it is learned and used as destination address in subsequent L2TP messages.

ignore — specifies that this system ignores any source IP address change of received L2TP control messages, does not learn any new peer IP address and does not change the destination address in subsequent L2TP messages

reject — specifies that this system rejects any source IP address change of received L2TP control messages and drops those messages

receive-window-size

Syntax **receive-window-size** [**4 to 1024**]
no receive-window-size

Context config>router>l2tp

Description This command configures the L2TP receive window size.

Default receive-window-size 64

session-limit

Syntax **session-limit** *session-limit*
no session-limit

Context config>router>l2tp

Description This command configures the L2TP session limit of this router.

Default no session-limit

Parameters *session-limit* — specifies the session limit

Values 1 to 131071

group

Syntax **group** *tunnel-group-name* [**create**]
no group *tunnel-group-name*

Context config>router>l2tp

Description This command configures an L2TP tunnel group.

Default n/a

Parameters *tunnel-group-name* — specifies a name string to identify a L2TP group up to 63 characters in length

create — mandatory keyword when creating a tunnel group name. The **create** keyword requirement can be enabled/disabled in the **environment>create** context.

session-limit

Syntax **session-limit** *session-limit*
no session-limit

Context config>router>l2tp

Description This command configures the L2TP session limit for the router. L2TP is connection-oriented. The L2TP Network Server (LNS) and LAC maintain state for each call that is initiated or answered by an LAC. An L2TP session is created between the LAC and LNS when an end-to-end PPP connection is established between a remote system and the LNS. Datagrams related to the PPP connection are sent over the tunnel between the LAC and LNS. There is a one to one relationship between established L2TP sessions and their associated calls.

Default no session-limit

Parameters *session-limit* — specifies the number of sessions allowed

Default no session-limit

Values 1 to 131071

avp-hiding

Syntax **avp-hiding** *sensitive* **|** *always*
no avp-hiding

Context config>router>l2tp>group

Description This command configures Attribute Value Pair (AVP) hiding. This capability can be used to avoid the passing of sensitive data, such as user passwords, as cleartext in an AVP.

The **no** form of the command returns the value to **never** allow AVP hiding.

Default no avp-hiding

Parameters *avp-hiding* — specifies the method to be used for the authentication of the tunnels in this L2TP group

Default no avp-hiding

Values sensitive — AVP hiding is used only for sensitive information (such as username/password)

always — AVP hiding is always used

challenge

Syntax **challenge** *always*
no challenge

Context config>router>l2tp>group

Description This command configures the use of challenge-response authentication.

The **no** form of the command reverts to the default **never** value.

Default no challenge

Parameters *always* — specifies that the challenge-response authentication is always used

Default no challenge

Values always

df-bit-lac

Syntax **df-bit-lac** {**always | never**}
no df-bit-lac

Context config>router>l2tp
config>service>vprn>l2tp

Description By default, the LAC df-bit-lac is always set and sends all L2TP packets with the DF bit set to 1. The DF bit is configurable to allow downstream routers to fragment the L2TP packets. The LAC itself will not fragment L2TP packets. L2TP packets that have a larger MTU size than what the LAC egress ports allows are dropped.

Default df-bit-lac always

Parameters **always —** specifies that the LAC will send all L2TP packets with the DF bit set to 1

never — specifies that the LAC will send all L2TP packets with the DF bit set to 0

df-bit-lac

Syntax **df-bit-lac** {**always | never | default**}
no df-bit-lac

Context config>router/service>vprn>l2tp>group
config>router/service>vprn>l2tp>group>tunnel

Description By default, the LAC df-bit-lac is set to default and sends all L2TP packets with the DF bit set to 1. The DF bit is configurable to allow downstream routers to fragment the L2TP packets. The LAC itself will not fragment L2TP packets. L2TP packets that have a larger MTU size than what the LAC egress ports allows are dropped. The configuration of the df-bit can be overridden at different levels: l2tp, tunnel, and group. The configuration at the tunnel level overrides the configuration on both group and l2tp. The configuration at the group level overrides the configuration on l2tp.

Default df-bit-lac default

Parameters **always —** specifies that the LAC will send all L2TP packets with the DF bit set to 1

never — specifies that the LAC will send all L2TP packets with the DF bit set to 0

default — Follows the DF-bit configuration specified on upper levels

destruct-timeout

Syntax **destruct-timeout** *destruct-timeout*
no destruct-timeout

Context config>router>l2tp>group
config>router>l2tp>group>tunnel

Description This command configures the period of time that the data of a disconnected tunnel will persist before being removed.

The **no** form of the command removes the value from the configuration.

Default no destruct-timeout

Parameters *destruct-timeout* — specifies the automatic removal of dynamic L2TP sessions, in seconds, that are no longer active

Default no destruct-timeout

Values 60 to 86400

hello-interval

Syntax **hello-interval** *hello-interval*
no hello-interval

Context config>router>l2tp>group

Description This command configures the time interval between two consecutive tunnel Hello messages. The Hello message is an L2TP control message sent by either peer of a LAC-LNS control connection. This control message is used as a keepalive for the tunnel.

The **no** form of the command removes the interval from the configuration.

Default no hello-interval

Parameters *hello-interval* — specifies the time interval, in seconds, between two consecutive tunnel Hello messages

Default no hello-interval

Values 60 to 3600

idle-timeout

Syntax **idle-timeout** *idle-timeout*
no idle-timeout

Context config>router>l2tp>group

Description This command configures the period of time that an established tunnel with no active sessions will persist before being disconnected.

Enter the **no** form of the command to maintain a persistent tunnel.

The **no** form of the command removes the idle timeout from the configuration.

Default no idle-timeout

Parameters *idle-timeout* — specifies the idle timeout value, in seconds until the group is removed

Default no idle-timeout

Values 0 to 3600

lns-group

Syntax **lns-group** *lns-group-id*
no lns-group

Context config>router>l2tp>group

Description This command configures the ISA LNS group.

Default no lns-group

Parameters *lns-group-id* — specifies the LNS group ID

Values 1 to 4

load-balance-method

Syntax **load-balance-method** {**per-session** | **per-tunnel**}
no load-balance-method

Context config>router>l2tp>group
config>router>l2tp>group>tunnel

Description This command describes how new sessions are assigned to an L2TP ISA MDA.

Default load-balance-method per-session

Parameters **per-session —** specifies that the lowest granularity for load-balancing is a session; each session can be assigned to a different

ISA MDA.

per-tunnel — specifies that the lowest granularity for load-balancing is a tunnel; all sessions associated with the same tunnel are assigned to the same ISA MDA; this may be useful or required in certain cases, for example:

MLPPP with multiple links per bundle;

HPol intermediate destination arbiters where the intermediate destination is an L2TP tunnel.

local-address

Syntax **local-address** *ip-address*
no local-address

Context config>router>l2tp>group>tunnel

Description This command configures the local address.

Default no local-address

Parameters *ip-address* — specifies the IP address used during L2TP authentication

local-name

Syntax **local-name** *host-name*
no local-name

Context config>router>l2tp>group
config>router>l2tp>group>tunnel

Description This command creates the local host name used by this system for the tunnels in this L2TP group during the authentication phase of tunnel establishment. It can be used to distinguish tunnels.

The **no** form of the command removes the name from the configuration.

Default no local-name

Parameters *host-name* — specifies the host name, up to 64 characters in length, that the router will use to identify itself during L2TP authentication

Default no local-name

max-retries-estab

Syntax **max-retries-estab** *max-retries*
no max-retries-estab

Context config>router>l2tp>group
config>router>l2tp>group>tunnel

Description This command configures the number of retries allowed for this L2TP tunnel while it is established, before its control connection goes down.

The **no** form of the command removes the value from the configuration.

Default no max-retries-estab

Parameters *max-retries* — specifies the maximum number of retries for an established tunnel

Default no max-retries-estab

Values 2 to 7

max-retries-not-estab

Syntax **max-retries-not-estab** *max-retries*
no max-retries-not-estab

Context config>router>l2tp>group
config>router>l2tp>group>tunnel

Description This command configures the number of retries allowed for this L2TP tunnel while it is not established, before its control connection goes down.

The **no** form of the command removes the value from the configuration.

Default no max-retries-not-estab

Parameters *max-retries* — specifies the maximum number of retries for non-established tunnels

Default no max-retries-not-estab

Values 2 to 7

password

Syntax **password** *password* [**hash** | **hash2**]
no password

Context config>router>l2tp>group
config>router>l2tp>group>tunnel

Description This command configures the password between L2TP LAC and LNS

The no form of the command removes the password.

Default no password

Parameters *password* — Configures the password used for challenge/response calculation and AVP hiding. The maximum length can be up to 20 characters if unhashed, 32 characters if hashed, 54 characters if the hash2 keyword is specified.

hash — specifies the key is entered in an encrypted form. If the **hash** or **hash2** parameter is not used, the key is assumed to be in an unencrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** or **hash2** parameter specified

hash2 — specifies the key is entered in a more complex encrypted form that involves more variables than the key value alone, meaning that the **hash2** encrypted variable cannot be copied and pasted. If the **hash** or **hash2** parameter is not used, the key is assumed to be in an unencrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** or **hash2** parameter specified.

ppp

Syntax **ppp**

Context config>router>l2tp>group

Description This command configures PPP for the L2TP tunnel group.

Default n/a

authentication

Syntax **authentication** {**chap | pap | pref-chap | prep-pap**}

Context config>router>l2tp>group>ppp

Description This command configures the PPP authentication protocol to negotiate authentication.

Default authentication pref-chap

Parameters **chap —** specifies to always use CHAP for authentication

pap — specifies to always use PAP for authentication

pref-chap — specifies to use CHAP as the preferred authentication method, and to use PAP if that attempt fails

pref-pap — specifies to use PAP as the preferred authentication method, and to use CHAP if that attempt fails

authentication-policy

Syntax **authentication-policy** *auth-policy-name*
no authentication-policy

Context config>router>l2tp>group>ppp

Description This command configures the authentication policy.

Default no authentication-policy

Parameters *auth-policy-name* — specifies the authentication policy name

Values 32 chars max

default-group-interface

Syntax **default-group-interface** *ip-int-name* **service-id** *service-id*
no default-group-interface

Context config>router>l2tp>group>ppp

Description This command configures the default group interface.

Default no default-group-interface

Parameters *ip-int-name* — specifies the interface name

Values 32 chars max

service-id — specifies the service ID

Values 1 to 2147483648

svc-name — specifies the service name (instead of service ID)

Values 64 chars max

keepalive

Syntax **keepalive** *seconds* [**hold-up-multiplier** *multiplier*]
no keepalive

Context config>router>l2tp>group>ppp

Description This command configures the PPP keepalive interval and multiplier.

Default keepalive 30 hold-up-multiplier 3

Parameters *seconds* — specifies in seconds the interval

Values 10 to 300

multiplier — specifies the multiplier

Values 1 to 5

mtu

Syntax **mtu** *mtu-bytes*

no mtu

Context config>router>l2tp>group>ppp

Description This command configures the maximum PPP MTU size.

Default mtu 1500

Parameters *mtu-bytes* — specifies, in bytes, the maximum PPP MTU size

Values 512 to 9212

proxy-authentication

Syntax [**no**] **proxy-authentication**

Context config>router>l2tp>group>ppp

Description This command configures the use of the authentication AVPs received from the LAC.

Default no proxy-authentication

proxy-lcp

Syntax [**no**] **proxy-lcp**

Context config>router>l2tp>group>ppp

Description This command configures the use of the proxy LCP AVPs received from the LAC.

Default no proxy-lcp

user-db

Syntax **user-db** *local-user-db-name*
no user-db

Context config>router>l2tp>group>ppp

Description This command configures the local user database to use for PPP PAP/CHAP authentication.

Default no user-db

Parameters *local-user-db-name* — specifies the local user database name

Values 32 chars max

session-assign-method

Syntax **session-assign-method** [**existing-first | weighted** | **weighted-random**]
no session-assign-method

Context config>router>l2tp>group

Description This command specifies how new sessions are assigned to one of the set of suitable tunnels that are available or could be made available.

Default existing-first

Parameters **existing-first —** specifies that all new sessions are placed by preference in the existing tunnels.

weighted — specifies that the sessions are shared between the available tunnels. If necessary, new tunnels are set up until the maximum number is reached. The distribution aims at an equal ratio of the actual number of sessions to the maximum number of sessions.

weighted-random — enhances the weighted algorithm such that when there are multiple tunnels with an equal number of sessions (equal weight), LAC randomly selects a tunnel.

session-limit

Syntax **session-limit** *session-limit*
no session-limit

Context config>router>l2tp>group
config>router>l2tp>group>tunnel

Description This command configures the session limit. The value controls how many L2TP session will be allowed within a given context (system, group, tunnel).

The no form of the command removes the value from the configuration.

Default no session-limit

Parameters *session-limit* — specifies the allowed number of sessions within the given context

Values 1 to 131071

2.13.2.3.1 Router L2TP Tunnel Commands

Router L2TP tunnel commands only apply to the 7750 SR and 7450 ESS.

tunnel

Syntax **tunnel** *tunnel-name* [**create**]
no tunnel *tunnel-name*

Context config>router>l2tp>group

Description This command configures an L2TP tunnel. A tunnel exists between a LAC-LNS pair and consists of a Control Connection and zero or more L2TP sessions. The tunnel carries encapsulated PPP datagrams and control messages between the LAC and the L2TP Network Server (LNS).

Default n/a

Parameters *tunnel-name* — specifies a valid string to identify a L2TP up to 32 characters in length

create — mandatory while creating a new tunnel

auto-establish

Syntax [**no**] **auto-establish**

Context config>router>l2tp>group>tunnel

Description This command specifies if this tunnel is to be automatically set up by the system.

Default no auto-establish

avp-hiding

Syntax **avp-hiding** {**never** | **sensitive** | **always**}
no avp-hiding

Context config>router>l2tp>group>tunnel

Description This command configures Attribute Value Pair (AVP) hiding. This capability can be used to avoid the passing of sensitive data, such as user passwords, as cleartext in an AVP.

It is recommended that sensitive information not be sent in clear text.

The **no** form of the command removes the parameter of the configuration and indicates that the value on group level will be taken.

Default no avp-hiding

Parameters *avp-hiding* — specifies the method to be used for the authentication of the tunnel

Values never — AVP hiding is not used.

sensitive — AVP hiding is used only for sensitive information (such as username/password).

always — AVP hiding is always used.

challenge

Syntax **challenge** *challenge-mode*
no challenge

Context config>router>l2tp>group>tunnel

Description This command configures the use of challenge-response authentication.

The **no** form of the command removes the parameter from the configuration and indicates that the value on group level will be taken.

Default no challenge

Parameters *challenge-mode* — specifies when challenge-response is to be used for the authentication of the tunnel

Values always — Always allows the use of challenge-response authentication.

never — Never allows the use of challenge-response authentication.

hello-interval

Syntax **hello-interval** *hello-interval*
hello-interval infinite
no hello-interval

Context config>router>l2tp>group>tunnel

Description This command configures the number of seconds between sending Hellos for a L2TP tunnel. The no form removes the parameter from the configuration and indicates that the value on group level will be taken.

Default no hello-interval

Parameters *hello-interval* — specifies the time interval, in seconds, between two consecutive tunnel Hello messages

Values 60 to 3600

infinite — specifies that no hello messages are sent

idle-timeout

Syntax **idle-timeout** *idle-timeout*
idle-timeout infinite
no idle-timeout

Context config>router>l2tp>group>tunnel

Description This command configures the idle timeout to wait before being disconnect. The no form indicates that the parameter will be removed from the configuration and that the value specified on group level will be taken.

Default no idle-timeout

Parameters *idle-timeout* — specifies the idle timeout, in seconds

Values 0 to 3600

infinite — specifies that the tunnel will not be closed when idle

peer

Syntax **peer** *ip-address*
no peer

Context config>router>l2tp>group>tunnel

Description This command configures the peer address.

The **no** form of the command removes the IP address from the tunnel configuration.

Default no peer

Parameters *ip-address* — Sets the LNS IP address for the tunnel.

preference

Syntax **preference** *preference*
no preference

Context config>router>l2tp>group>tunnel

Description This command configures a preference number that indicates the relative preference assigned to a tunnel when using a weighted session assignment.

The **no** form of the command removes the preference value from the tunnel configuration.

Default no preference

Parameters *preference* — specifies the tunnel preference number with its group. The value 0 corresponds to the highest preference.

Values 0 to 16777215

remote-name

Syntax **remote-name** *host-name*
no remote-name

Context config>router>l2tp>group>tunnel

Description This command configures a string to be compared to the host name used by the tunnel peer during the authentication phase of tunnel establishment.

Default no remote-name

Parameters *host-name* — specifies a remote host name for the tunnel up to 64 characters in length

tunnel-selection-blacklist

Syntax **tunnel-selection-blacklist**

Context config>router>l2tp

Description This command enables the context to configure L2TP Tunnel Selection Blacklist parameters.

Default n/a

add-tunnel

Syntax **add-tunnel never**
add-tunnel on *reason* [*reason*...(**upto 8 max**)]
no add-tunnel

Context config>router>l2tp>tunnel-selection-blacklist
config>service>vprn>l2tp>tunnel-selection-blacklist

Description This command will force the tunnel to the blacklist and render it unavailable for new sessions for the duration of preconfigured time. Peers are always forced to the black list in case that they time out (failure to receive response to control packets). In addition to time outs, certain events can be used to trigger placement of the tunnel on the black list.

Default add-tunnel never

Parameters *reason* — specifies the return codes or events that determine which tunnels are added to the blacklist

cdn-err-code	A tunnel will be forced to the blacklist in case that CDN message with the Result Code 2 (Call disconnected for the reasons indicated in error code) is received.
cdn-inv-dest	A tunnel will be forced to the blacklist in case that CDN message with the Result Codes 6 (Invalid destination) is received.
cdn-tmp-no-facilities	A tunnel will be forced to the blacklist in case that CDN message with the Result Code 4 is received (Call failed due to lack of appropriate facilities being available - temporary condition) is received.
cdn-perm-no-facilities	A tunnel will be forced to the blacklist in case that CDN message with the Result Codes 5 (Call failed due to lack of appropriate facilities being available - permanent condition) is received.
tx-cdn-not-established-in-time	A tunnel will be forced to the blacklist in case that CDN message with the Result Code 10 (Call was not established within time allotted by LAC) is sent from the LAC to the LNS.
stop-ccn-err-code	A tunnel will be forced to the blacklist in case that StopCCN message with the Result Code 2 (General error – Error Code indicates the problem) is sent or received.
stop-ccn-other	A tunnel will be forced to the blacklist in case that StopCCN message with the following Result Codes is received: (1) General request to clear control connection (4) Requester is not authorized to establish a control channel (5) Protocol version not supported (6) Requester is being shutdown Or in the case that the StopCCN with the following result codes is transmitted: (4) Requester is not authorized to establish a control channel. (5) Protocol version not supported The receipt of the following Result Codes will NEVER blacklist a tunnel: (0) Reserved (3) Control channel already exist (7) Finite state machine error (8) Undefined Transmission of the following Result Codes will NEVER blacklist a tunnel: (1) General request to clear control connection (3) Control channel already exist (6) Requester is being shutdown (7) Finite state machine error

addr-change-timeout — A timed-out tunnel for which the peer IP address has changed mid-session (from the one that is provided initially during configuration) will be forced to the blacklist. In absence of this configuration option, only the configured peer for the tunnel will be blacklisted, but not the tunnel itself which now has a different peer address than the one initially configured.

never — When specified, no tunnels will be placed on blacklist under any circumstance. This parameter will available to preserve backward compatibility.

max-list-length

Syntax **max-list-length unlimited**
max-list-length *count*
no max-list-length

Context config>router>l2tp>tunnel-selection-blacklist
config>service>vprn>l2tp>tunnel-selection-blacklist

Description This command configured the maximum length of the peer/tunnel blacklist.

This command specifies how many items (tunnels or peers) can be in the tunnel-selection-blacklist. If a tunnel or peer needs to be added to the tunnel-selection-blacklist and the tunnel-selection-blacklist is full, the system will remove the item (tunnel or peer) from the blacklist that was in this blacklist for the longest time.

Default max-list-length unlimited

Parameters **unlimited —** specifies there is no limit

count — specifies how many items (tunnels or peers) can be in the tunnel-selection-blacklist

Values 1 to 65635

max-time

Syntax **max-time** *minutes*
no max-time

Context config>router>l2tp>tunnel-selection-blacklist
config>service>vprn>l2tp>tunnel-selection-blacklist

Description This command configures time for which an entity (peer or a tunnel) are kept in the blacklist.

Default max-time 5

Parameters *minutes* — specifies the maximum time a tunnel or peer may remain in the blacklist

Values 1 to 60

timeout-action

Syntax **timeout-action** *action*
no timeout-action

Context config>router>l2tp>tunnel-selection-blacklist
config>service>vprn>l2tp>tunnel-selection-blacklist

Description This command defines an action that will be executed on the entity (peer/tunnel) in the blacklist once the entity becomes eligible for selection again.

Default timeout-action remove-from-blacklist

Parameters *action* — specifies the Action to be taken when a tunnel or peer has been in the blacklist for the max-period of time

Values remove-from-blacklist — The peer or tunnel in the blacklist will be removed completely from the blacklist and made eligible for the selection process once the max-time expires. In this mode of operation, multiple new sessions can be mapped into the same, newly released tunnel from the blacklist. The first such session will try to setup the tunnel, while the other will be buffered until the tunnel establishment process is completed. In case that the tunnel remains unavailable, it will be placed in the blacklist again. Consequently all new sessions will have be renegotiated over an alternate tunnel.

try-one-session — Once the max-time expired, the peer or tunnel in the blacklist is made available for selection only to a single new session request. Only upon successful tunnel establishment will the incoming new sessions be eligible to be mapped into this tunnel. This behavior will avoid session establishment delays in case that the tunnel just removed from the blacklist is still unavailable.

2.13.2.4 Router Interface Commands

interface

Syntax [**no**] **interface** *ip-int-name* [*unnumbered-mpls-tp*]
[**no**] **interface** *ip-int-name gmpls-loopback*

Context config>router

Description This command creates a logical IP routing or unnumbered MPLS-TP interface. Once created, attributes like IP address, port, or system can be associated with the IP interface.

Interface names are case-sensitive and must be unique within the group of IP interfaces defined for **config router interface** and **config service ies interface**. Interface names must not be in the dotted decimal notation of an IP address.; for example, the name “1.1.1.1” is not allowed, but “int-1.1.1.1” is allowed. Show commands for router interfaces use either the interface names or the IP addresses. Ambiguity can exist if an IP address is used as an IP address and an interface name. Duplicate interface names can exist in different router instances, although this is not recommended because it is confusing.

When a new name is entered, a new logical router interface is created. When an existing interface name is entered, the user enters the router interface context for editing and configuration.

Although not a keyword, the ip-int-name “**system**” is associated with the network entity (such as a specific router), not a specific interface. The system interface is also referred to as the loopback address.

An unnumbered MPLS-TP interface is a special type of interface that is only intended for MPLS-TP LSPs. IP routing protocols are blocked on interfaces of this type. If an interface is configured as unnumbered-mpls-tp, then it can only be associated with an Ethernet port or VLAN, using the port command, then either a unicast, multicast, or broadcast remote MAC address may be configured. Only static ARP is supported.

A GMPLS loopback interface is a special type of loopback interface that is used as the IP interface for a GMPLS IP Control Channel (IPCC). RSVP and LMP packets associated with GMPLS are associated with this loopback interface. All other IP protocols are blocked on this interface. One **gmpls-loopback** interface is required for each GMPLS peer node.

The **no** form of the command removes the IP interface and all the associated configurations. The interface must be administratively shut down before issuing the **no interface** command.

Default No interfaces or names are defined within the system.

Parameters *ip-int-name* — The name of the IP interface. Interface names must be unique within the group of defined IP interfaces for **config router interface** and **config service ies interface** commands. An interface name cannot be in the form of an IP address. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

Values 1 to 32 alphanumeric characters.

If the *ip-int-name* already exists, the context is changed to maintain that IP interface. If *ip-int-name* already exists within another service ID or is an IP interface defined within the **config router** commands, an error will occur and the context will not be changed to that IP interface. If *ip-int-name* does not exist, the interface is created and the context is changed to that interface for further command processing.

unnumbered-mpls-tp — specifies that an interface is of type Unnumbered MPLS-TP. An unnumbered MPLS-TP interface is a special type of interface that is only intended for MPLS-TP LSPs. IP routing protocols are blocked on interfaces of this type. If an interface is configured as **unnumbered-mpls-tp**, then it can only be associated with an Ethernet port or VLAN, using the **port** command. Either a unicast, multicast or broadcast remote MAC address may be configured using the **static-arp** command. Only static ARP is supported.

gmpls-loopback — specifies that the interface is a loopback interface for GMPLS control plane packets

address

Syntax **address** {**ip-address/mask | ip-address netmask**} [**broadcast all-ones | host-ones**] [**track-srrp srrp-instance**]
no address

Context config>router>if

Description This command assigns an IP address, IP subnet, and broadcast address format to an IP interface. Only one IP address can be associated with an IP interface.

An IP address must be assigned to each IP interface. An IP address and a mask combine to create a local IP prefix. The defined IP prefix must be unique within the context of the routing instance. It cannot overlap with other existing IP prefixes defined as local subnets on other IP interfaces in the same routing context within the router.

The local subnet that the **address** command defines must not be part of the services address space within the routing context by use of the **config router service-prefix** command. Once a portion of the address space is allocated as a service prefix, that portion is not available to IP interfaces for network core connectivity.

The IP address for the interface can be entered in either CIDR (Classless Inter-Domain Routing) or traditional dotted decimal notation. **Show** commands display CIDR notation and are stored in configuration files.

By default, no IP address or subnet association exists on an IP interface until it is explicitly created.

The **no** form of the command removes the IP address assignment from the IP interface. Interface specific configurations for MPLS are also removed. This will operationally stop any MPLS LSPs that explicitly reference that IP address. When a new IP address is configured, interface specific configurations for MPLS need to be added. IEEE 1588 port based timestamping configured with **ptp-hw-assist** is also disabled.

Default No IP address is assigned to the IP interface.

Parameters *ip-address* — The IP address of the IP interface. The *ip-addr* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation.

Values 1.0.0.0 to 223.255.255.255

/* —** The forward slash is a parameter delimiter that separates the *ip-addr* portion of the IP address from the mask that defines the scope of the local subnet. No spaces are allowed between the *ip-addr*, the "/***" and the *mask-length* parameter. If a forward slash does not immediately follow the *ip-addr*, a dotted decimal mask must follow the prefix.

mask-length — The subnet mask length when the IP prefix is specified in CIDR notation. When the IP prefix is specified in CIDR notation, a forward slash (/) separates the *ip-addr* from the *mask-length* parameter. The mask length parameter indicates the number of bits used for the network portion of the IP address; the remainder of the IP address is used to determine the host portion of the IP address. Allowed values are integers in the range 1— 32. A mask length of 32 is reserved for system IP addresses.

Values 1 to 32

mask — The subnet mask in dotted decimal notation. When the IP prefix is not specified in CIDR notation, a space separates the *ip-addr* from a traditional dotted decimal mask. The *mask* parameter indicates the complete mask that will be used in a logical 'AND' function to derive the local subnet of the IP address. A mask of 255.255.255.255 is reserved for system IP addresses.

Values 128.0.0.0 to 255.255.255.255

netmask — The subnet mask in dotted decimal notation.

Values 0.0.0.0 to 255.255.255.255 (network bits all 1 and host bits all 0)

broadcast {all-ones | host-ones} — The optional **broadcast** parameter overrides the default broadcast address used by the IP interface when sourcing IP broadcasts on the IP interface. If no broadcast format is specified for the IP address, the default value is **host-ones,** which indicates a subnet broadcast address. Use this parameter to change the broadcast address to **all-ones** or revert back to a broadcast address of **host-ones**.

The **all-ones** keyword following the **broadcast** parameter specifies that the broadcast address used by the IP interface for this IP address will be 255.255.255.255, also known as the local broadcast.

The **host-ones** keyword following the **broadcast** parameter specifies that the broadcast address used by the IP interface for this IP address will be the subnet broadcast address. This is an IP address that corresponds to the local subnet described by the *ip-addr* and the *mask-length* or *mask* with all the host bits set to binary 1. This is the default broadcast address used by an IP interface.

The **broadcast** parameter within the **address** command does not have a negate feature, which is usually used to revert a parameter to the default value. To change the **broadcast** type to **host-ones** after being changed to **all-ones**, the **address** command must be executed with the **broadcast** parameter defined.

The broadcast format on an IP interface can be specified when the IP address is assigned or changed.

This parameter does not affect the type of broadcasts that can be received by the IP interface. A host sending either the local broadcast (**all-ones**) or the valid subnet broadcast address (**host-ones**) will be received by the IP interface.

Default host-ones

Values **all-ones**, **host-ones**

track-srrp — specifies the SRRP instance ID that this interface route needs to track

allow-directed-broadcasts

Syntax [**no**] **allow-directed-broadcasts**

Context config>router>if

Description This command enables the forwarding of directed broadcasts out of the IP interface.

A directed broadcast is a packet received on a local router interface destined for the subnet broadcast address of another IP interface. The **allow-directed-broadcasts** command on an IP interface enables or disables the transmission of packets destined to the subnet broadcast address of the egress IP interface.

When enabled, a frame destined to the local subnet on this IP interface is sent as a subnet broadcast out this interface.

Note: Allowing directed broadcasts is a well-known mechanism used for denial-of-service attacks.

By default, directed broadcasts are not allowed and are discarded at this egress IP interface.

The **no** form of the command disables directed broadcasts forwarding out of the IP interface.

Default no allow-directed-broadcasts — Directed broadcasts are dropped.

arp-limit

Syntax **arp-limit** *limit* [**log-only**] [**threshold** *percent*]
no arp-limit

Context config>router>if

Description This command configures the maximum amount of dynamic IPv4 ARP entries that can be learned on an IP interface.

When the number of dynamic ARP entries reaches the configured percentage of this limit, an SNMP trap is sent. When the limit is exceeded, no new entries are learned until an entry expires and traffic to these destinations will be dropped. Entries that have already been learned will be refreshed.

The **no** form of the command removes the **arp-limit.**

Default 90 percent

Parameters **log-only —** Enables the warning message to be sent at the specified threshold percentage, and also when the limit is exceeded. However, entries above the limit will be learned.

percent — The threshold value (as a percentage) that triggers a warning message to be sent.

Values 0 to 100

limit — The number of entries that can be learned on an IP interface expressed as a decimal integer. If the limit is set to 0, dynamic ARP learning is disabled and no dynamic ARP entries are learned.

Values 0 to 524288

arp-timeout

Syntax **arp-timeout** *seconds*
no arp-timeout

Context config>router>if

Description This command configures the minimum time, in seconds, an ARP entry learned on the IP interface is stored in the ARP table. ARP entries are automatically refreshed when an ARP request or gratuitous ARP is seen from an IP host. Otherwise, the ARP entry is aged from the ARP table. If the **arp-timeout** value is set to 0 seconds, ARP aging is disabled.

The **no** form of the command reverts to the default value.

Default 14400 seconds (4 hours)

Parameters *seconds* — The minimum number of seconds a learned ARP entry is stored in the ARP table, expressed as a decimal integer. A value of 0 specifies that the timer is inoperative and learned ARP entries will not be aged.

Values 0 to 65535

bfd

Syntax **bfd** *transmit-interval* [**receive** *receive-interval*] [**multiplier** *multiplier*] [**echo-receive** *echo-interval*] [**type cpm-np**]
no bfd

Context config>router>if
config>router>if>ipv6

Description This command specifies the bi-directional forwarding detection (BFD) parameters for the associated IP interface. If no parameters are defined the default values are used.

The multiplier specifies the number of consecutive BFD messages that must be missed from the peer before the BFD session state is changed to down and the upper level protocols (OSPF, IS-IS, BGP or PIM) is notified of the fault.

The **no** form of the command removes BFD from the router interface regardless of the IGP/RSVP.

Important notes: On the 7750 SR and 7950 XRS SR OS, the *transmit-interval* and **receive receive-interval** values can only be modified to a value less than 100 ms when:

1. The **type cpm-np option** is explicitly configured.
2. The service is shut down (**shutdown**)
3. The interval is specified 10 to 100000.
4. The service is re-enabled (**no shutdown**)

To remove the **type cpm-np** option, re-issue the **bfd** command without specifying the **type** parameter.

Default no bfd

Parameters *transmit-interval* — Sets the transmit interval, in milliseconds, for the BFD session.

Values 10 to 100000 (see Important Notes above) The minimum value is 300 msec for central BFD sessions in the 7950 XRS.

Default 100

receive receive-interval — Sets the receive interval, in milliseconds, for the BFD session.

Values 10 to 100000 (see Important Notes above)

Default 100

multiplier multiplier — Set the multiplier for the BFD session.

Values 3 to 20

Default 3

echo-receive echo-interval — Sets the minimum echo receive interval, in milliseconds, for the session.

Values 100 to 100000

Default 0

type cpm-np — Selects the CPM network processor as the local termination point for the BFD session for the 7750 SR and 7950 XRS. See Important Notes, above.

cflowd-parameters

Syntax **cflowd-parameters**
no cflowd-parameters

Context config>router>if

Description This command creates the configuration context to configure cflowd parameters for the associated IP interfaces.

cflowd is used for network planning and traffic engineering, capacity planning, security, application and user profiling, performance monitoring, usage-based billing, and SLA measurement.

At a minimum, the **sampling** command must be configured within this context in order to enable cflowd sampling, otherwise traffic sampling will not occur.

Default no cflowd-parameters

sampling

Syntax **sampling** {**unicast** | **multicast**} **type** {**acl** | **interface**} [**direction** {**ingress-only** | **egress-only** | **both**}]
no sampling {**unicast** | **multicast**}

Context config>router>if>cflowd-parameters

Description This command enables and configures the cflowd sampling behavior to collect traffic flow samples through a router for analysis.

This command can be used to configure the sampling parameters for unicast and multicast traffic separately. If sampling is not configured for either unicast or multicast traffic, then that type of traffic will not be sampled.

If cflowd is enabled without either **egress-only** or **both** specified or with the **ingress-only** keyword specified, then only ingress sampling will be enabled on the associated IP interface.

The **no** form of the command disables the associated type of traffic sampling on the associated interface.

Default no sampling

Parameters **unicast —** specifies that the sampling command will control the sampling of unicast traffic on the associated interface/SAP

multicast — specifies that the sampling command will control the sampling of multicast traffic on the associated interface/SAP

type — specifies whether the traffic sampling is based on an **acl** match, or all traffic entering or exiting the associated interface

Values acl — specifies that the sampled traffic is controlled via an IP traffic filter entry with the action "filter-sample" configured
interface — specifies that all traffic entering or exiting the interface is subject to sampling

direction — specifies the direction to collect traffic flow samples

Values ingress-only — Enables ingress sampling only on the associated interface.

egress-only — Enables egress sampling only on the associated interface.

both — Enables both ingress and egress cflowd sampling.

cpu-protection

Syntax **cpu-protection** *policy-id*
no cpu-protection

Context config>router>if

Description This command assigns an existing CPU protection policy for the interface. The CPU protection policies are configured in the **config>sys>security>cpu-protection>policy** *cpu-protection-policy-id* context.

Default cpu-protection 255

Parameters *policy-id* — specifies an existing CPU protection policy

Values 1 to 255

dist-cpu-protection

Syntax **dist-cpu-protection** *policy-name*

no dist-cpu-protection

Context config>router>if

Description This command assigns a Distributed CPU protection policy for the interface.

Default no dist-cpu-protection

enable-ingress-stats

Syntax [**no**] **enable-ingress-stats**

Context config>router>if
config>service>ies >if
config>service>vprn>if
config>service>ies>sub-if>grp-if
config>service>vprn>sub-if>grp-if

Description This command enables the collection of ingress interface IP stats. This command is only applicable to IP statistics, and not to uRPF statistics.

If enabled, then the following statistics are collected:

- IPv4 offered packets
- IPv4 offered octets
- IPv6 offered packets
- IPv6 offered octets

Octet statistics for IPv4 and IPv6 bytes at IP interfaces include the layer 2 frame overhead.

Default no enable-ingress-stats

enable-mac-accounting

Syntax [**no**] **enable-mac-accounting**

Context config>router>if

Description This command enables MAC Accounting functionality for the interface.

Default no enable-mac-accounting

if-attribute

Syntax **if-attribute**

Context config>router>if

Description This command adds and removes interface attributes.

Default n/a

if-admin-group

Syntax [**no**] **if-admin-group** *group-name* [*group-name*...(**upto 5 max**)]

Context config>router>if

Description This command configures interface Admin Group memberships for this interface.

Default n/a

if-srlg-group

Syntax [**no**] **if-srlg-group** *group-name* [*group-name*...(**upto 5 max**)]

Context config>router>if

Description This command configures interface SRLG Group memberships for this interface

Default n/a

local-proxy-arp

Syntax [**no**] **local-proxy-arp**

Context config>router>if

Description This command enables local proxy ARP on the interface.

Default no local-proxy-arp

ip-mtu

Syntax **ip-mtu** *octets*
no ip-mtu

Context config>router>if

Description This command configures the IP maximum transmit unit (packet) for the associated router IP interface.

The configured IP-MTU cannot be larger then the calculated IP MTU based on the port MTU configuration.

The MTU that will be used is:

MINIMUM((Port_MTU - EtherHeaderSize), (Configured ip-mtu))

The **no** form of the command returns the associated IP interfaces MTU to its default value, which is calculated, based on the port MTU setting. (For Ethernet ports this will typically be 1554.)

Default **no ip-mtu**

Parameters *octets* — specifies the IP MTU value that should be associated with the IP interface, specified in octets

Values 512 to 9000

lag-link-map-profile

Syntax **lag-link-map-profile** *link-map-profile-id*
no lag-link-map-profile

Context config>router>if

Description This command assigns a preconfigured lag link map profile to a SAP/network interface configured on a LAG or a PW port that exists on a LAG. Once assigned/unassigned, the SAP/ network interface egress traffic will be re-hashed over LAG as required by the new configuration.

The **no** form of this command reverts the SAP/network interface to use per-flow, service or link hash as configured for the service/LAG.

Default **no lag-link-map-profile**

Parameters *link-map-profile-id* — An integer from 1 to 32 that defines a unique lag link map profile on which the LAG the SAP/network interface exist.

lag-per-link-hash

Syntax **lag-per-link-hash class** {**1** | **2** | **3**} **weight** [**1..1024**]
no per-link-hash

Context config>router>if

Description This command configures weight and class to this interface to be used on LAG egress when the LAG uses weighted per-link-hash.

The **no** form of this command restores the default configuration.

Default no lag-per-link-hash (equivalent to weight 1 class 1)

ldp-shortcut

Syntax [**no**] **ldp-shortcut**

Context config>router

Description This command enables the resolution of IGP routes using LDP LSP across all network interfaces participating in the IS-IS and OSPF routing protocol in the system.

When LDP shortcut is enabled, LDP populates the routing table with next-hop entries corresponding to all prefixes for which it activated an LDP FEC. For a given prefix, two route entries are populated in the system routing table. One route corresponds to the LDP shortcut next-hop and has an owner of LDP. The other route is the regular IP next-hop. The LDP shortcut next-hop always has preference over the regular IP next-hop for forwarding user packets and specified control packets over a given outgoing interface to the route next-hop.

All user and specified control packets for which the longest prefix match in RTM yields the FEC prefix will be forwarded over the LDP LSP.

When an IPv4 packet is received on an ingress network interface, a subscriber IES interface, or a regular IES interface, the lookup of the packet by the ingress IOM, IMMM, or XMA will result in the packet being sent labeled with the label stack corresponding to the NHLFE of the LDP LSP when the preferred RTM entry corresponds to an LDP shortcut.

If the preferred RTM entry corresponds to an IP next-hop, the IPv4 packet is forwarded unlabeled.

When ECMP is enabled and multiple equal-cost next-hops exit for the IGP route, the ingress IOM, IMMM, or XMA will spray the packets for this route based on hashing routine currently supported for IPv4 packets. When the preferred RTM entry corresponds to an LDP shortcut route, spraying will be performed across the multiple next-hops for the LDP FEC. The FEC next-hops can either be direct link LDP neighbors or T-LDP neighbors reachable over RSVP LSPs in the case of LDP-over-RSVP but not both.

When the preferred RTM entry corresponds to a regular IP route, spraying will be performed across regular IP next-hops for the prefix.

The no form of this command disables the resolution of IGP routes using LDP shortcuts.

Default no ldp-shortcut

ldp-sync-timer

Syntax **ldp-sync-timer** *seconds* [**end-of-lib**]
no ldp-sync-timer

Context config>router>if

Description This command enables synchronization of an IGP and LDP. When a link is restored after a failure, the IGP sets the link cost to infinity and advertises it. The actual value advertised in OSPF is 0xFFFF (65535). The actual value advertised in IS-IS regular metric is 0x3F (63) and in IS-IS wide-metric is 0xFFFFFE (16777214). This feature is not supported on RIP interfaces.

If an interface belongs to both IS-IS and OSPF, a physical failure will cause both IGPs to advertise an infinite metric and to follow the IGP-LDP synchronization procedures. If only one IGP bounces on this interface or on the system, then only the affected IGP advertises the infinite metric and follows the IGP-LDP synchronization procedures.

Next, an LDP Hello adjacency is brought up with the neighbor. The LDP synchronization timer is started by the IGP when the LDP session to the neighbor is up over the interface. This is to allow time for the label-FEC bindings to be exchanged.

When the LDP synchronization timer expires, the link cost is restored and is readvertised. The IGP will announce a new best next hop and LDP will use it if the label binding for the neighbor’s FEC is available.

If the user changes the cost of an interface, the new value is advertised at the next flooding of link attributes by the IGP. However, if the LDP synchronization timer is still running, the new cost value will only be advertised after the timer expires. The new cost value will also be advertised after the user executes any of the following commands:

- **tools>perform>router>isis>ldp-sync-exit**
- **tools>perform>router>ospf>ldp-sync-exit**
- **config>router>if>no ldp-sync-timer**
- **config>router>ospf>disable-ldp-sync**
- **router>isis>disable-ldp-sync**

If the user changes the value of the LDP synchronization timer parameter, the new value will take effect at the next synchronization event. If the timer is still running, it will continue to use the previous value.

If parallel links exist to the same neighbor, then the bindings and services should remain up as long as there is one interface that is up. However, the user-configured LDP synchronization timer still applies on the interface that failed and was restored. In this case, the router will only consider this interface for forwarding after the IGP readvertises its actual cost value.

The LDP Sync Timer State is not always synchronized across to the standby CPM,; therefore, after an activity switch, the timer state might not be same as it was on the previously active CPM.

If the **end-of-lib** option is configured, then the system will start the LDP synchronization timer as usual. If the LDP End of LIB Typed Wildcard FEC messages are received for every FEC type negotiated for a given session to an LDP peer for that IGP interface, the **ldp-sync-timer** is terminated early and the IGP link cost is restored. If the **ldp-sync-timer** expires before the LDP End of LIB messages are received for every negotiated FEC type, then the system will restore the IGP link cost. The **end-of-lib** option is disabled by default.

The **no** form of this command disables IGP-LDP synchronization and deletes the configuration.

Default no ldp-sync-timer

Parameters *seconds* — specifies the time interval for the IGP-LDP synchronization timer

Values 1 to 1800

end-of-lib — specifies that the system should terminate the **ldp-sync-timer** early if the LDP End of LIB Typed Wildcard FEC messages are received for every FEC type negotiated for a given session to an LDP peer for that IGP interface.

load-balancing

Syntax **load-balancing**

Context config>router>if

Description This command enables the load-balancing context to configure interface per-flow load balancing options that will apply to traffic entering this interface and egressing over a LAG/ECMP on system-egress. This is a per interface setting. For load-balancing options that can also be enabled on the system level, the options enabled on the interface level overwrite system level configurations.

Default n/a

egr-ip-load-balancing

Syntax **egr-ip-load-balancing** {**source** | **destination** | **inner-ip**}
no egr-ip-load-balancing

Context config>router>if>load-balancing

Description This command specifies whether to include source address or destination address or both in LAG/ECMP hash on IP interfaces. Additionally, when l4-load-balancing is enabled the command applies also to inclusion of source/destination port in the hash inputs.

The **no** form of this command includes both source and destination parameters.

Default no egr-ip-load-balancing

Parameters *source* — specifies using source address and (if l4-load balancing is enabled) source port in the hash, ignore destination address/port

destination — specifies using destination address and (if l4-load balancing is enabled) destination port in the hash, ignore source address/port

inner-ip — specifies use of the inner IP header parameters instead of outer IP header parameters in LAG/ECMP hash for IPv4 encapsulated traffic

lsr-load-balancing

Syntax **lsr-load-balancing** *hashing-algorithm*
no lsr-load-balancing

Context config>router>if>load-balancing

Description This command specifies whether the IP header is used in the LAG and ECMP LSR hashing algorithm. This is the per interface setting.

Default no lsr-load-balancing

Parameters **lbl-only —** Only the label is used in the hashing algorithm.

lbl-ip — The IP header is included in the hashing algorithm.

ip-only — the IP header is used exclusively in the hashing algorithm

eth-encap-ip — The hash algorithm parses down the label stack (up to 3 labels supported) and once it hits the bottom, the stack assumes Ethernet II non-tagged header follows. At the expected Ethertype offset location, algorithm checks whether the value present is IPv4/v6 (0x0800 or0x86DD). If the check passes, the hash algorithm checks the first nibble at the expected IP header location for IPv4/IPv6 (0x0100/0x0110). If the secondary check passes, the hash is performed using IP SA/DA fields in the expected IP header; otherwise (any of the check failed) label-stack hash is performed.

spi-load-balancing

Syntax [**no**] **spi-load-balancing**

Context config>router>if>load-balancing

Description This command enables use of the SPI in hashing for ESP/AH encrypted IPv4/v6 traffic. This is a per interface setting.

The **no** form disables the SPI function.

Default no spi-load-balancing

teid-load-balancing

Syntax [**no**] **teid-load-balancing**

Context config>router>if>load-balancing

Description This command enables inclusion of TEID in hashing for GTP-U/C encapsulates traffic for GTPv1/GTPv2. The **no** form of this command ignores TEID in hashing.

Default no teid-load-balancing

loopback

Syntax [**no**] **loopback**

Context config>router>if

Description This command configures the interface as a loopback interface. The **vas-if-type** and **loopback** commands are mutually exclusive

Default Not enabled

mac

Syntax **mac** *ieee-mac-addr*
no mac

Context config>router>if

Description This command assigns a specific MAC address to an IP interface. Only one MAC address can be assigned to an IP interface. When multiple **mac** commands are entered, the last command overwrites the previous command.

The **no** form of the command returns the MAC address of the IP interface to the default value.

Default IP interface has a system-assigned MAC address.

Parameters *ieee-mac-addr* — specifies the 48-bit MAC address for the IP interface in the form *aa***:***bb***:***cc***:***dd***:***ee***:***ff* or *aa***-***bb***-***cc***-***dd***-***ee***-***ff,* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

network-domain

Syntax **network-domain** *network-domain-name*
no network-domain

Context config>router>if

Description This command assigns a given interface to a given network-domain. The network-domain is then taken into account during sap-ingress queue allocation for VPLS SAP.

The network-domain association can only be done in a base-routing context. Associating a network domain with an loop-back or system interface will be rejected. Associating a network-domain with an interface that has no physical port specified will be accepted, but will have no effect as long as a corresponding port, or LAG, is defined.

Single interfaces can be associated with multiple network-domains.

Default per default “default” network domain is assigned

ntp-broadcast

Syntax [**no**] **ntp-broadcast**

Context config>router>if

Description This command enables SNTP broadcasts received on the IP interface. This parameter is only valid when the SNTP **broadcast-client** global parameter is configured.

The **no** form of the command disables SNTP broadcast received on the IP interface.

Default no ntp-broadcast

port

Syntax **port** *port-name*
no port

Context config>router>if

Description This command creates an association with a logical IP interface and a physical port.

An interface can also be associated with the system (loopback address).

The command returns an error if the interface is already associated with another port or the system. In this case, the association must be deleted before the command is re-attempted. The *port-id or port-id for* Ethernet ports can be in one of the following forms:

Ethernet interfaces

If the card in the slot has MDAs/XMAs, *port-id* is in the *slot_number***/**MDA or XMA_*number***/** *port_number* format; for example, **1/1/3** specifies port 3 of the MDA/XMA installed in MDA/XMA slot 1 on the card installed in chassis slot 1.

SONET/SDH interfaces

When the *port-id* represents a POS interface, the *port-id* must include the *channel-id.* The POS interface must be configured as a **network** port.

The **no** form of the command deletes the association with the port. The **no** form of this command can only be performed when the interface is administratively down.

Default No port is associated with the IP interface.

Parameters *port-name* — The physical port identifier to associate with the IP interface.

Values The following values apply to the 7750 SR:

port-name	*port-id*[:*encap-val*]		
	encap-val	0	for null
		0..4094	for dot1q

		0..4094.*	for qinq
port-id	*slot/mda/port*[.*channel*]		
	eth-sat-id	esat-*id*/*slot*/*port*	
		esat	keyword
		id	1 to 20
	pxc-id	pxc-*id*.*sub-port*	
		pxc	keyword
		id	1 to 64
		sub-port	a, b
	bundle-id - bundle-*type-slot/mda*.*bundle-num*		
		bundle	keyword
		type	ima, fr, ppp
		bundle-num	1..336
	bpgrp-id	bpgrp-*type*-*bpgrp-num*	
		bpgrp	keyword
		type	ima, ppp
		bpgrp-num	1 to 2000
	aps-id	aps-*group-id*[.*channel*]	
		aps	keyword
		group-id	1 to 64
	ccag-id	ccag-*id*.*path-id*[*cc-type*]	
		ccag	keyword
		id	1..8
		path-id	a, b
		cc-type	.sap-*net*, .net-*sap*
	lag-id	lag-*id*	
		lag	keyword
		id	1 to 800

port-id	slot/mda/ port[.channel]		
	eth-sat-id	esat-*id*/*slot*/*port*	
		esat	keyword
		id	1 to 20
	pxc-id	pxc-*id*.*sub-port*	
		pxc	keyword
		id	1 to 64
		sub-port	a, b

bundle-id	bundle-type-slot/mda.bundle-num	
	bundle	keyword
	type	ima, ppp
	bundle-num	1 to 336
bpgrp-id	bpgrp-type-bpgrp-num	
	bpgrp	keyword
	type	ima, ppp
	bpgrp-num	1 to 256
aps-id	aps-group-id[.channel]	
	aps	keyword
	group-id	1 to 16
lag-id	lag-id	
	lag	keyword
	id	1 to 64

port-id	slot/mda/port[.channel]		
	eth-sat-id	esat-*id*/*slot*/*port*	
		esat	keyword
		id	1 to 20
	pxc-id	pxc-*id*.*sub-port*	
		pxc	keyword
		id	1 to 64
		sub-port	a, b
	ccag-id	ccag-id.path-id[cc-type]	
		ccag	keyword
		id	1 to 8
		path-id	a, b
		cc-type	.sap-net, .net-sap
	lag-id	lag-id	
		lag	keyword
		id	1 to 200
	gtg-id	gmpls-tun-grp-id	
		gmpls-tun-grp	keyword
		id	1 to 1024

Values The following values apply to the 7450 ESS:

port-id	*slot/mda/port*[.*channel*]	
	eth-sat-id	esat-*id*/*slot*/*port*

	esat	keyword
	id	1 to 20
pxc-id	pxc-*id*.*sub-port*	
	pxc	keyword
	id	1 to 64
	sub-port	a, b
ccag-id	ccag-*id*.path-*id*[*cc-type*]	
	ccag	keyword
	id	1 to 8
	path-id	a, b
	cc-type	.sap-net, .net-sap
lag-id	lag-*id*	
	lag	keyword
	id	1 to 800
gtg-id	gmpls-tun-grp-**id**	
	gmpls-tun-grp	keyword
	id	1 to 200

proxy-arp-policy

Syntax [**no**] **proxy-arp-policy** *policy-name* [*policy-name*...(**up to 5 max**)]

Context config>router>if

Description This command enables and configure proxy ARP on the interface and specifies an existing policy-statement to analyze match and action criteria that controls the flow of routing information to and from a given protocol, set of protocols, or a particular neighbor. The policy-name is configured in the **config>router>policy-options** context.

Use proxy ARP so the router responds to ARP requests on behalf of another device. Static ARP is used when a router needs to know about a device on an interface that cannot or does not respond to ARP requests. Thus, the router configuration can state that if it has a packet that has a certain IP address to send it to the corresponding ARP address.

Default no proxy-arp-policy

Parameters *policy-name* — The export route policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. The specified policy name(s) must already be defined.

ptp-hw-assist

Syntax [**no**] **ptp-hw-assist**

Context config>router>if

Description This command configures the 1588 port based timestamping assist function for the interface. Various checks are performed to ensure that this feature can be enabled. If a check fails:

- The command is blocked/rejected with an appropriate error message.
- If the SAP configuration of the interface is removed, the ptp-hw-assist configuration will be removed.
- If the IPv4 address configuration of the interface is removed, the ptp-hw-assist configuration will be removed.

The port will validate the destination IP address on received 1588 messages. If the 1588 messages are sent to a loopback address within the node rather than the address of the interface, then the loopback address must be configured in the **configure**>**system**>**security**>**source-address application ptp** context.

Default no ptp-hw-assist

qos-route-lookup

Syntax **qos-route-lookup** [**source** | **destination**]
no qos-route-lookup

Context config>router>if
config>router>if>ipv6

Description This command enables QoS classification of the ingress IP packets on an interface based on the QoS information associated with routes in the forwarding table.

If the optional **destination** parameter is specified and the destination address of an incoming IP packet matches a route with QoS information the packet is classified to the fc and priority associated with that route, overriding the fc and priority/profile determined from the sap-ingress or network qos policy associated with the IP interface. If the destination address of the incoming packet matches a route with no QoS information the fc and priority of the packet remain as determined by the sap-ingress or network qos policy.

If the optional **source** parameter is specified and the source address of an incoming IP packet matches a route with QoS information the packet is classified to the fc and priority associated with that route, overriding the fc and priority/profile determined from the sap-ingress or network qos policy associated with the IP interface. If the source address of the incoming packet matches a route with no QoS information the fc and priority of the packet remain as determined by the sap-ingress or network qos policy.

If neither the optional **source** or **destination** parameter is present, then the default is **destination** address matching.

The functionality enabled by the qos-route-lookup command can be applied to IPv4 packets or IPv6 packets on an interface, depending on whether it is present at the interface context (applies to IPv4) or the interface>ipv6 context (applies to IPv6). Subscriber management group interfaces for the 7750 SR and 7450 ESS also do not support the source QPPB option.

The **no** form of the command reverts to the default.

Default no qos-route-lookup

Parameters **source —** Enables QoS classification of incoming IP packets based on the source address matching a route with QoS information.

destination — Enables QoS classification of incoming IP packets based on the destination address matching a route with QoS information.

qos

Syntax **qos** *network-policy-id* [**egress-port-redirect-group** *queue-group-name*] [**egress-instance** *instance-id*]] [**ingress-fp- redirect-group** *queue-group-name* **ingress-instance** *instance-id*]
no qos

Context config>router>if

Description This command associates a network Quality of Service (QoS) policy with a network IP interface. Only one network QoS policy can be associated with an IP interface at one time. Attempts to associate a second QoS policy return an error.

Associating a network QoS policy with a network interface is useful for the following purposes:

- To apply classification rules for determining the forwarding-class and profile of ingress packets on the interface.
- To associate ingress packets on the interface with a queue-group instance applied to the ingress context of the interface's forwarding plane (FP). (This is only applicable to interfaces on IOM3 and later cards.) The referenced ingress queue-group instance may have policers defined in order to rate limit ingress traffic on a per-forwarding class (and forwarding type: unicast vs. multicast) basis.
- To perform 802.1p, DSCP, IP precedence and/or MPLS EXP re-marking of egress packets on the interface.
- To associate egress packets on the interface with a queue-group instance applied to the egress context of the interface's port. The referenced egress queue-group instance may have policers and/or queues defined in order to rate limit egress traffic on a per-forwarding class basis.

The **no** form of the command removes the network QoS policy association from the network IP interface, and the QoS policy reverts to the default.

Default **no qos**

Parameters *network-policy-id* — An existing network policy ID to associate with the IP interface.

Values 1 to 65535

egress-port-redirect-group *queue-group-name* **—** This optional parameter specifies the egress queue-group used for all egress forwarding-class redirections specified within the network QoS policy ID. The specified *queue-group-name* must exist as an egress queue group applied to the egress context of the port associated with the IP interface.

egress-instance *instance-id* **—** Since multiple instances of the same egress queue-group can be applied to the same port this optional parameter is used to specify which particular instance to associate with this particular network IP interface.

Values 1 to 16384

ingress-fp- redirect-group *queue-group-name* **—** This optional parameter specifies the ingress queue-group used for all ingress forwarding-class redirections specified within the network QoS policy ID. The specified queue-group-name must exist as an ingress queue group applied to the ingress context of the forwarding plane associated with the IP interface.

ingress-instance *instance-id* **—** Since multiple instances of the same ingress queue-group can be applied to the same forwarding plane this parameter is required to specify which particular instance to associate with this particular network IP interface.

Values 1 to 16384

remote-proxy-arp

Syntax [**no**] **remote-proxy-arp**

Context config>router>if

Description This command enables remote proxy ARP on the interface.

Default no remote-proxy-arp

secondary

Syntax **secondary** {[*ip-address***/***mask* **|** *ip-address netmask*]} [**broadcast** {**all-ones** **|** **host-ones**}] [**igp-inhibit**]
no secondary *ip-addr*

Context config>router>if

Description Use this command to assign a secondary IP address to the interface. Up to 16 total primary and secondary IPv4 and IPv6 addresses can be assigned to the interface. Each address can be configured in an IP address, IP subnet or broadcast address format.

Default n/a

Parameters *ip-address* — The IP address of the IP interface. The *ip-address* portion of the **address** command specifies the IP host address that will be used by the IP interface within the subnet. This address must be unique within the subnet and specified in dotted decimal notation.

Values 1.0.0.0 to 223.255.255.255

/* —** The forward slash is a parameter delimiter that separates the *ip-address* portion of the IP address from the mask that defines the scope of the local subnet. No spaces are allowed between the *ip-addr*, the "/***" and the *mask-length* parameter. If a forward slash does not immediately follow the *ip-addr*, a dotted decimal mask must follow the prefix.

mask-length — The subnet mask length when the IP prefix is specified in CIDR notation. When the IP prefix is specified in CIDR notation, a forward slash (/) separates the *ip-address* from the *mask-length* parameter. The mask length parameter indicates the number of bits used for the network portion of the IP address; the remainder of the IP address is used to determine the host portion of the IP address. Allowed values are integers in the range 1 to 32. A mask length of 32 is reserved for system IP addresses.

Values 1 to 32

mask — The subnet mask in dotted decimal notation. When the IP prefix is not specified in CIDR notation, a space separates the *ip-addr* from a traditional dotted decimal mask. The *mask* parameter indicates the complete mask that will be used in a logical 'AND' function to derive the local subnet of the IP address. A mask of 255.255.255.255 is reserved for system IP addresses.

Values 128.0.0.0 to 255.255.255.255

broadcast {all-ones | host-ones} — The optional **broadcast** parameter overrides the default broadcast address used by the IP interface when sourcing IP broadcasts on the IP interface. If no broadcast format is specified for the IP address, the default value is **host-ones,** which indicates a subnet broadcast address. Use this parameter to change the broadcast address to **all-ones** or revert back to a broadcast address of **host-ones**.

The **all-ones** keyword following the **broadcast** parameter specifies that the broadcast address used by the IP interface for this IP address will be 255.255.255.255, also known as the local broadcast.

The **host-ones** keyword following the **broadcast** parameter specifies that the broadcast address used by the IP interface for this IP address will be the subnet broadcast address. This is an IP address that corresponds to the local subnet described by the *ip-addr* and the *mask-length* or *mask* with all the host bits set to binary 1. This is the default broadcast address used by an IP interface.

The **broadcast** parameter within the **address** command does not have a negate feature, which is usually used to revert a parameter to the default value. To change the **broadcast** type to **host-ones** after being changed to **all-ones**, the **address** command must be executed with the **broadcast** parameter defined.

The broadcast format on an IP interface can be specified when the IP address is assigned or changed.

This parameter does not affect the type of broadcasts that can be received by the IP interface. A host sending either the local broadcast (**all-ones**) or the valid subnet broadcast address (**host-ones**) will be received by the IP interface.

igp-inhibit — The secondary IP address should not be recognized as a local interface by the running IGP.

static-arp

Syntax **static-arp** *ip-addr ieee-mac-addr unnumbered*
no static-arp *unnumbered*

Context config>router>if

Description This command configures a static Address Resolution Protocol (ARP) entry associating an IP address with a MAC address for the core router instance. This static ARP appears in the core routing ARP table. A static ARP can only be configured if it exists on the network attached to the IP interface.

If an entry for a particular IP address already exists and a new MAC address is configured for the IP address, the existing MAC address is replaced by the new MAC address.

The number of static-arp entries that can be configured on a single node is limited to 1000.

Static ARP is used when a router needs to know about a device on an interface that cannot or does not respond to ARP requests. Thus, the router configuration can state that if it has a packet that has a certain IP address to send it to the corresponding ARP address. Use proxy ARP so the router responds to ARP requests on behalf of another device.

The **no** form of the command removes a static ARP entry.

Default No static ARPs are defined.

Parameters *unnumbered* — specifies the static ARP MAC for an unnumbered interface. Unnumbered interfaces support dynamic ARP. Once this command is configured, it overrides any dynamic ARP.

ieee-mac-addr — specifies the 48-bit MAC address for the static ARP in the form *aa***:***bb***:***cc***:***dd***:***ee***:***ff* or *aa***-***bb***-***cc***-***dd***-***ee***-***ff*, where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC and non-IEEE reserved MAC addresses.

strip-label

Syntax [**no**] **strip-label**

Context config>router>if

Description This command forces packets to be stripped of all (max 5) MPLS labels before the packets are handed over for possible filter (PBR) processing.

If the packets do not have an IP header immediately following the MPLS label stack after the strip, they are discarded. Only MPLS encapsulated IP, IGP shortcuts and VPRN over MPLS packets will be processed. However, IPv4 and IPv6 packets that arrive without any labels are supported on an interface with **strip-label** enabled.

This command is supported on:

- Optical ports for the 7750 SR and 7450 ESS
- IOM3-XP cards for the 7750 SR and 7450 ESS
- Null/Dot1q encaps
- Network ports
- IPv4
- IPv6

The **no** form of the command removes the strip-label command.

In order to associate an interface that is configured with the strip-label parameter with a port, the port must be configured as single-fiber for the command to be valid.

Packets that are subject to the strip-label action and are mirrored (using mirrors or lawful interception) will contain the original MPLS labels (and other L2 encapsulation) in the mirrored copy of the packet, as they appeared on the wire, when the mirror-dest type is the default type “ether”. If the mirror-dest type is “ip-only”, then the mirrored copy of the packet will not contain the original L2 encapsulation or the stripped MPLS labels.

Default no strip-label

tos-marking-state

Syntax **tos-marking-state** {**trusted** | **untrusted**}
no tos-marking-state

Context config>router>if

Description This command is used on a network IP interface to alter the default trusted state to a non-trusted state. When unset or reverted to the trusted default, the ToS field will not be remarked by egress network IP interfaces unless the egress network IP interface has the remark-trusted state set, in which case the egress network interface treats all IES and network IP interface as untrusted.
When the ingress network IP interface is set to untrusted, all egress network IP interfaces will remark IP packets received on the network interface according to the egress marking definitions on each network interface. The egress network remarking rules also apply to the ToS field of IP packets routed using IGP shortcuts (tunneled to a remote next-hop). However, the tunnel QoS markings are always derived from the egress network QoS definitions.
Egress marking and remarking is based on the internal forwarding class and profile state of

the packet once it reaches the egress interface. The forwarding class is derived from ingress classification functions. The profile of a packet is either derived from ingress classification or ingress policing.
The default marking state for network IP interfaces is trusted. This is equivalent to declaring no tos-marking-state on the network IP interface. When undefined or set to tos-marking-state trusted, the trusted state of the interface will not be displayed when using show config or show info unless the detail parameter is given. The **save config** command will not store the default tos-marking-state trusted state for network IP interfaces unless the detail parameter is also specified.

The **no** form of the command is used to restore the trusted state to a network IP interface. This is equivalent to executing the tos-marking-state trusted command.

Default tos-marking-state trusted

Parameters **trusted —** The default prevents the ToS field to not be remarked by egress network IP interfaces unless the egress network IP interface has the remark-trusted state set

untrusted — specifies that all egress network IP interfaces will remark IP packets received on the network interface according to the egress marking definitions on each network interface.

unnumbered

Syntax **unnumbered** [*ip-address* | *ip-int-name*]
no unnumbered

Context config>router>if

Description This command sets an IP interface as an unnumbered interface and specifies the IP address to be used for the interface.

To conserve IP addresses, unnumbered interfaces can be configured. The address used when generating packets on this interface is the *ip-addr* parameter configured.

An error message will be generated if an **unnumbered** interface is configured, and an IP address already exists on this interface.

The **no** form of the command removes the IP address from the interface, effectively removing the unnumbered property. The interface must be **shutdown** before **no unnumbered** is issued to delete the IP address from the interface, or an error message will be generated.

Default **no unnumbered**

Parameters *ip-addr* | *ip-int-name* — Optional. The IP address or IP interface name to associate with the unnumbered IP interface in dotted decimal notation. The configured IP address must exist on this node. It is recommended to use the system IP address as it is not associated with a particular interface and is therefore always reachable. The system IP address is the default if no *ip-addr* or *ip-int-name* is configured.

qos-route-lookup

Syntax **qos-route-lookup** [**source** | **destination**]
no qos-route-lookup

Context config>router>if
config>router>if>ipv6

Description This command enables QoS classification of the ingress IP packets on an interface based on the QoS information associated with routes in the forwarding table.

If the optional **destination** parameter is specified and the destination address of an incoming IP packet matches a route with QoS information the packet is classified to the fc and priority associated with that route, overriding the fc and priority/profile determined from the sap-ingress or network qos policy associated with the IP interface. If the destination address of the incoming packet matches a route with no QoS information the fc and priority of the packet remain as determined by the sap-ingress or network qos policy.

If the optional **source** parameter is specified and the source address of an incoming IP packet matches a route with QoS information the packet is classified to the fc and priority associated with that route, overriding the fc and priority/profile determined from the sap-ingress or network qos policy associated with the IP interface. If the source address of the incoming packet matches a route with no QoS information the fc and priority of the packet remain as determined by the sap-ingress or network qos policy.

If neither the optional **source** or **destination** parameter is present, then the default is **destination** address matching.

The functionality enabled by the qos-route-lookup command can be applied to IPv4 packets or IPv6 packets on an interface, depending on whether it is present at the interface context (applies to IPv4) or the interface>ipv6 context (applies to IPv6). The ability to specify source address based QoS lookup is not supported for IPv6. Subscriber management group interfaces also do not support the source QPPB option.

The **no** form of the command reverts to the default.

Default destination

Parameters **source —** Enables QoS classification of incoming IP packets based on the source address matching a route with QoS information.

destination — Enables QoS classification of incoming IP packets based on the destination address matching a route with QoS information.

secure-nd

Syntax [**no**] **secure-nd**

Context config>router>if>ipv6

Description This command enables Secure Neighbor Discovery (SeND) on the IPv6 interface.

The **no** form of the command reverts to the default and disabled SeND.

allow-unsecured-msgs

Syntax [**no**] **allow-unsecured-msgs**

Context config>router>if>ipv6>secure-nd

Description This command specifies whether unsecured messages are accepted. When Secure Neighbor Discovery (SeND) is enabled, only secure messages are accepted by default.

The **no** form of the command disables accepting unsecured messages.

link-local-modifier

Syntax **link-local-modifier** *modifier*
[**no**] **link-local-modifier**

Context config>router>if>ipv6>secure-nd

Description This command configures the Cryptographically Generated Address (CGA) modifier for link-local addresses.

Parameters *modifier* — specifies the modifier in 32 hexadecimal nibbles

Values 0x0 to 0xFFFFFFFF

public-key-min-bits

Syntax **public-key-min-bits** *bits*
[**no**] **public-key-min-bits**

Context config>router>if>ipv6>secure-nd

Description This command configures the minimum acceptable key length for public keys used in the generation of a Cryptographically Generated Address (CGA).

Parameters *bits* — specifies the number of bits

Values 512 to 1024

security-parameter

Syntax **security-parameter** *sec*

[**no**] **security-parameter**

Context config>router>if>ipv6>secure-nd

Description This command configures the security parameter used in the generation of a Cryptographically Generated Address (CGA).

Parameters *sec* — specifies the security parameter

Values 0 to 1

shutdown

Syntax [**no**] **shutdown**

Context config>router>if>ipv6>secure-nd

Description This command enables or disables Secure Neighbor Discovery (SeND) on the interface.

stale-time

Syntax **stale-time** *seconds*
no stale-time

Context config>router>ipv6
config>router>if>ipv6

Description This command configures the time a neighbor discovery cache entry can remain stale before being removed.

The **no** form of the command removes the stale-time value.

Default **no stale-time**

Parameters *seconds* — The allowed stale time (in seconds) before a neighbor discovery cache entry is removed.

Values 60 to 65535

tcp-mss

Syntax **tcp-mss** *mss-value*
no tcp-mss

Context config>router>if
config>router>if>ipv6

Description This command statically sets the TCP maximum segment size (MSS) for TCP connections originated from the associated IP interface to the specified value.

The **no** form of the command removes the static value and allows the TCP MSS value to be calculated based on the IP MTU value by subtracting the base IP and TCP header lengths from the IP MTU value (tcp_mss = ip_mtu – 40).

Default **no tcp-mss**

Parameters *mss-value* — The TCP MSS value that should be used in the TCP SYN packet during the three-way handshake negotiation of a TCP connection.

9158 = max-IP_MTU (9198)-40

Values 536 to 9158 (IPv4)
1220 to 9138 (IPv6)

urpf-check

Syntax [**no**] **urpf-check**

Context config>router>if
config>router>if>ipv6

Description This command enables unicast RPF (uRPF) Check on this interface.

The **no** form of the command disables unicast RPF (uRPF) Check on this interface.

Default n/a

vas-if-type

Syntax **vas-if-type** {**to-from-access | to-from-network | to-from-both**}
no vas-if-type

Context config>router>if

Description This command configures the type of a Value Added Service (VAS) facing interface. To change the **vas-if-type**, the **shutdown** command is required. The **vas-if-type** and **loopback** commands are mutually exclusive.

The **no** form of the command removes the VAS interface type configuration.

Default no vas-if-type

Parameters **to-from-access —** used when two separate (**to-from-access** and **to-from-network**) interfaces are used for VAS connectivity. For service chaining, traffic arriving from access interfaces (upstream) is redirected to a PBR target reachable over this interface for upstream VAS processing. Downstream traffic after VAS processing must arrive on this interface, so that the traffic is subject to regular routing but is not subject to AA divert, nor egress subscriber PBR.

to-from-network — used when two separate (**to-from-access** and **to-from-network**) interfaces are used for VAS connectivity. For service chaining, traffic arriving from network interfaces (downstream) is redirected to a PBR target reachable over this interface for downstream VAS processing. Upstream traffic after VAS processing must arrive on this interface, so that regular routing can be applied.

to-from-both — used when a single interface is used for VAS connectivity (no local-to-local traffic). For service chaining, both traffic arriving from access interfaces and from network interfaces is redirected to a PBR target reachable over this interface for upstream/downstream VAS processing. Traffic after VAS processing must arrive on this interface, so that the traffic is subject to regular routing but is not subject to AA divert, nor to egress subscriber PBR.

mode

Syntax **mode** {**strict** | **loose** | **strict-no-ecmp**}
no mode

Context config>router>if>urpf-check
config>router>if>ipv6>urpf-check

Description This command specifies the mode of unicast RPF check.

The **no** form of the command reverts to the default (strict) mode.

Default mode strict

Parameters **strict —** When specified, uRPF checks whether incoming packet has a source address that matches a prefix in the routing table, and whether the interface expects to receive a packet with this source address prefix.

loose — In **loose** mode, uRPF checks whether incoming packet has source address with a corresponding prefix in the routing table. However, the loose mode does not check whether the interface expects to receive a packet with a specific source address prefix. This object is valid only when **urpf-check** is enabled.

strict-no-ecmp — When a packet is received on an interface in this mode and the SA matches an ECMP route the packet is dropped by uRPF.

if-attribute

Syntax **if-attribute**

Context config>router
config>router>if
config>service>ies>if
config>service>vprn>if

Description This command creates the context to configure or apply IP interface attributes such as administrative group (admin-group) or Shared Risk Loss Group (SRLG).

Default n/a

admin-group

Syntax **admin-group** *group-name* **value** *group-value*
no admin-group *group-name*

Context config>router>if-attribute

Description This command defines an administrative group (admin-group) that can be associated with an IP or MPLS interface.

Admin groups, also known as affinity, are used to tag IP and MPLS interfaces that share a specific characteristic with the same identifier. For example, an admin group identifier can represent all links that connect to core routers, or all links that have a bandwidth higher than 10G, or all links that are dedicated to a specific service.

The user first configures locally on each router the name and identifier of each admin group. A maximum of 32 admin groups can be configured per system.

The user then configures the admin group membership of an interface. The user can apply admin groups to a IES, VPRN, network IP, or MPLS interface.

When applied to MPLS interfaces, the interfaces can be included or excluded in the LSP path definition by inferring the admin-group name. CSPF will compute a path that satisfies the admin-group include and exclude constraints.

When applied to IES, VPRN, or network IP interfaces, the interfaces can be included or excluded in the route next-hop selection by inferring the admin-group name in a route next-hop policy template applied to an interface or a set of prefixes.

The following provisioning rules are applied to admin group configuration. The system will reject the creation of an admin-group if it re-uses the same name but with a different group value than an existing group. The system will also reject the creation of an admin-group if it re-uses the same group value but with a different name than an existing group.

Only the admin groups bound to an MPLS interface are advertised area-wide in TE link TLVs and sub-TLVs when the **traffic-engineering** option is enabled in IS-IS or OSPF. IES and VPRN interfaces do not have their attributes advertised in TE TLVs.

Default n/a

Parameters *group-name* — specifies the name of the group with up to 32 characters. The association of group name and value should be unique within an IP/MPLS domain

value *group-value* **—** specifies the integer value associated with the group. The association of group name and value should be unique within an IP/MPLS domain.

Values 0 to 31

admin-group

Syntax **admin-group** *group-name* [*group-name*...(**up to 5 max**)]
no admin-group *group-name* [*group-name*...(**up to 5 max**)]
no admin-group

Context config>router>if>if-attribute
config>service>ies>if>if-attribute
config>service>vprn>if>if-attribute
config>router>mpls>if

Description This command configures the admin group membership of an interface. The user can apply admin groups to an IES, VPRN, network IP, or MPLS interface.

Each single operation of the **admin-group** command allows a maximum of five (5) groups to be specified at a time. However, a maximum of 32 groups can be added to a given interface through multiple operations. Once an admin group is bound to one or more interface, its value cannot be changed until all bindings are removed.

The configured admin-group membership will be applied in all levels/areas the interface is participating in. The same interface cannot have different memberships in different levels/areas.

Only the admin groups bound to an MPLS interface are advertised area-wide in TE link TLVs and sub-TLVs when the **traffic-engineering** option is enabled in IS-IS or OSPF. IES and VPRN interfaces do not have their attributes advertised in TE TLVs.

The **no** form of this command deletes one or more of the admin-group memberships of an interface. The user can also delete all memberships of an interface by not specifying a group name.

Default n/a

Parameters *group-name* — specifies the name of the group with up to 32 characters. The association of group name and value should be unique within an IP/MPLS domain.

srlg-group

Syntax **srlg-group** *group-name* **value** *group-value* [**penalty-weight penalty-weight**]
no srlg-group *group-name*

Context config>router>if-attribute

Description This command defines a Shared Risk Link Group (SRLG) which can be associated with an IP or MPLS interface.

SRLG is used to tag IP or MPLS interfaces which share a specific fate with the same identifier. For example, an SRLG group identifier could represent all links which use separate fibers but are carried in the same fiber conduit. If the conduit is accidentally cut, all the fiber links are cut which means all interfaces using these fiber links will fail.

The user first configures locally on each router the name and identifier of each SRLG group. A maximum of 1024 SRLGs can be configured per system.

The user then configures the SRLG membership of an interface. The user can apply SRLGs to an IES, VPRN, network IP, or MPLS interface. A maximum of 64 SRLGs can be applied to a given interface.

When SRLGs are applied to MPLS interfaces, CSPF at an LER will exclude the SRLGs of interfaces used by the LSP primary path when computing the path of the secondary path. CSPF at an LER or LSR will also exclude the SRLGs of the outgoing interface of the primary LSP path in the computation of the path of the FRR backup LSP. This provides path disjointness between the primary path and the secondary path or FRR backup path of an LSP.

When SRLGs applied to IES, VPRN, or network IP interfaces, they are evaluated in the route next-hop selection by adding the **srlg-enable** option in a route next-hop policy template applied to an interface or a set of prefixes. For instance, the user can enable the SRLG constraint to select a LFA next-hop for a prefix which avoids all interfaces that share fate with the primary next-hop.

The following provisioning rules are applied to SRLG configuration. The system will reject the creation of a SRLG if it re-uses the same name but with a different group value than an existing group. The system will also reject the creation of an SRLG if it re-uses the same group value but with a different name than an existing group.

Only the SRLGs bound to an MPLS interface are advertised area-wide in TE link TLVs and sub-TLVs when the **traffic-engineering** option is enabled in IS-IS or OSPF. IES and VPRN interfaces do not have their attributes advertised in TE TLVs.

A user may specify a penalty weight (**penalty-weight**) associated with an SRLG. This controls the likelihood of paths with links sharing SRLG values with a primary path being used by a bypass or detour LSP. The higher the penalty weight, the less desirable it is to use the link with a given SRLG.

Default n/a

Parameters *group-name* — specifies the name of the group, up to 32 characters. The association of group name and value should be unique within an IP/MPLS domain.

value group-value — specifies the integer value associated with the group. The association of group name and value should be unique within an IP/MPLS domain.

Values 0 to 4294967295

penalty-weight penalty-weight — specifies the integer value of the penalty weight that is assigned to the SRLG group

Values 0 to 65535

Default 0

srlg-group

Syntax **srlg-group** *group-name* [*group-name*...(**up to 5 max**)]
no srlg-group *group-name* [*group-name*...(**up to 5 max**)]
no srlg-group

Context config>router>if>if-attribute
config>service>ies>if>if-attribute
config>service>vprn>if>if-attribute
config>router>mpls>if

Description This command configures the SRLG membership of an interface. The user can apply SRLGs to an IES, VPRN, network IP, or MPLS interface.

An interface can belong to up to 64 SRLG groups. However, each single operation of the **srlg-group** command allows a maximum of five (5) groups to be specified at a time. Once an SRLG group is bound to one or more interface, its value cannot be changed until all bindings are removed.

The configured SRLG membership will be applied in all levels/areas the interface is participating in. The same interface cannot have different memberships in different levels/areas.

Only the SRLGs bound to an MPLS interface are advertised area-wide in TE link TLVs and sub-TLVs when the **traffic-engineering** option is enabled in IS-IS or OSPF. IES and VPRN interfaces do not have their attributes advertised in TE TLVs.

The **no** form of this command deletes one or more of the SRLG memberships of an interface. The user can also delete all memberships of an interface by not specifying a group name.

Default n/a

Parameters *group-name* — specifies the name of the group, up to 32 characters. The association of group name and value should be unique within an IP/MPLS domain.

route-next-hop-policy

Syntax **route-next-hop-policy**

Context config>router

Description This command creates the context to configure route next-hop policies.

Default n/a

template

Syntax [**no**] **template** *template-name*

Context config>router>route-next-hop-policy

Description This command creates a template to configure the attributes of a Loop-Free Alternate (LFA) Shortest Path First (SPF) policy. An LFA SPF policy allows the user to apply specific criteria, such as admin group and SRLG constraints, to the selection of an LFA backup next-hop for a subset of prefixes that resolve to a specific primary next-hop.

The user first creates a route next-hop policy template under the global router context and then applies it to a specific OSPF or IS-IS interface in the global routing instance or in a VPRN instance.

A policy template can be used in both IS-IS and OSPF to apply the specific criteria to prefixes protected by LFA. Each instance of IS-IS or OSPF can apply the same policy template to one or more interface.

The commands within the route next-hop policy template use the **begin-commit-abort** model. The following are the steps to create and modify the template:

To create a template, the user enters the name of the new template directly under the route-next-hop-policy context.

1. To delete a template that is not in use, the user enters the **no** form for the template name under the route-next-hop-policy context.
2. The user enters the editing mode by executing the begin command under the route-next-hop-policy context. The user can then edit and change any number of route next-hop policy templates. However, the parameter value will still be stored temporarily in the template module until the commit is executed under the route-next-hop-policy context. Any temporary parameter changes will be lost if the user enters the abort command before the commit command.
3. The user is allowed to create or delete a template instantly once in the editing mode without the need to enter the commit command. Furthermore, the abort command, if entered, will have no effect on the prior deletion or creation of a template.

Once the commit command is issued, IS-IS or OSPF will re-evaluate the templates and if there are any net changes, it will schedule a new LFA SPF to re-compute the LFA next-hop for the prefixes associated with these templates.

Default n/a

Parameters *template-name* — specifies the name of the template, up to 32 characters

include-group

Syntax **include-group** *group-name* [**pref** *pref*]
no include-group *group-name*

Context config>router>route-next-hop-policy>template

Description This command configures the admin group constraint into the route next-hop policy template.

Each group is entered individually. The **include-group** statement instructs the LFA SPF selection algorithm to pick uinp a subset of LFA next-hops among the links which belong to one or more of the specified admin groups. A link which does not belong to at least one of the admin-groups is excluded. However, a link can still be selected if it belongs to one of the groups in a include-group statement but also belongs to other groups which are not part of any include-group statement in the route next-hop policy.

The **pref** option is used to provide a relative preference for the admin group to select. A lower preference value means that LFA SPF will first attempt to select a LFA backup next-hop which is a member of the corresponding admin group. If none is found, then the admin group with the next higher preference value is evaluated. If no preference is configured for a given admin group name, then it is supposed to be the least preferred, i.e., numerically the highest preference value.

When evaluating multiple **include-group** statements within the same preference, any link which belongs to one or more of the included admin groups can be selected as an LFA next-hop. There is no relative preference based on how many of those included admin groups the link is a member of.

The **exclude-group** statement simply prunes all links belonging to the specified admin group before making the LFA backup next-hop selection for a prefix.

If the same group name is part of both include and exclude statements, the exclude statement will win. It other words, the exclude statement can be viewed as having an implicit preference value of 0.

The admin-group criteria are applied before running the LFA next-hop selection algorithm.

The **no** form deletes the admin group constraint from the route next-hop policy template.

Default n/a

Parameters *group-name* — specifies the name of the group, up to 32 characters

pref *pref* **—** An integer specifying the relative preference of a group.

Values 1 to 255

Default 255

exclude-group

Syntax **exclude-group** *group-name*
no exclude-group *group-name*

Context config>router>route-next-hop-policy>template

Description This command configures the admin group constraint into the route next-hop policy template.

Each group is entered individually. The **include-group** statement instructs the LFA SPF selection algorithm to pick up a subset of LFA next-hops among the links that belong to one or more of the specified admin groups. A link that does not belong to at least one of the admin-groups is excluded. However, a link can still be selected if it belongs to one of the groups in an include-group statement but also belongs to other groups that are not part of any include-group statement in the route next-hop policy.

The **pref** option is used to provide a relative preference for the admin group to select. A lower preference value means that LFA SPF will first attempt to select an LFA backup next-hop that is a member of the corresponding admin group. If none is found, then the admin group with the next highest preference value is evaluated. If no preference is configured for a given admin group name, then it is supposed to be the least preferred (i.e., numerically the highest preference value).

When evaluating multiple **include-group** statements within the same preference, any link that belongs to one or more of the included admin groups can be selected as an LFA next-hop. There is no relative preference based on how many of those included admin groups the link is a member of.

The **exclude-group** statement simply prunes all links belonging to the specified admin group before making the LFA backup next-hop selection for a prefix.

If the same group name is part of both include and exclude statements, the exclude statement will win. It other words, the exclude statement can be viewed as having an implicit preference value of zero (0).

The admin-group criteria are applied before running the LFA next-hop selection algorithm.

The **no** form deletes the admin group constraint from the route next-hop policy template.

Default n/a

Parameters *group-name* — specifies the name of the group, up to 32 characters

srlg-enable

Syntax [**no**] **srlg-enable**

Context config>router>route-next-hop-policy>template

Description This command configures the SRLG constraint into the route next-hop policy template.

When this command is applied to a prefix, the LFA SPF will attempt to select an LFA next-hop, among the computed ones, which uses an outgoing interface that does not participate in any of the SLRGs of the outgoing interface used by the primary next-hop.

The SRLG criterion is applied before running the LFA next-hop selection algorithm.

The **no** form deletes the SRLG constraint from the route next-hop policy template.

Default no srlg-enable

protection-type

Syntax **protection-type** {**link** | **node**}
no protection-type

Context config>router>route-next-hop-policy>template

Description This command configures the protection type constraint into the route next-hop policy template.

The user can select if link protection or node protection is preferred in the selection of an LFA next-hop for all IP prefixes and LDP FEC prefixes to which a route next-hop policy template is applied. The default in SR OS implementation is node protection. The implementation will fall back to the other type if no LFA next-hop of the preferred type is found.

When the route next-hop policy template is applied to an IP interface, all prefixes using this interface as a primary next-hop will follow the protection type preference specified in the template.

The **no** form deletes the protection type constraint from the route next-hop policy template.

Default protection-type node

Parameters *{link* **|** *node}* — specifies the two possible values for the protection type

Default node

nh-type

Syntax **nh-type** {**ip** | **tunnel**}
no nh-type

Context config>router>route-next-hop-policy>template

Description This command configures the next-hop type constraint into the route next-hop policy template.

The user can select if tunnel backup next-hop or IP backup next-hop is preferred. The default in SR OS implementation is to prefer IP next-hop over tunnel next-hop. The implementation will fall back to the other type if no LFA next-hop of the preferred type is found.

When the route next-hop policy template is applied to an IP interface, all prefixes using this interface as a primary next-hop will follow the next-hop type preference specified in the template.

The **no** form deletes the next-hop type constraint from the route next-hop policy template.

Default nh-type ip

Parameters *{ip* | *tunnel}* — specifies the two possible values for the next-hop type

Default ip

2.13.2.4.1 Router Interface Filter Commands

egress

Syntax **egress**

Context config>router>if

Description This command enables access to the context to configure egress network filter policies for the IP interface. If an egress filter is not defined, no filtering is performed.

Default n/a

ingress

Syntax **ingress**

Context config>router>if

Description This command enables access to the context to configure ingress network filter policies for the IP interface. If an ingress filter is not defined, no filtering is performed.

Default n/a

filter

Syntax **filter ip** *ip-filter-id*
filter ipv6 *ipv6-filter-id*
no filter [**ip** *ip-filter-ip*] [**ipv6** *ipv6-filter-id*]

Context config>router>if>ingress
config>router>if>egress

Description This command associates an IP filter policy with an IP interface.

Filter policies control packet forwarding and dropping based on IP match criteria.

The *ip-filter-id* must have been preconfigured before this **filter** command is executed. If the filter ID does not exist, an error occurs.

Only one filter ID can be specified.

The **no** form of the command removes the filter policy association with the IP interface.

Default No filter is specified.

Parameters *ip ip-filter-id* — The filter name acts as the ID for the IP filter policy expressed as a decimal integer. The filter policy must already exist within the **config>filter>ip** context.

Values 1 to 16384

ipv6 *ipv6-filter-id* **—** The filter name acts as the ID for the IPv6 filter policy expressed as a decimal integer. The filter policy must already exist within the **config>filter>ipv6** context. This parameter only applies to the 7750 SR and 7950 XRS.

Values 1 to 65535

2.13.2.4.2 Router Interface ICMP Commands

hold-time

Syntax **hold-time**

Context config>router>if
config>service>ies>if
config>service>ies>subscriber-interface
config>service>ies>redundant-interface
config>service>vprn>if
config>service>vprn>network-interface
config>service>vprn>subscriber-interface
config>service>vprn>redundant-interface
config>service>vpls>if

Description This command creates the CLI context to configure interface level hold-up and hold-down timers for the associated IP interface.

The **up** timer controls a delay for the associated IPv4 or IPv6 interface so that the system will delay the deactivation of the associated interface for the specified amount of time.

The **down** timer controls a delay for the associated IPv4 or IPv6 interface so that the system will delay the activation of the associated interface for the specified amount of time

Default n/a

up

Syntax **up ip** *seconds*
no up ip
up ipv6 *seconds*
no up ipv6

Context config>router>if>hold-time
config>service>ies>if>hold-time
config>service>ies>sub-if>hold-time
config>service>ies>red-if>hold-time
config>service>vprn>if>hold-time
config>service>vprn>nw-if>hold-time
config>service>vprn>sub-if>hold-time
config>service>vprn>red-if>hold-time
config>service>vpls>if>hold-time

Description This command will cause a delay in the deactivation of the associated IP interface by the specified number of seconds. The delay is invoked whenever the system attempts to bring the associated IP interface down.

The **no** form of the command removes the command from the active configuration and removes the delay in deactivating the associated IP interface. If the configuration is removed during a delay period, the currently running delay will continue until it expires.

Default no up ip

Parameters *seconds* — The time delay, in seconds, to make the interface operational.

Values 1 to 1200

down

Syntax **down ip** *seconds* [**init-only**]
no up ip
up ipv6 *seconds* [**init-only**]
no up ipv6

Context config>router>if>hold-time
config>service>ies>if>hold-time
config>service>ies>sub-if>hold-time
config>service>ies>red-if>hold-time
config>service>vprn>if>hold-time

config>service>vprn>nw-if>hold-time
config>service>vprn>sub-if>hold-time
config>service>vprn>red-if>hold-time
config>service>vpls>if>hold-time

Description This command will cause a delay in the activation of the associated IP interface by the specified number of seconds. The delay is invoked whenever the system attempts to bring the associated IP interface up, unless the **init-only** option is configured. If the **init-only** option is configured, the delay is only applied when the IP interface is first configured or after a system reboot.

The **no** form of the command removes the command from the active configuration and removes the delay in activating the associated IP interface. If the configuration is removed during a delay period, the currently running delay will continue until it completes.

Default no down ip

Parameters *seconds* — The time delay, in seconds, to make the interface operational.

Values 1 to 1200

init-only — specifies that the **down** delay is only applied when the interface is configured or after a reboot

Values 1 to 1200

icmp

Syntax **icmp**

Context config>router>if

Description This command enables access to the context to configure Internet Control Message Protocol (ICMP) parameters on a network IP interface. ICMP is a message control and error reporting protocol that also provides information relevant to IP packet processing.

Default n/a

mask-reply

Syntax [**no**] **mask-reply**

Context config>router>if>icmp

Description This command enables responses to ICMP mask requests on the router interface.

If a local node sends an ICMP mask request to the router interface, the **mask-reply** command configures the router interface to reply to the request.

The **no** form of the command disables replies to ICMP mask requests on the router interface.

Default mask-reply — Replies to ICMP mask requests.

redirects

Syntax **redirects** [*number seconds*]
no redirects

Context config>router>if>icmp

Description This command enables and configures the rate for ICMP redirect messages issued on the router interface.

When routes are not optimal on this router, and another router on the same subnetwork has a better route, the router can issue an ICMP redirect to alert the sending node that a better route is available.

The **redirects** command enables the generation of ICMP redirects on the router interface. The rate at which ICMP redirects are issued can be controlled with the optional *number* and *time* parameters by indicating the maximum number of redirect messages that can be issued on the interface for a given time interval.

By default, generation of ICMP redirect messages is enabled at a maximum rate of 100 per 10 second time interval.

The **no** form of the command disables the generation of ICMP redirects on the router interface.

Default redirects 100 10 — Maximum of 100 redirect messages in 10 seconds.

Parameters *number* — The maximum number of ICMP redirect messages to send, expressed as a decimal integer. This parameter must be specified with the *time* parameter.

Values 10 to 1000

seconds — The time frame, in seconds, used to limit the *number* of ICMP redirect messages that can be issued, expressed as a decimal integer.

Values 1 to 60

ttl-expired

Syntax **ttl-expired** [*number seconds*]
no ttl-expired

Context config>router>if>icmp

Description This command configures the rate that Internet Control Message Protocol (ICMP) Time To Live (TTL) expired messages are issued by the IP interface.

By default, generation of ICMP TTL expired messages is enabled at a maximum rate of 100 per 10 second time interval.

The **no** form of the command disables the generation of TTL expired messages.

Default ttl-expired 100 10 — Maximum of 100 TTL expired message in 10 seconds.

Parameters *number* — The maximum number of ICMP TTL expired messages to send, expressed as a decimal integer. The *seconds* parameter must also be specified.

Values 10 to 1000

seconds — The time frame, in seconds, used to limit the *number* of ICMP TTL expired messages that can be issued, expressed as a decimal integer.

Values 1 to 60

unreachables

Syntax **unreachables** [*number seconds*]
no unreachables

Context config>router>if>icmp

Description This command enables and configures the rate for ICMP host and network destination unreachable messages issued on the router interface.

The **unreachables** command enables the generation of ICMP destination unreachables on the router interface. The rate at which ICMP unreachables is issued can be controlled with the optional *number* and *seconds* parameters by indicating the maximum number of destination unreachable messages that can be issued on the interface for a given time interval.

By default, generation of ICMP destination unreachables messages is enabled at a maximum rate of 100 per 10 second time interval.

The **no** form of the command disables the generation of ICMP destination unreachables on the router interface.

Default unreachables 100 10 — Maximum of 100 unreachable messages in 10 seconds.

Parameters *number* — The maximum number of ICMP unreachable messages to send, expressed as a decimal integer. The *seconds* parameter must also be specified.

Values 10 to 1000

seconds — The time frame, in seconds, used to limit the *number* of ICMP unreachable messages that can be issued, expressed as a decimal integer.

2.13.2.4.3 Router Interface IPv6 Commands

ipv6

Syntax [**no**] **ipv6**

Context config>router>if

Description This command configures IPv6 for a router interface.

The **no** form of the command disables IPv6 on the interface.

Default not enabled

address

Syntax **address** {*ipv6-address/prefix-length*} [**eui-64**]
no address {*ipv6-address/prefix-length*}

Context config>router>if>ipv6

Description This command assigns an IPv6 address to the interface.

Default none

Parameters *ipv6-address/prefix-length* — specify the IPv6 address on the interface

Values

ipv6-address/prefix:	ipv6-address	x:x:x:x:x:x:x:x (eight 16-bit pieces)
		x:x:x:x:x:x:d.d.d.d
		x [0 to FFFF]H
		d [0 to 255]D
	prefix-length	1 to 128

eui-64 — When the **eui-64** keyword is specified, a complete IPv6 address from the supplied prefix and 64-bit interface identifier is formed. The 64-bit interface identifier is derived from MAC address on Ethernet interfaces. For interfaces without a MAC address, for example POS interfaces, the Base MAC address of the chassis should be used.

dad-disable

Syntax [**no**] **dad-disable**

Context config>router>if>ipv6

Description This command disables duplicate address detection (DAD) on a per-interface basis. This prevents the router from performing a DAD check on the interface. All IPv6 addresses of an interface with DAD disabled, immediately enter a preferred state, without checking for uniqueness on the interface. This is useful for interfaces which enter a looped state during troubleshooting and operationally disable themselves when the loop is detected, requiring manual intervention to clear the DAD violation.

The **no** form of the command turns off **dad-disable** on the interface.

Default not enabled

icmp6

Syntax **icmp6**

Context config>router>if>ipv6

Description This command enables the context to configure ICMPv6 parameters for the interface.

packet-too-big

Syntax **packet-too-big** [*number seconds*]
no packet-too-big

Context config>router>if>ipv6>icmp6

Description This command configures the rate for ICMPv6 packet-too-big messages.

Parameters *number* — Limits the number of packet-too-big messages issued per the time frame specified in the *seconds* parameter.

Values 10 to 1000

seconds — Determines the time frame, in seconds, that is used to limit the number of packet-too-big messages issued per time frame.

Values 1 to 60

param-problem

Syntax **param-problem** [*number seconds*]
no param-problem

Context config>router>if>ipv6>icmp6

Description This command configures the rate for ICMPv6 param-problem messages.

Parameters *number* — Limits the number of param-problem messages issued per the time frame specified in the *seconds* parameter.

Values 10 to 1000

seconds — Determines the time frame, in seconds, that is used to limit the number of param-problem messages issued per time frame.

Values 1 to 60

redirects

Syntax **redirects** [*number seconds*]
no redirects

Context config>router>if>ipv6>icmp6

Description This command configures the rate for ICMPv6 redirect messages. When configured, ICMPv6 redirects are generated when routes are not optimal on the router and another router on the same subnetwork has a better route to alert that node that a better route is available.

The **no** form of the command disables ICMPv6 redirects.

Default 100 10 (when IPv6 is enabled on the interface)

Parameters *number* — Limits the number of redirects issued per the time frame specified in *seconds* parameter.

Values 10 to 1000

seconds — determines the time frame, in seconds, that is used to limit the number of redirects issued per time frame

Values 1 to 60

time-exceeded

Syntax **time-exceeded** [*number seconds*]
no time-exceeded

Context config>router>if>ipv6>icmp6

Description This command configures rate for ICMPv6 time-exceeded messages.

Parameters *number* — Limits the number of time-exceeded messages issued per the time frame specified in *seconds* parameter.

Values 10 to 1000

seconds — Determines the time frame, in seconds, that is used to limit the number of time-exceeded messages issued per time frame.

Values 1 to 60

unreachables

Syntax **unreachables** [*number seconds*]
no unreachables

Context config>router>if>ipv6>icmp6

Description This command configures the rate for ICMPv6 unreachable messages. When enabled, ICMPv6 host and network unreachable messages are generated by this interface.

The **no** form of the command disables the generation of ICMPv6 host and network unreachable messages by this interface.

Default 100 10 (when IPv6 is enabled on the interface)

Parameters *number* — Determines the number destination unreachable ICMPv6 messages to issue in the time frame specified in *seconds* parameter.

Values 10 to 1000

seconds — Sets the time frame, in seconds, to limit the number of destination unreachable ICMPv6 messages issued per time frame.

Values 1 to 60

link-local-address

Syntax **link-local-address** *ipv6-address* [**preferred**]

Context config>router>if>ipv6
config>service>ies>if>ipv6
config>service>vprn>if>ipv6

Description This command configures the IPv6 link local address.

The **no** form of the command removes the configured link local address, and the router automatically generates a default link local address.

Removing a manually configured link local address may impact routing protocols or static routes that have a dependency on that address. It is not recommended to remove a link local address when there are active IPv6 subscriber hosts on an IES or VPRN interface.

Parameters **preferred —** Disables duplicated address detection and sets the address to preferred, even if there is a duplicate address.

local-proxy-nd

Syntax [**no**] **local-proxy-nd**

Context config>router>if>ipv6

Description This command enables local proxy neighbor discovery on the interface.

The **no** form of the command disables local proxy neighbor discovery.

neighbor

Syntax **neighbor** [*ipv6-address*] [*mac-address*]
no neighbor [*ipv6-address*]

Context config>router>if>ipv6

Description This command configures an IPv6-to-MAC address mapping on the interface. Use this command if a directly attached IPv6 node does not support ICMPv6 neighbor discovery, or for some reason, a static address must be used. This command can only be used on Ethernet media.

The *ipv6-address* must be on the subnet that was configured from the IPv6 **address** command or a link-local address.

Parameters *ipv6-address* — The IPv6 address assigned to a router interface.

Values

ipv6-address:	x:x:x:x:x:x:x:x (eight 16-bit pieces)	
	x:x:x:x:x:x:d.d.d.d	
	x:	[0 to FFFF]H
	d:	[0 to 255]D

mac-address — specifies the MAC address for the neighbor in the form of xx:xx:xx:xx:xx:xx or xx-xx-xx-xx-xx-xx

neighbor-limit

Syntax **neighbor-limit** *limit* [**log-only**] [**threshold** *percent*]
no neighbor-limit

Context config>router>if>ipv6

Description This command configures the maximum amount of dynamic IPv6 neighbor entries that can be learned on an IP interface.

When the number of dynamic neighbor entries reaches the configured percentage of this limit, an SNMP trap is sent. When the limit is exceeded, no new entries are learned until an entry expires and traffic to these destinations will be dropped. Entries that have already been learned will be refreshed.

The **no** form of the command removes the neighbor-limit.

Default 90 percent

Parameters **log-only —** Enables the warning message to be sent at the specified threshold percentage, and also when the limit is exceeded. However, entries above the limit will be learned.

percent — the threshold value (as a percentage) that triggers a warning message to be sent

Values 0 to 100

limit — The number of entries that can be learned on an IP interface expressed as a decimal integer. If the limit is set to 0, dynamic neighbor learning is disabled and no dynamic neighbor entries are learned.

Values 0 to 102400

proxy-nd-policy

Syntax **proxy-nd-policy** *policy-name* [*policy-name*...(**up to 5 max**)]
no proxy-nd-policy

Context config>router>if>ipv6

Description This command configure a proxy neighbor discovery policy for the interface.

Parameters *policy-name* — The neighbor discovery policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. The specified policy name(s) must already be defined.

2.13.2.4.4 Router Interface DHCP Commands

dhcp

Syntax **dhcp**

Context config>router>if

Description This command enables the context to configure DHCP parameters.

Default n/a

gi-address

Syntax **gi-address ip-address** [**src-ip-addr**]
no gi-address

Context config>router>if>dhcp

Description This command configures the gateway interface address for the DHCP relay. The GI address is needed, when the router functions as a DHCP relay, to distinguish between the different subscriber interfaces and potentially between the group interfaces defined.

Default no gi-address

Parameters *ip-address* — specifies the host IP address to be used for DHCP relay packets

src-ip-address — specifies the source IP address to be used for DHCP relay packets

option

Syntax [**no**] **option**

Context config>router>if>dhcp

Description This command enables DHCP Option 82 (Relay Agent Information Option) parameters processing and enters the context for configuring Option 82 sub-options.

The **no** form of this command returns the system to the default.

Default no option

action

Syntax **action** {**replace | drop | keep**}
no action

Context config>router>if>dhcp>option

Description This command configures the processing required when the SR-Series router receives a DHCP request that already has a Relay Agent Information Option (Option 82) field in the packet.

The **no** form of this command returns the system to the default value.

Default Per RFC 3046, **DHCP Relay Agent Information Option**, section 2.1.1, **Reforwarded DHCP requests**, the default is to keep the existing information intact. The exception to this is if the GI address of the received packet is the same as the ingress address on the router. In that case the packet is dropped and an error is logged.

Parameters **replace —** In the upstream direction (from the user), the existing Option 82 field is replaced with the Option 82 field from the router. In the downstream direction (towards the user) the Option 82 field is stripped (in accordance with RFC 3046).

drop — The packet is dropped, and an error is logged.

keep — The existing information is kept in the packet and the router does not add any additional information. In the downstream direction the Option 82 field is not stripped and is sent on towards the client.

The behavior is slightly different in case of Vendor Specific Options (VSOs). When the keep parameter is specified, the router will insert his own VSO into the Option 82 field. This will only be done when the incoming message has already an Option 82 field.

If no Option 82 field is present, the router will not create the Option 82 field. In this in that case, no VSO will be added to the message.

circuit-id

Syntax **circuit-id** [**ascii-tuple | ifindex | sap-id | vlan-ascii-tuple**]
no circuit-id

Context config>router>if>dhcp>option

Description When enabled, the router sends the interface index (If Index) in the **circuit-id** suboption of the DHCP packet. The If Index of a router interface can be displayed using the command **show>router>if>detail**. This option specifies data that must be unique to the router that is relaying the circuit.

If disabled, the **circuit-id** suboption of the DHCP packet will be left empty.

The **no** form of this command returns the system to the default.

Default circuit-id ascii-tuple

Parameters **ascii-tuple —** specifies that the ASCII-encoded concatenated tuple will be used which consists of the access-node-identifier, service-id, and interface-name, separated by “|”

ifindex — specifies that the interface index will be used. The If Index of a router interface can be displayed using the command **show>router>if>detail**.

sap-id — specifies that the SAP ID will be used

vlan-ascii-tuple — specifies that the format will include VLAN-id and dot1p bits in addition to what is included in ascii-tuple already. The format is supported on dot1q and qinq ports only. Thus, when the Option 82 bits are stripped, dot1p bits will be copied to the Ethernet header of an outgoing packet.

remote-id

Syntax **remote-id** [**mac** | **string** *string*]
no remote-id

Context config>router>if>dhcp>option

Description When enabled, the router sends the MAC address of the remote end (typically the DHCP client) in the **remote-id** suboption of the DHCP packet. This command identifies the host at the other end of the circuit. If disabled, the **remote-id** suboption of the DHCP packet will be left empty.

The **no** form of this command returns the system to the default.

Default no remote-id

Parameters **mac —** This keyword specifies the MAC address of the remote end is encoded in the suboption.

string *string* **—** specifies the remote-id

vendor-specific-option

Syntax [**no**] **vendor-specific-option**

Context config>router>if>dhcp>option

Description This command configures the Nokia vendor specific suboption of the DHCP relay packet.

Default n/a

client-mac-address

Syntax [**no**] **client-mac-address**

Context config>router>if>dhcp>option

Description This command enables the sending of the MAC address in the Nokia vendor specific suboption of the DHCP relay packet.

The **no** form of the command disables the sending of the MAC address in the Nokia vendor specific suboption of the DHCP relay packet.

Default no client-mac-address

pool-name

Syntax [**no**] **pool-name**

Context config>router>if>dhcp>option>vendor-specific-option

Description This command enables the sending of the pool name in the Nokia vendor-specific suboption of the DHCP relay packet.

The **no** form of the command disables the feature.

Default no pool-name

port-id

Syntax [**no**] **port-id**

Context config>router>if>dhcp>option>vendor-specific-option

Description This command enables sending of the port-id in the Nokia vendor specific suboption of the DHCP relay packet

The **no** form of the command disables the sending.

Default no port-id

service-id

Syntax [**no**] **service-id**

Context config>router>if>dhcp>option>vendor-specific-option

Description This command enables the sending of the service ID in the Nokia vendor specific suboption of the DHCP relay packet.

The **no** form of the command disables the sending of the service ID in the Nokia vendor specific suboption of the DHCP relay packet.

Default no service-id

string

Syntax [**no**] **string** *text*

Context config>router>if>dhcp>option>vendor-specific-option

Description This command specifies the vendor specific suboption string of the DHCP relay packet.

The **no** form of the command returns the default value.

Default no string

Parameters *text* — The string can be any combination of ASCII characters up to 32 characters in length. If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

system-id

Syntax [**no**] **system-id**

Context config>router>if>dhcp>option>vendor-specific-option

Description This command specifies whether the system-id is encoded in the Nokia vendor specific sub-option of Option 82.

Default no system-id

relay-plain-bootp

Syntax [**no**] **relay-plain-bootp**

Context config>router>if>dhcp

Description This command enables the relaying of plain BOOTP packets.

The **no** form of the command disables the relaying of plain BOOTP packets.

Default no relay-plain-bootp

server

Syntax **server** *server1* [*server2*...(**up to 8 max**)]

Context config>router>if>dhcp

Description This command specifies a list of servers where requests will be forwarded. The list of servers can entered as either IP addresses or fully qualified domain names. There must be at least one server specified for DHCP relay to work. If there are multiple servers then the request is forwarded to all of the servers in the list. There can be a maximum of 8 DHCP servers configured.

The flood command is applicable only in the VPLS case. There is a scenario with VPLS where the VPLS node only wants to add Option 82 information to the DHCP request to provider per-subscriber information, but it does not do full DHCP relay. In this case, the server is set to "flood". This means the DHCP request is still a broadcast and is sent through the VPLS domain. A node running at L3 further upstream then can perform the full L3 DHCP relay function.

Default no server

Parameters *server* — specifies the DHCP server IP address

trusted

Syntax [**no**] **trusted**

Context config>router>if>dhcp

Description According to RFC 3046, **DHCP Relay Agent Information Option**, a DHCP request where the GI address is 0.0.0.0 and which contains a Option 82 field in the packet, should be discarded, unless it arrives on a "trusted" circuit.

If trusted mode is enabled on an IP interface, the relay agent (the SR-Series) will modify the request's GI address to be equal to the ingress interface and forward the request.

This behavior only applies when the action in the Relay Agent Information Option is "keep". In the case where the Option 82 field is being replaced by the relay agent (action = "replace"), the original Option 82 information is lost anyway, and there is thus no reason for enabling the trusted option.

The **no** form of this command returns the system to the default.

Default no trusted

python-policy

Syntax **python-policy** *name*
no python-policy

Context config>router>if>dhcp

Description This command specifies a python policy. Python policies are configured in the **config>python> python-policy** *name* context.

Default no python-policy

Parameters *name* — specifies the name of an existing python script up to 32 characters in length

2.13.2.5 Router Advertisement Commands

router-advertisement

Syntax [**no**] **router-advertisement**

Context config>router

Description This command configures router advertisement properties. By default, it is disabled for all IPv6 enabled interfaces.

The **no** form of the command disables all IPv6 interface. However, the **no interface** *interface-name* command disables a specific interface.

Default disabled

dns-options

Syntax [**no**] **dns-options**

Context config>router>router-advert
config>router>router-advert>if

Description This command enables the context for configuration of DNS information for Stateless Address Auto-Configuration (SLAAC) hosts.

When specified at the router-advertisement level in the routing context, this command allows configuration of service-wide parameters. These can then be inherited at the interface level by specifying the **config>router>router-advert>if>dns-options>include-dns** command.

The **no** form of the command disables configuration of DNS information for Stateless Address Auto-Configuration (SLAAC) hosts.

Default disabled

servers

Syntax **server** *ipv6-address*
no server

Context config>router>router-advert>dns-options
config>router>router-advert>if>dns-options

Description This command specifies the IPv6 DNS servers to include in the RDNSS option in Router Advertisements. When specified at the router advertisement level this applies to all interfaces that have **include-dns** enabled, unless the interfaces have more specific **dns-options** configured.

Default n/a

Parameters *ipv6-address* — Specify the IPv6 address of the DNS server(s), up to 4 max. Specified as eight 16-bit hexadecimal pieces.

include-dns

Syntax [**no**] **include-dns**

Context config>router>router-advert>if>dns-options

Description This command enables the Recursive DNS Server (RDNSS) Option in router advertisements. This must be enabled for each interface on which the RDNSS option is required in router advertisement messages.

The **no** form of the command disables the RDNSS option in router advertisements.

Default disabled

rdnss-lifetime

Syntax **rdnss-lifetime** {*seconds* | **infinite**}
no rdnss-lifetime

Context config>router>router-advert>dns-options
config>router>router-advert>if>dns-options

Description This command specifies the maximum time that the RDNSS address may be used for name resolution by the client. The RDNSS Lifetime must be no more than twice MaxRtrAdvLifetime with a maximum of 3600 seconds.

Default rdnss-lifetime infinite

Parameters *infinite* — specifies an infinite RDNSS lifetime

seconds — specifies the time in seconds

Values 4 to 3600

interface

Syntax [**no**] **interface** *ip-int-name*

Context config>router>router-advert

Description This command configures router advertisement properties on a specific interface. The interface must already exist in the **config>router>if** context.

Default No interfaces are configured by default.

Parameters *ip-int-name* — Specify the interface name. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

current-hop-limit

Syntax **current-hop-limit** *number*
no current-hop-limit

Context config>router>router-advert>if

Description This command configures the current-hop-limit in the router advertisement messages. It informs the nodes on the subnet about the hop-limit when originating IPv6 packets.

Default current-hop-limit 64

Parameters *number* — specifies the hop limit

Values 0 to 255. A value of zero means there is an unspecified number of hops.

managed-configuration

Syntax [**no**] **managed-configuration**

Context config>router>router-advert>if

Description This command sets the managed address configuration flag. This flag indicates that DHCPv6 is available for address configuration in addition to any address autoconfigured using stateless address autoconfiguration. See RFC 3315, *Dynamic Host Configuration Protocol (DHCP) for IPv6*.

Default no managed-configuration

max-advertisement-interval

Syntax [**no**] **max-advertisement-interval** *seconds*

Context config>router>router-advert>if

Description This command configures the maximum interval between sending router advertisement messages.

Default max-advertisement-interval 600

Parameters *seconds* — specifies the maximum interval in seconds between sending router advertisement messages

Values 4 to 1800

min-advertisement-interval

Syntax [**no**] **min-advertisement-interval** *seconds*

Context config>router>router-advert>if

Description This command configures the minimum interval between sending ICMPv6 neighbor discovery router advertisement messages.

Default min-advertisement-interval 200

Parameters *seconds* — Specify the minimum interval in seconds between sending ICMPv6 neighbor discovery router advertisement messages.

Values 3 to 1350

mtu

Syntax [**no**] **mtu** *mtu-bytes*

Context config>router>router-advert>if

Description This command configures the MTU for the nodes to use to send packets on the link.

Default no mtu — The MTU option is not sent in the router advertisement messages.

Parameters *mtu-bytes* — Specify the MTU for the nodes to use to send packets on the link.

Values 1280 to 9212

other-stateful-configuration

Syntax [**no**] **other-stateful-configuration**

Context config>router>router-advert>if

Description This command sets the "Other configuration" flag. This flag indicates that DHCPv6lite is available for autoconfiguration of other (non-address) information such as DNS-related information or information on other servers in the network. See RFC 3736, *Stateless Dynamic Host Configuration Protocol (DHCP) for IPv6*.

Default no other-stateful-configuration

prefix

Syntax [**no**] **prefix** [*ipv6-prefix***/***prefix-length*]

Context config>router>router-advert>if

Description This command configures an IPv6 prefix in the router advertisement messages. To support multiple IPv6 prefixes, use multiple prefix statements. No prefix is advertised until explicitly configured using prefix statements.

Default n/a

Parameters *ip-prefix* — The IP prefix for prefix list entry in dotted decimal notation.

Values

ipv4-prefix	a.b.c.d (host bits must be 0)	
ipv4-prefix-length	0 to 32	
ipv6-prefix	x:x:x:x:x:x:x:x (eight 16-bit pieces)	
	x:x:x:x:x:x:d.d.d.d	
	x:	[0 to FFFF]H
	d:	[0 to 255]D
ipv6-prefix-length	0 to 128	

prefix-length — specifies a route must match the most significant bits and have a prefix length

Values 1 to 128

autonomous

Syntax [**no**] **autonomous**

Context config>router>router-advert>if>prefix

Description This command specifies whether the prefix can be used for stateless address autoconfiguration.

Default enabled

on-link

Syntax [**no**] **on-link**

Context config>router>router-advert>if>prefix

Description This command specifies whether the prefix can be used for onlink determination.

Default enabled

preferred-lifetime

Syntax [**no**] **preferred-lifetime** {*seconds* | **infinite**}

Context config>router>router-advert>if

Description This command configures the remaining length of time in seconds that this prefix will continue to be preferred, such as, time until deprecation. The address generated from a deprecated prefix should not be used as a source address in new communications, but packets received on such an interface are processed as expected.

Default 604800

Parameters *seconds* — specifies the remaining length of time in seconds that this prefix will continue to be preferred

infinite — specifies that the prefix will always be preferred. A value of 4,294,967,295 represents infinity

valid-lifetime

Syntax **valid-lifetime** {*seconds* | **infinite**}

Context config>router>router-advert>if

Description This command specifies the length of time in seconds that the prefix is valid for the purpose of on-link determination. A value of all one bits (0xffffffff) represents infinity.

The address generated from an invalidated prefix should not appear as the destination or source address of a packet.

Default 2592000

Parameters *seconds* — specifies the remaining length of time in seconds that this prefix will continue to be valid

infinite — specifies that the prefix will always be valid. A value of 4,294,967,295 represents infinity

reachable-time

Syntax **reachable-time** *milli-seconds*
no reachable-time

Context config>router>router-advert>if

Description This command configures how long this router should be considered reachable by other nodes on the link after receiving a reachability confirmation.

Default no reachable-time

Parameters *milli-seconds* — specifies the length of time the router should be considered reachable

Values 0 to 3600000

retransmit-time

Syntax **retransmit-timer** *milli-seconds*
no retransmit-timer

Context config>router>router-advert>if

Description This command configures the retransmission frequency of neighbor solicitation messages.

Default no retransmit-time

Parameters *milli-seconds* — specifies how often the retransmission should occur

Values 0 to 1800000

router-lifetime

Syntax **router-lifetime** *seconds*
no router-lifetime

Context config>router>router-advert>if

Description This command sets the router lifetime.

Default 1800

Parameters *seconds* — The length of time, in seconds, (relative to the time the packet is sent) that the prefix is valid for route determination.

Values 0, 4 to 9000 seconds. 0 means that the router is not a default router on this link.

use-virtual-mac

Syntax [**no**] **use-virtual-mac**

Context config>router>router-advert>if

Description This command enables sending router advertisement messages using the VRRP virtual MAC address, provided that the virtual router is currently the master.

If the virtual router is not the master, no router advertisement messages are sent.

The **no** form of the command disables sending router advertisement messages.

Default no use-virtual-mac

2.14 Show, Clear, and Debug Command Reference

- Command Hierarchies
- Command Descriptions

2.14.1 Command Hierarchies

- Show Commands
- Clear Commands
- Debug Commands
- Tools Commands

2.14.1.1 Show Commands

The show L2TP commands apply only to the 7750 SR and 7450 ESS.

show
- — **router** [*router-instance*]
- — **router service-name** *service-name*
  - — **aggregate** [*family*] [**active**]
  - — **arp** [*ip-int-name* | *ip-address/mask* | **mac** *ieee-mac-address* | **summary**] [**local** | **dynamic** | **static** | **managed**]
  - — **authentication**
    - — **statistics**
    - — **statistics interface** [*ip-int-name* | *ip-address*]
    - — **statistics policy** *name*
  - — **bfd**
    - — **bfd-template** *template-name*
    - — **interface** [*interface-name*]
    - — **session detail lsp-rsvp** {**head** | **tail**}
    - — **session** {**ipv4** | **ipv6**} **detail** [**lag** *lag-id*] **lag-port** *port-id*
    - — **session lsp-name** *lsp-name*
    - — **session lsp-rsvp** {**head** | **tail**}
    - — **session** {**src** *ip-address*/**link-local** *address* **dest** *ip-address* | **link-local** *address*} **detail lsp-rsvp** {**head** | **tail**} **tunnel-id** *tunnel-id* **lsp-id** *lsp-id*
    - — **session mpls-tp**
    - — **session lsp-name** *lsp-name* [**link-type** {**cc-only** | **cc-cv**}] **detail**
    - — **session p2mp-interface** *interface-name* **detail**
    - — **session src** *ip-address*/**link-local** *address* **detail lsp-rsvp** {**head** | **tail**} **rsvp-session-name** *rsvp-session-name*
    - — **session** [**src** *ip-address*/**link-local** *address*] [**ipv4** | **ipv6**]
    - — **session src** *ip-address*/**link-local** *address* **dest** *ip-address* | **link-local** *address*
    - — **session src** *ip-address*/**link-local** *address* **detail**
    - — **session summary**
    - — **session type** *type* [**ipv4** | **ipv6**]
  - — **dhcp**
    - — **statistics** [*ip-int-name* | *ip-address*]
    - — **summary**
  - — **dhcp6**
    - — **statistics** [*ip-int-name* | *ip-address*]
    - — **summary**
  - — **ecmp**
  - — **fib** *slot-number* [*family*] [*ip-prefix/prefix-length* [**longer**]] [**secondary**]

— **fib** *slot-number* [*family*] **summary**
— **fib** *slot-number nh-table-usage*
— **fp-tunnel-table** *slot-number* [*ip-prefix/prefix-length*]
— **icmp** [**interface** *interface-name*]
— **icmp6** [**interface** *interface-name*]
— **if-attribute**
    — **srlg-group** [*name*]
— **interface** [{[*ip-address* | *ip-int-name*] [**detail**] [*family*]} | **summary** | **exclude-services**]
— **interface** {*ip-address* | *ip-int-name*} **eth-cfm** [**detail**]
— **interface** {*ip-address* | *ip-int-name*} **mac** [*ieee-address*]
— **interface** {*ip-address* | *ip-int-name*} **statistics**
— **interface** **dist-cpu-protection** [**detail**]
— **interface** **policy-accounting** [**class** [*index*]]
— **l2tp**
    — **eth-tunnel** [**group** *tunnel-group-name* [**vc-id** *vc-id*]]
    — **group** [*tunnel-group-name* [**statistics**]]
    — **group** **connection-id** *connection-id* [**detail**]
    — **group** [**detail**] [**session-id** *session-id* (**v2**)] [**state** *session-state*] [**peer** *ip-address*] [**group** *group-name*] [**assignment-id** *assignment-id*] [**local-name** *local-host-name*] [**remote-name** *remote-host-name*] [**tunnel-id** *tunnel-id* (*v2*)]
    — **peer** *ip-address* [**statistics**] [{**udp-port** *port* | **ip**}]
    — **peer** [**draining**] [{**blacklisted** | **selectable** | **unreachable**}]
    — **session** [**detail**] [**state** *session-state*] [**peer** *ip-address*] [**group** *group-name*] [**assignment-id** *assignment-id*] [**local-name** *local-host-name*] [**remote-name** *remote-host-name*] [**control-connection-id** *connection-id* (*v3*)]
    — **statistics**
    — **tunnel** [**statistics**] [**detail**] [**peer** *ip-address*] [**state** *tunnel-state*] [**remote-connection-id** *remote-connection-id* (*v3*)] [**group** *group-name*] [**assignment-id** *assignment-id*] [**local-name** *host-name*] [**remote-name** *host-name*] | **tunnel** [**statistics**] [**detail**] [**peer** *ip-address*] [**state** *tunnel-state*] [**remote-tunnel-id** *remote-tunnel-id* (*v2*)] [**group** *group-name*] [**assignment-id** *assignment-id*] [**local-name** *host-name*] [**remote-name** *host-name*]
    — **tunnel** **tunnel-id** *tunnel-id* (*v2*) [**statistics**] [**detail**]
    — **tunnel** **connection-id** *connection-id* (*v3*) [**statistics**] [**detail**]
— **ldp**
    — **bindings** **active**
— **mvpn**
— **neighbor** [*ip-address* | *ip-int-name* | **mac** *ieee-mac-address* | **summary**]
— **network-domains** [**detail**] [*network-domain-name*]
— **origin-validation**
    — **database** [*family*] [*ip-prefixlip-prefix-length*] [**upto** *prefix-length2*] [**origin-as** *as-number*]
    — **database** [*family*] [*ip-prefixlip-prefix-length*] [**longer**]
    — **database** {**summary**}
    — **database** [*family*] [**static**]
    — **rpki-session** [*ipv4-address*] [**detail**]
— **policy** [*name* | **damping** | **prefix-list** *name* | **as-path** *name* | **community** *name* | **admin**]
— **policy-edits**
— **route-table** [*family*] [*ip-prefix*[**/***prefix-length*] [**longer** | **exact** | **protocol** *protocol-name*] [**all**]] [**next-hop-type** *type*] [**qos**] [**alternative**]
— **route-table** [*family*] **summary**

— **route-table** *tunnel-endpoints* [**ip-prefix**[**/prefix-length**]] [**longer** | **exact**] [**detail**]
— **rtr-advertisement** [**interface** *interface-name*] [**prefix** *ipv6-prefix*[*/prefix-length*] [**conflicts**]
— **service-prefix**
— **sgt-qos**
    — **application** [*app-name*] [**dscp-dot1p**]
    — **dscp-map** [*dscp-name*]
— **static-arp** [*ip-address* | *ip-int-name* | **mac** *ieee-mac-addr*]
— **static-route** [*family*] [[*ip-prefix* **/***mask*] | [**preference** *preference*] | [**next-hop** *ip-address*] | [**tag** *tag*] [**detail**]
— **status**
— **tms** **routes**
— **tunnel-table** **summary** [**ipv4** | **ipv6**]
— **tunnel-table** [**protocol** *protocol*] {**ipv4** | **ipv6**}
— **tunnel-table** [*ip-prefix*[**/***mask*]] [**alternative**] [**ipv4** | **ipv6**] [**detail**]
— **tunnel-table** **mpls-tp**
— **tunnel-table** [*ip-prefix*[**/***mask*]] **protocol** *protocol* [**detail**]
— **tunnel-table** [*ip-prefix*[**/***mask*]] **sdp** *sdp-id*
— **neighbor** [*interface-name*]

2.14.1.2 Clear Commands

clear
- — **router** [*router-instance*]
  - — **arp** {**all** | *ip-addr* | **interface** {*ip-int-name* | *ip-addr*}}
  - — **bfd**
    - — **session** **src-ip** *ip-address* **dst-ip** *ip-address*
    - — **statistics** **src-ip** *ip-address* **dst-ip** *ip-address*
    - — **statistics** **all**
  - — **dhcp**
    - — **statistics** [*ip-int-name* | *ip-address*]
  - — **dhcp6**
    - — **statistics** [*ip-int-name* | *ip-address*]
  - — **forwarding-table** [*slot-number*]
  - — **grt-lookup**
  - — **icmp** **all**
  - — **icmp** **global**
  - — **icmp** **interface** *interface-name*
  - — **icmp-redirect-route** {**all** | *ip-address*}
  - — **icmp6** **all**
  - — **icmp6** **global**
  - — **icmp6** **interface** *interface-name*
  - — **interface** [*ip-int-name* | *ip-addr*] [**icmp**] [**urpf-stats**] [**statistics**]
  - — **l2tp**
    - — **group** *tunnel-group-name*
      - — **statistics**
    - — **statistics**
    - — **tunnel** *tunnel-id*
      - — **statistics**
  - — **neighbor** {**all** | *ip-address*}
  - — **neighbor** [**interface** *ip-int-name* | *ip-address*]
  - — **router-advertisement** **all**
  - — **router-advertisement** [**interface** *interface-name*]
  - — **forwarding-table** [*slot-number*]
  - — **interface** [*ip-int-name* | *ip-addr*] [**icmp**]

2.14.1.3 Debug Commands

debug
- **— trace**
  - **— destination** *trace-destination*
  - **— enable**
  - **—** [**no**] **trace-point** [**module** *module-name*] [**type** *event-type*] [**class** *event-class*] [**task** *task-name*] [**function** *function-name*]
- **— router** *router-instance*
  - **— ip**
    - **—** [**no**] **arp**
    - **— icmp**
    - **— no icmp**
    - **— icmp6** [*ip-int-name*]
    - **— no icmp6**
    - **—** [**no**] **interface** [*ip-int-name* | *ip-address*]
    - **—** [**no**] **neighbor**
    - **— packet** [*ip-int-name* | *ip-address*] [**headers**] [*protocol-id*]
    - **— no packet** [*ip-int-name* | *ip-address*]
    - **— route-table** [*ip-prefix***/***prefix-length*] [**longer**]
    - **— no route-table**
    - **— tunnel-table** [*ip-address*] [**ldp** | **rsvp** [**tunnel-id** *tunnel-id*] | **sdp** [**sdp-id** *sdp-id*]]
  - **— l2tp**
    - **— peer** *ip-address* [{**udp-port** *port* | **ip**}]
  - **— mtrace**
    - **—** [**no**] **misc**
    - **—** [**no**] **packet** [**query** | **request** | **response**]
  - **— tms** [**interface** *tms-interface*] **api** [**detail**] *tms-interface*

2.14.1.4 Tools Commands

tools
— **dump**
— **router**
— **segment-routing**
— **tunnel**
— **perform**
— **router**
— **l2tp**
— **peer** *ip-address* [{**udp-port** *port* | **ip**}]

2.14.2 Command Descriptions

- Show Commands
  - L2TP Show Commands
- Clear Commands
- Debug Commands
- Tools Commands

2.14.2.1 Show Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

router

Syntax **router** [*router-instance*]
router service-name *service-name*

Context show

Description This command enables the context to display various types of information for the specified router instance.

Parameters *router-instance* — specifies the router name, CPM router instance, or VPRN service ID

Values

router-instance : *router name* | *vprn-svc-id*

router-name	Base | management | *cpm-vr-name* | vpls-management
cpm-vr-name	[32 characters maximum]
vprn-svc-id	[1..2147483647]

Default Base

service-name — specifies the service name, up to 64 characters

Output

Sample Output: show router with PIM and S-PMSI

```
*A:Dut-D# \show router 100 pim s-pmsi
===============================================================================
```

```
PIM RSVP Spmsi tunnels
===============================================================================
P2mp  Tunnel ID   Ext Tunnel Adrs       SPMSI Index   Num          State   Multistr
e
ID                                                                              VPN
 SGs                  am-ID
-----------------------------------------------------------------------------------
-----------------------
100   61442       10.20.1.4                     73919         8                  U
p      10
===============================================================================
PIM RSVP Spmsi Interfaces : 1
===============================================================================
*A:Dut-D# \show router 100 pim s-pmsi detail
===============================================================================
PIM RSVP Spmsi tunnels
===============================================================================
P2MP ID             : 100               Tunnel ID         : 61442
Ext Tunnnel Addrs   : 10.20.1.4         Spmsi IfIndex     : 73919
Number of VPN SGs   : 8                 Up Time           : 0d 00:01:04
VPN Group Address   : 232.100.0.0
VPN Source Address  : 100.114.1.2
Up Time             : 0d 00:01:04       Multistream-Id    : 10
State               : TX Joined         Mdt Threshold     : N/A
Join Timer          : N/A               Holddown Timer    : 0d 00:00:54
VPN Group Address   : 232.100.0.1
VPN Source Address  : 100.114.1.2
Up Time             : 0d 00:01:04       Multistream-Id    : 10
State               : TX Joined         Mdt Threshold     : N/A
Join Timer          : N/A               Holddown Timer    : 0d 00:00:55
VPN Group Address   : 232.100.0.2
VPN Source Address  : 100.114.1.2
Up Time             : 0d 00:01:04       Multistream-Id    : 5
State               : TX Joined         Mdt Threshold     : N/A
Join Timer          : N/A               Holddown Timer    : 0d 00:00:53
```

aggregate

Syntax **aggregate** [*family*] [**active**]

Context show>router

Description This command displays aggregate routes.

Parameters *family* — specifies whether IPv4 or IPv6 aggregate routes are displayed

Values ipv4, ipv6

active — When the active keyword is specified, inactive aggregates are filtered out.

Output The following output is an example of aggregate route information.

Sample Output

```
*A:CPM133>config>router# show router aggregate
===============================================================================
```

```
Aggregates (Router: Base)
===============================================================================
Prefix                                               Aggr IP-Address   Aggr AS
   Summary                                             AS Set            State
     NextHop                                          Community        NextHopType
-------------------------------------------------------------------------------
10.0.0.0/8                                            0.0.0.0           0
   False                                                False            Inactive
                                                      100:33           Blackhole
-------------------------------------------------------------------------------
No. of Aggregates: 1
===============================================================================
*A:CPM133>config>router#
```

arp

Syntax **arp** [*ip-int-name* | *ip-address/mask* | **mac** *ieee-mac-address* | **summary**] [**local** | **dynamic** | **static** | **managed**]

Context show>router

Description This command displays the router ARP table sorted by IP address. If no command line options are specified, all ARP entries are displayed.

Parameters *ip-address/mask* — only displays ARP entries associated with the specified IP address and mask

ip-int-name — only displays ARP entries associated with the specified IP interface name

mac *ieee-mac-addr* **—** only displays ARP entries associated with the specified MAC address

summary — displays an abbreviate list of ARP entries

[**local** | **dynamic** | **static** | **managed**] **—** only displays ARP information associated with the keyword

Output **ARP Table Output —** The following output is an example of router ARP table information, and Table 8 describes the ARP table output fields.

Sample Output

```
*B:7710-Red-RR# show router arp
===============================================================================
ARP Table (Router: Base)
===============================================================================
IP Address      MAC Address       Expiry    Type   Interface
-------------------------------------------------------------------------------
10.20.1.24      00:16:4d:23:91:b8 00h00m00s Oth    system
10.10.4.11      00:03:fa:00:d0:c9 00h57m03s Dyn[I] to-core-sr1
10.10.4.24      00:03:fa:41:8d:20 00h00m00s Oth[I] to-core-sr1
-------------------------------------------------------------------------------
No. of ARP Entries: 3
===============================================================================
```

```
A:ALA-A# show router ARP 10.10.0.3
===============================================================================
ARP Table
===============================================================================
IP Address      MAC Address       Expiry      Type Interface
-------------------------------------------------------------------------------
10.10.0.3       04:5d:ff:00:00:00 00:00:00    Oth  system
===============================================================================
A:ALA-A#


A:ALA-A# show router ARP to-ser1
===============================================================================
ARP Table
===============================================================================
IP Address      MAC Address       Expiry      Type Interface
-------------------------------------------------------------------------------

10.10.13.1      04:5b:01:01:00:02 03:53:09    Dyn  to-ser1
===============================================================================
A:ALA-A#
```

Table 8 **ARP Fields**

Label	Description
IP Address	The IP address of the ARP entry.
MAC Address	The MAC address of the ARP entry.
Expiry	The age of the ARP entry.
Type	Dyn The ARP entry is a dynamic ARP entry. Inv The ARP entry is an inactive static ARP entry (invalid). Oth The ARP entry is a local or system ARP entry. Sta The ARP entry is an active static ARP entry.
*Man	The ARP entry is a managed ARP entry.
Int	The ARP entry is an internal ARP entry.
[I}	The ARP entry is in use.
Interface	The IP interface name associated with the ARP entry.
No. of ARP Entries	The number of ARP entries displayed in the list.

authentication

Syntax **authentication**

Context show>router

Description This command enables the command to display authentication statistics.

statistics

Syntax **statistics**
statistics interface [*ip-int-name* | *ip-address*]
statistics policy *name*

Context show>router>authentication

Description This command displays interface or policy authentication statistics.

Parameters **interface** [*ip-int-name* | *ip-address*] **—** specifies an existing interface name or IP address

Values *ip-int-name:* 32 chars max
ip-address: a.b.c.d

policy *name* **—** specifies an existing policy name

Output **Authentication Statistics Output —** The following output is an example of authentication statistics, and Table 9 describes the fields.

Sample Output

```
A:ALU-3>show>router>auth# statistics
===================================================================
Authentication Global Statistics
===================================================================
Client Packets Authenticate Fail      : 0
Client Packets Authenticate Ok        : 12
===================================================================
```

Table 9 **Authentication Statistics Fields**

Label	Description
Client Packets Authenticate Fail	The number of packets that failed authentication.
Client Packets Authenticate Ok	The number of packets that were authenticated.

bfd

Syntax **bfd**

Context show>router

Description This command enables the context to display bi-directional forwarding detection (BFD) information.

Output The following output is an example of BFD information.

Sample Output

```
*A:Dut-D# show router 3 bfd session
===============================================================================
BFD Session
===============================================================================
InterfaceState                 Tx Intvl  Rx Intvl  Multipl
  Remote Address              Protocols            Tx Pkts   Rx Pkts   Type
-------------------------------------------------------------------------------
ies-3-121.1.3.3               Up (3)               10        10        3
   121.1.3.2                  ospf2                N/A       N/A       cpm-np
ies-3-122.1.4.3               Up (3)               100       100       3
   122.1.4.2                  pim                  455       464       iom
-------------------------------------------------------------------------------
No. of BFD sessions: 2
===============================================================================
*A:Dut-D#


*A:Dut-C# show router bfd session src 11.120.1.4 dest 11.120.1.3
===============================================================================
BFD Session
===============================================================================
Remote Address : 11.120.1.3
Admin State    : Up                      Oper State       : Up (3)
Protocols      : static
Rx Interval    : 10                      Tx Interval      : 10
Multiplier     : 3                       Echo Interval    : 0
Up Time        : 1d 19:03:28             Up Transitions   : 2
Down Time      : None                    Down Transitions : 1
                                         Version Mismatch : 0
Forwarding Information
Local Discr    : 19269                   Local State      : Up (3)
Local Diag     : 0 (None)                Local Mode       : Async
Local Min Tx   : 10                      Local Mult       : 3
Last Sent (ms) : 6                       Local Min Rx     : 10
Type           : cpm-np
Remote Discr   : 5101                    Remote State     : Up (3)
Remote Diag    : 0 (None)                Remote Mode      : Async
Remote Min Tx  : 1000                    Remote Mult      : 3
Last Recv (ms) : 367                     Remote Min Rx    : 10
===============================================================================
*A:Dut-C#
```

bfd-template

Syntax **bfd-template** *template-name*

Context show>router>bfd

Description This command displays BFD template information.

Output The following output is an example of BFD template information.

Sample Output

```
*A:mlstp-dutA# show router bfd bfd-template "privatebed-bfd-template"

===============================================================================
BFD Template privatebed-bfd-template
===============================================================================
Template Name          : privatebed-* Template Type            : cpmNp
Transmit Timer         : 10 msec      Receive Timer            : 10 msec
CV Transmit Interval   : 1000 msec
Template Multiplier    : 3            Echo Receive Interval    : 100 msec

Mpls-tp Association
privatebed-oam-template
===============================================================================
* indicates that the corresponding row element may have been truncated.
*A:mlstp-dutA# show router bfd session

===============================================================================
BFD Session
===============================================================================
Interface/Lsp Name           State                 Tx Intvl  Rx Intvl  Multipl
  Remote Address/Info        Protocols             Tx Pkts   Rx Pkts   Type
-------------------------------------------------------------------------------
wp::lsp-32                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
wp::lsp-33                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
wp::lsp-34                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
wp::lsp-35                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
wp::lsp-36                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
wp::lsp-37                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
wp::lsp-38                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
wp::lsp-39                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
wp::lsp-40                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
wp::lsp-41                   Down (1)              1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
pp::lsp-32                   Up (3)                1000      1000      3
    0::0.0.0.0               mplsTp                N/A       N/A       cpm-np
pp::lsp-33                   Up (3)                1000      1000      3
```

```
    0::0.0.0.0                 mplsTp              N/A       N/A       cpm-np
pp::lsp-34                     Up (3)              1000      1000      3
    0::0.0.0.0                 mplsTp              N/A       N/A       cpm-np
pp::lsp-35                     Up (3)              1000      1000      3
    0::0.0.0.0                 mplsTp              N/A       N/A       cpm-np
pp::lsp-36                     Up (3)              1000      1000      3
    0::0.0.0.0                 mplsTp              N/A       N/A       cpm-np
pp::lsp-37                     Up (3)              1000      1000      3
    0::0.0.0.0                 mplsTp              N/A       N/A       cpm-np
pp::lsp-38                     Up (3)              1000      1000      3
    0::0.0.0.0                 mplsTp              N/A       N/A       cpm-np
pp::lsp-39                     Up (3)              1000      1000      3
    0::0.0.0.0                 mplsTp              N/A       N/A       cpm-np
pp::lsp-40                     Up (3)              1000      1000      3
    0::0.0.0.0                 mplsTp              N/A       N/A       cpm-np
pp::lsp-41                     Up (3)              1000      1000      3
    0::0.0.0.0                 mplsTp              N/A       N/A       cpm-np
-------------------------------------------------------------------------------
No. of BFD sessions: 20
-------------------------------------------------------------------------------
wp = Working path   pp = Protecting path
===============================================================================
```

interface

Syntax **interface** [*interface-name*]

Context show>router>bfd

Description This command displays interface information.

Output The following output is an example of BFD interface information, and Table 10 describes the fields.

Sample Output

```
*A:Dut-B# show router bfd interface
===============================================================================
BFD Interface
===============================================================================
Interface name                     Tx Interval    Rx Interval    Multiplier
-------------------------------------------------------------------------------
port-1-1                           500            500            3
port-1-1                           10             10             3
port-1-2                           500            500            3
port-1-2                           10             10             3
port-1-3                           500            500            3
port-1-3                           10             10             3
port-1-4                           500            500            3
port-1-4                           10             10             3
port-1-5                           500            500            3
...
===============================================================================
```

Table 10 **BFD Interface Fields**

Label	**Description**
TX Interval	Displays the interval, in milliseconds, between the transmitted BFD messages to maintain the session
RX Interval	Displays the expected interval, in milliseconds, between the received BFD messages to maintain the session
Multiplier	Displays the integer used by BFD to declare when the neighbor is down.

session

Syntax
session detail lsp-rsvp {**head** | **tail**}
session {**ipv4** | **ipv6**} **detail** [**lag** *lag-id*] **lag-port** *port-id*
session lsp-name *Lsp Name*
session lsp-rsvp {**head** | **tail**}
session src *ip-address*/**link-local** *address* **dest** *ip-address* | **link-local** *address* **detail lsp-rsvp** {**head** | **tail**} **tunnel-id** *tunnel-id* **lsp-id** *lsp-id*
session mpls-tp
session lsp-name *Lsp Name* [**link-type** {**cc-only** | **cc-cv**}] **detail**
session p2mp-interface *interface-name* **detail**
session src *ip-address*/**link-local** *address* **detail lsp-rsvp** {**head** | **tail**} **rsvp-session-name** *rsvp-session-name*
session [**src** *ip-address*/**link-local** *address*] [**ipv4** | **ipv6**]
session src *ip-address*/**link-local** *address* **dest** *ip-address* | **link-local** *address*
session src *ip-address*/**link-local** *address* **detail**
session summary
session type *type* [**ipv4** | **ipv6**]

Context show>router>bfd

Description This command displays session information.

Parameters *ip-address* — only displays the interface information associated with the specified IP address

Values ipv4-address: a.b.c.d (host bits must be 0)

type — specifies the session type

Values iom | central | cpm-np

Output The following output is an example of BFD session information, and Table 11 describes the fields.

Sample Output

```
A:Dut-B# show router bfd session
===============================================================================
BFD Session
===============================================================================
Interface                     State                 Tx Intvl  Rx Intvl  Multipl
  Remote Address              Protocols             Tx Pkts   Rx Pkts   Type
-------------------------------------------------------------------------------
port-1-1                      Up (3)                500       500       3
   10.1.1.3                   pim isis              50971     50718     iom
port-1-1                      Up (3)                10        10        3
   3FFE::A01:103              static bgp            N/A       N/A       cpm-np
port-1-1                      Up (3)                10        10        3
   FE80::A0A:A03              pim isis ospf3        N/A       N/A       cpm-np
port-1-2                      Up (3)                500       500       3
   10.2.1.3                   pim isis              50968     50718     iom
port-1-2                      Up (3)                10        10        3
   3FFE::A02:103              static bgp            N/A       N/A       cpm-np
port-1-2                      Up (3)                10        10        3
...
===============================================================================
*A:Dut-B#


A:Dut-B# show router bfd session src  3FFE::A01:102 dest  3FFE::A01:103
===============================================================================
BFD Session
===============================================================================
Remote Address : 3FFE::A01:103
Admin State    : Up                         Oper State       : Up (3)
Protocols      : static bgp
Rx Interval    : 10                         Tx Interval      : 10
Multiplier     : 3                          Echo Interval    : 0
Up Time        : 0d 07:24:54                Up Transitions   : 1
Down Time      : None                       Down Transitions : 0
                                            Version Mismatch : 0
Forwarding Information
Local Discr    : 2051                       Local State      : Up (3)
Local Diag     : 0 (None)                   Local Mode       : Async
Local Min Tx   : 10                         Local Mult       : 3
Last Sent (ms) : 5                          Local Min Rx     : 10
Type           : cpm-np
Remote Discr   : 1885                       Remote State     : Up (3)
Remote Diag    : 0 (None)                   Remote Mode      : Async
Remote Min Tx  : 10                         Remote Mult      : 3
Last Recv (ms) : 1                          Remote Min Rx    : 10
===============================================================================
A:Dut-B#


*A:Dut-B# show router bfd session src FE80::A0A:A02-port-1-10 dest FE80::A0A:A03-
port-1-10
===============================================================================
BFD Session
===============================================================================
Remote Address : FE80::A0A:A03
Admin State    : Up                         Oper State       : Up (3)
Protocols      : pim isis ospf3
Rx Interval    : 10                         Tx Interval      : 10
Multiplier     : 3                          Echo Interval    : 0
```

```
Up Time         : 0d 07:10:20            Up Transitions   : 3
Down Time       : None                   Down Transitions : 2
                                         Version Mismatch : 0
Forwarding Information
Local Discr     : 42                     Local State      : Up (3)
Local Diag      : 3 (Neighbor signalled s* Local Mode     : Async
Local Min Tx    : 10                     Local Mult       : 3
Last Sent (ms)  : 6                      Local Min Rx     : 10
Type            : cpm-np
Remote Discr    : 270                    Remote State     : Up (3)
Remote Diag     : 0 (None)               Remote Mode      : Async
Remote Min Tx   : 10                     Remote Mult      : 3
Last Recv (ms)  : 8                      Remote Min Rx    : 10
===============================================================================
* indicates that the corresponding row element may have been truncated.
*A:Dut-D#


*A:Dut-B# show router bfd session ipv4
===============================================================================
BFD Session
===============================================================================
Interface                     State                 Tx Intvl  Rx Intvl  Multipl
  Remote Address              Protocols             Tx Pkts   Rx Pkts   Type
-------------------------------------------------------------------------------
port-1-1                      Up (3)                500       500       3
   10.1.1.3                   pim isis              51532     51279     iom
port-1-2                      Up (3)                500       500       3
   10.2.1.3                   pim isis              51529     51279     iom
port-1-3                      Up (3)                500       500       3
   10.3.1.3                   pim isis              51529     51279     iom
port-1-4                      Up (3)                500       500       3
   10.4.1.3                   pim isis              51529     51279     iom
port-1-5                      Up (3)                500       500       3
   10.5.1.3                   pim isis              51529     51279     iom
port-1-6                      Up (3)                500       500       3
   10.6.1.3                   pim isis              51529     51279     iom
...
===============================================================================
*A:Dut-B#


*A:Dut-B# show router bfd session ipv6
===============================================================================
BFD Session
===============================================================================
Interface                     State                 Tx Intvl  Rx Intvl  Multipl
  Remote Address              Protocols             Tx Pkts   Rx Pkts   Type
-------------------------------------------------------------------------------
port-1-1                      Up (3)                10        10        3
   3FFE::A01:103              static bgp            N/A       N/A       cpm-np
port-1-1                      Up (3)                10        10        3
   FE80::A0A:A03              pim isis ospf3        N/A       N/A       cpm-np
port-1-2                      Up (3)                10        10        3
   3FFE::A02:103              static bgp            N/A       N/A       cpm-np
port-1-2                      Up (3)                10        10        3
   FE80::A0A:A03              pim isis ospf3        N/A       N/A       cpm-np
port-1-3                      Up (3)                10        10        3
   3FFE::A03:103              static bgp            N/A       N/A       cpm-np
```

```
port-1-3                      Up (3)              10        10        3
   FE80::A0A:A03              pim isis ospf3      N/A       N/A       cpm-np
port-1-4                      Up (3)              10        10        3
   3FFE::A04:103              static bgp          N/A       N/A       cpm-np
port-1-4                      Up (3)              10        10        3
...
===============================================================================
*A:Dut-B#


*A:Dut-D# show router bfd session summary
=============================
BFD Session Summary
=============================
Termination   Session Count
-----------------------------
central                    0
cpm-np                   500
iom, slot 1                0
iom, slot 2                0
iom, slot 3              250
iom, slot 4                0
iom, slot 5                0

Total                    750
=============================
*A:Dut-D#


*A:Dut-B# show router bfd session detail lsp-
rsvp head src 10.20.1.2 dest 10.20.1.5 tunnel-id 1 lsp-id 31744
===============================================================================
BFD On LSP Session
===============================================================================
Rsvp Session Name : lsp1::path1
Remote Address : 10.20.1.5
Lsp Id         : 31744                    Tunnel Id         : 1
Oper State     : Up                       Protocols         : lsp
Recd Msgs      : 240                      Sent Msgs         : 240
Up Time        : 0d 00:03:58              Up Transitions    : 1
Down Time      : None                     Down Transitions : 0
                                          Version Mismatch : 0

Forwarding Information

Local Discr    : 1                        Local State       : Up
Local Diag     : 0 (None)
Local Mode     : Async
Local Min Tx   : 1000                     Local Mult        : 3
Last Sent      : 07/28/2015 19:05:13      Local Min Rx      : 1000
Type           : central
Remote Discr   : 1                        Remote State      : Up
Remote Diag    : 0 (None)                 Remote Mode       : Async
Remote Min Tx  : 1000                     Remote Mult       : 3
Last Recv      : 07/28/2015 19:05:13      Remote Min Rx     : 1000
===============================================================================
===============================================================================
```

Table 11 **BFD Session Field Descriptions**

Label	Description
State	Displays the administrative state for this BFD session.
Protocol	Displays the active protocol.
Tx Intvl	Displays the interval, in milliseconds, between the transmitted BFD messages to maintain the session
Tx Pkts	Displays the number of transmitted BFD packets.
Rx Intvl	Displays the expected interval, in milliseconds, between the received BFD messages to maintain the session
Rx Pkts	Displays the number of received packets.
Mult	Displays the integer used by BFD to declare when the neighbor is down.

dhcp

Syntax **dhcp**

Context show>router

Description This command enables the context to display DHCP related information.

dhcp6

Syntax **dhcp6**

Context show>router

Description This command enables the context to display DHCP6 related information.

statistics

Syntax **statistics** [*ip-int-name* **|** *ip-address*]

Context show>router>dhcp
show>router>dhcp6

Description This command displays statistics for DHCP relay and DHCP snooping.

If no IP address or interface name is specified, then all configured interfaces are displayed.

If an IP address or interface name is specified, then only data regarding the specified interface is displayed.

Parameters *ip-int-name* | *ip-address* — displays statistics for the specified IP interface

Output The following output is an example of DHCP statistics information, and Table 12 describes the output fields.

Sample Output

```
A:ALA-1# show router dhcp6 statistics
===========================================================================
DHCP6 statistics (Router: Base)
===========================================================================
Msg-type                      Rx             Tx             Dropped
---------------------------------------------------------------------------
1 SOLICIT                     0              0              0
2 ADVERTISE                   0              0              0
3 REQUEST                     0              0              0
4 CONFIRM                     0              0              0
5 RENEW                       0              0              0
6 REBIND                      0              0              0
7 REPLY                       0              0              0
8 RELEASE                     0              0              0
9 DECLINE                     0              0              0
10 RECONFIGURE                0              0              0
11 INFO_REQUEST               0              0              0
12 RELAY_FORW                 0              0              0
13 RELAY_REPLY                0              0              0
---------------------------------------------------------------------------
Dhcp6 Drop Reason Counters :
---------------------------------------------------------------------------
 1 Dhcp6 oper state is not Up on src itf                         0
 2 Dhcp6 oper state is not Up on dst itf                         0
 3 Relay Reply Msg on Client Itf                                 0
 4 Hop Count Limit reached                                       0
 5 Missing Relay Msg option, or illegal msg type                 0
 6 Unable to determine destination client Itf                   0
 7 Out of Memory                                                 0
 8 No global Pfx on Client Itf                                   0
 9 Unable to determine src Ip Addr                               0
10 No route to server                                            0
11 Subscr. Mgmt. Update failed                                   0
12 Received Relay Forw Message                                   0
13 Packet too small to contain valid dhcp6 msg                   0
14 Server cannot respond to this message                         0
15 No Server Id option in msg from server                        0
16 Missing or illegal Client Id option in client msg             0
17 Server Id option in client msg                                0
18 Server DUID in client msg does not match our own              0
19 Client sent message to unicast while not allowed              0
20 Client sent message with illegal src Ip address               0
21 Client message type not supported in pfx delegation           0
22 Nbr of addrs or pfxs exceeds allowed max (128) in msg         0
23 Unable to resolve client's mac address                        0
24 The Client was assigned an illegal address                    0
25 Illegal msg encoding                                          0
```

```
===============================================================================
A:ALA-1#
```

Table 12   DHCP Statistics Fields

Label	Description
Received Packets	The number of packets received from the DHCP clients.
Transmitted Packets	The number of packets transmitted to the DHCP clients.
Received Malformed Packets	The number of malformed packets received from the DHCP clients.
Received Untrusted Packets	The number of untrusted packets received from the DHCP clients.
Client Packets Discarded	The number of packets received from the DHCP clients that were discarded.
Client Packets Relayed	The number of packets received from the DHCP clients that were forwarded.
Client Packets Snooped	The number of packets received from the DHCP clients that were snooped.
Server Packets Discarded	The number of packets received from the DHCP server that were discarded.
Server Packets Relayed	The number of packets received from the DHCP server that were forwarded.
Server Packets Snooped	The number of packets received from the DHCP server that were snooped.

summary

Syntax **summary**

Context show>router>dhcp

Description Display the status of the DHCP Relay and DHCP Snooping functions on each interface.

Output The following output is an example of DHCP summary information, and Table 13 describes the output fields for DHCP summary.

Sample Output

```
A:ALA-1# show router dhcp summary
===============================================================================
DHCP6 Summary (Router: Base)
```

```
===============================================================================
Interface Name                    Nbr      Used/Max Relay     Admin  Oper Relay
  SapId                           Resol.   Used/Max Server    Admin  Oper Server
-------------------------------------------------------------------------------
interfaceServiceDefault           No          0/0             Up     NoServerCo*
  sap:1/2/12:1                                0/8000          Up     Up
interfaceService                  No          0/0             Down   Down
  sap:1/2/1                                   0/8000          Down   Down
interfaceServiceNonDefault        No          0/0             Up     NoServerCo*
  sap:1/2/12:2                                0/8000          Down   Down
ip-61.4.113.4                     Yes       575/8000          Up     Up
  sap:1/1/1:1                               580/8000          Up     Up
==============================================================================
A:ALA-1#
```

Table 13 **DHCP Summary Field Descriptions**

Label	Description
Interface Name	Name of the router interface.
Info Option	Indicates whether Option 82 processing is enabled on the interface.
Auto Filter	Indicates whether IP Auto Filter is enabled on the interface.
Snoop	Indicates whether Auto ARP table population is enabled on the interface.
Interfaces	Indicates the total number of router interfaces on the router.

ecmp

Syntax **ecmp**

Context show>router

Description This command displays the ECMP settings for the router.

Output The following output is an example of ECMP settings information, and Table 14 describes the output fields for the router ECMP settings.

Sample Output

```
A:ALA-A# show router ecmp
===============================================================================
Router ECMP
===============================================================================
Instance       Router Name                      ECMP    Configured-ECMP-Routes
-------------------------------------------------------------------------------
1              Base                             True    8
===============================================================================
A:ALA-A#
```

```
*A:Dut-C# show router ecmp

===============================================================================
Router ECMP
===============================================================================
Instance       Router Name                      ECMP    Max-ECMP-   Weight ECMP
                                                        Rtes
-------------------------------------------------------------------------------
1              Base                             True    32          True
===============================================================================
```

Table 14 **ECMP Fields**

Label	**Description**
Instance	The router instance number.
Router Name	The name of the router instance.
ECMP	False ECMP is disabled for the instance.
	True ECMP is enabled for the instance.
Configured-ECMP-Routes	The number of ECMP routes configured for path sharing.

fib

Syntax **fib** *slot-number* [*family*] [*ip-prefix/prefix-length*] [**longer**] [**secondary**] [**exclude-services**]
fib *slot-number* [*family*] **summary**
fib *slot-number* **nh-table-usage**

Context show>router

Description This command displays the active FIB entries for a specific IOM or linecard.

Parameters *slot-number* — displays routes only matching the specified chassis slot number

Default all IOMs

Values 1 to 10

family — displays the router IP interface table to display

Values **ipv4** — displays only those peers that have the IPv4 family enabled
ipv6 — displays the peers that are IPv6-capable

ip-prefix/prefix-length — displays FIB entries only matching the specified *ip-prefix* and length

Values The following values apply to the 7450 ESS:

ipv4-prefix:	a.b.c.d (host bits must be 0)
ipv4-prefix-length:	0 to 32

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-prefix:	a.b.c.d (host bits must be 0)
ipv4-prefix-length:	0 to 32
ipv6-prefix:	x:x:x:x:x:x:x:x (eight 16-bit pieces) x:x:x:x:x:x:d.d.d.d x: [0 to FFFF]H d: [0 to 255]D
ipv6-prefix-length:	0 to 128

longer — displays FIB entries matching the *ip-prefix/mask* and routes with longer masks

secondary — displays secondary VRF ID information

summary — displays summary FIB information for the specified slot number

nh-table-usage — displays next-hop table usage

Output The following output is an example of FIB information.

Sample Output

```
show router fib 1 131.132.133.134/32
========================================================================
FIB Display
========================================================================
Prefix                                                          Protocol
    NextHop
------------------------------------------------------------------------
131.132.133.134/32                                              OSPF
    66.66.66.66 (loop7)
    Next-hop type: tunneled, Owner: RSVP, Tunnel-ID: <out-ifindex-from-route>
------------------------------------------------------------------------
Total Entries : 1
------------------------------------------------------------------------
========================================================================

*A:Dut-C# show router fib 1 1.1.1.1/32
===============================================================================
FIB Display
===============================================================================
Prefix                                                          Protocol
    NextHop
-------------------------------------------------------------------------------
1.1.1.1/32                                                      BGP
    10.20.1.1 (Transport:RSVP LSP:1)
-------------------------------------------------------------------------------
Total Entries : 1
-------------------------------------------------------------------------------
```

```
===============================================================================
*A:Dut-C# show router fib 1
===============================================================================
FIB Display
===============================================================================
Prefix                                                      Protocol
    NextHop
-------------------------------------------------------------------------------
1.1.2.0/24                                                  ISIS
    1.1.3.1 (to_Dut-A)
    1.2.3.2 (to_Dut-B)
1.1.3.0/24                                                  LOCAL
    1.1.3.0 (to_Dut-A)
1.1.9.0/24                                                  ISIS
    1.1.3.1 (to_Dut-A)
1.2.3.0/24                                                  LOCAL
    1.2.3.0 (to_Dut-B)
1.2.9.0/24                                                  ISIS
    1.2.3.2 (to_Dut-B)
10.12.0.0/24                                                LOCAL
    10.12.0.0 (itfToArborCP_02)
10.20.1.1/32                                                ISIS
    1.1.3.1 (to_Dut-A)
10.20.1.2/32                                                ISIS
    1.2.3.2 (to_Dut-B)
10.20.1.3/32                                                LOCAL
    10.20.1.3 (system)
20.12.0.43/32                                               STATIC
    vprn1:mda-1-1
20.12.0.44/32                                               STATIC
    vprn1:mda-2-1
20.12.0.45/32                                               STATIC
    vprn1:mda-2-2
20.12.0.46/32                                               STATIC
    vprn1:mda-3-1
100.0.0.1/32                                                TMS
    vprn1:mda-1-1
    vprn1:mda-3-1
138.203.71.202/32                                           STATIC
    10.12.0.2 (itfToArborCP_02)
-------------------------------------------------------------------------------
Total Entries : 15
-------------------------------------------------------------------------------
===============================================================================


*A:Dut-C>config>router>mpls>lsp# show router fib 1 5.3.0.1/32 extensive

===============================================================================
FIB Display (Router: Base)
===============================================================================
Dest Prefix             : 5.3.0.1/32
  Protocol              : BGP
  Indirect Next-Hop     : 10.0.0.1
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    ECMP-Weight         : 1
    Resolving Next-Hop  : 1.0.0.2 (RSVP tunnel:115)
      ECMP-Weight       : 1
```

```
    Resolving Next-Hop  : 1.0.0.2 (RSVP tunnel:61443)
      ECMP-Weight       : 1
  Indirect Next-Hop     : 10.0.0.2
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    ECMP-Weight         : 30
    Resolving Next-Hop  : 1.0.0.3 (RSVP tunnel:94)
      ECMP-Weight       : 20
    Resolving Next-Hop  : 1.0.0.3 (RSVP tunnel:61442)
      ECMP-Weight       : 1
===============================================================================
Total Entries : 1
===============================================================================
*A:Dut-C> show router fib 1 10.0.0.2/32 extensive

===============================================================================
FIB Display (Router: Base)
===============================================================================
Dest Prefix             : 10.0.0.2/32
  Protocol              : OSPF
  Next-Hop              : 1.0.0.3 (RSVP tunnel:94)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    ECMP-Weight         : 20
  Next-Hop              : 1.0.0.3 (RSVP tunnel:61442)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    ECMP-Weight         : 1
===============================================================================
Total Entries : 1
===============================================================================

*A:Dut-C> show router route-table 10.1.0.5/32 extensive
===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix             : 10.1.0.5/32
  Protocol              : STATIC
  Age                   : 00h01m37s
  Preference            : 5
  Next-Hop              : 1.0.0.2 (RSVP tunnel:128)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 1
    ECMP-Weight         : 10
  Next-Hop              : 1.0.0.2 (RSVP tunnel:132)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 1
    ECMP-Weight         : 1
-------------------------------------------------------------------------------
No. of Destinations: 1
===============================================================================
```

```
*A:Dut-C> show router fib 1 10.1.0.5/32 extensive

===============================================================================
FIB Display (Router: Base)
===============================================================================
Dest Prefix             : 10.1.0.5/32
  Protocol              : STATIC
  Next-Hop              : 1.0.0.2 (RSVP tunnel:128)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    ECMP-Weight         : 10
  Next-Hop              : 1.0.0.2 (RSVP tunnel:132)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    ECMP-Weight         : 1
===============================================================================
Total Entries : 1
===============================================================================


*A:Dut-B# show router fib 1 10.15.1.0/24

===============================================================================
FIB Display
===============================================================================
Prefix [Flags]                                              Protocol
  NextHop
-------------------------------------------------------------------------------
10.15.1.0/24                                                BGP
  10.20.1.3 (Transport:SR)
-------------------------------------------------------------------------------
Total Entries : 1
-------------------------------------------------------------------------------
===============================================================================


*A:Dut-B# show router fib 1 10.15.1.0/24 extensive
===============================================================================
FIB Display (Router: Base)
===============================================================================
Dest Prefix             : 10.15.1.0/24
  Protocol              : BGP
  Installed             : Y
  Indirect Next-Hop     : 10.20.1.3
    Label               : 262123
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    ECMP-Weight         : 1
    Resolving Next-Hop  : 10.20.1.3 (SR tunnel)
      ECMP-Weight       : 1
===============================================================================
Total Entries : 1
===============================================================================
```

fp-tunnel-table

Syntax **fp-tunnel-table** *slot-number* [*ip-prefix/prefix-length*]

Context show>router

Description This command displays the IOM/IMM label, next-hop and outgoing interface information for BGP, LDP and RSVP tunnels used in any of the following applications:

- BGP shortcut (**configure>router>bgp>next-hop-resolution>shortcut-tunnel**)
- IGP shortcut (**config>router>isis**[**ospf**]**>rsvp-shortcut**)
- IGP prefix resolved to an LDP LSP (**config>router>ldp-shortcut**)
- Static route resolved to a LDP or RSVP LSP
- VPRN auto-bind
- 6PE/6VPE.

Parameters *slot-number* — displays information for the specified slot

Values 1 to 10

ip-prefix[*/prefix-length*] **—** displays routes only matching the specified *ip-address* and length

Values

ipv4-prefix:	a.b.c.d (host bits must be set to 0)	
ipv4-prefix-length:	0 to 32	
ipv6	ipv6-prefix[/pref*:	x:x:x:x:x:x:x:x (eight 16-bit pieces)
		x:x:x:x:x:x:d.d.d.d
		x: [0 to FFFF]H
		d: [0 to 255]D
	prefix-length:	1 to 128

Output The following output is an example of router FP tunnel information.

Sample Output

```
*A:Dut-B# show router fp-tunnel-table 1 10.20.1.3/32
===============================================================================
Tunnel Table Display

Legend:
B - FRR Backup
===============================================================================
Destination                                           Protocol   Tunnel-ID
       Lbl               NextHop           Intf/Tunnel
-------------------------------------------------------------------------------
10.20.1.3/32                                          LDP         -
       262137            10.2.1.3          1/1/3:1
```

```
10.20.1.3/32                                              RSVP        1
       262133           10.2.1.3         1/1/3:1
10.20.1.3/32                                              SR-ISIS-0   -
       18602            10.2.1.3         1/1/3:1
10.20.1.3/32                                              SR-OSPF-0   -
       19102            10.2.1.3         1/1/3:1
-------------------------------------------------------------------------------
Total Entries : 4
-------------------------------------------------------------------------------
===============================================================================
*A:Dut-B#


*A:Dut-C# show router fp-tunnel-table 1
===============================================================================
Tunnel Table Display

Legend:
B - FRR Backup
===============================================================================
Destination                                               Protocol   Tunnel-ID
       Lbl              NextHop          Intf/Tunnel
-------------------------------------------------------------------------------
4.0.0.1/32                                                SR-ISIS-0   -
       20001            1.3.4.4          2/1/3:1
       20001/21005      1.2.3.2(B)       1/1/2
10.20.1.2/32                                              SR-ISIS-0   -
       21002            1.2.3.2          1/1/2
       21002/21005      1.3.4.4(B)       2/1/3:1
10.20.1.4/32                                              SR-ISIS-0   -
       21004            1.3.4.4          2/1/3:1
       21004/21005      1.2.3.2(B)       1/1/2
10.20.1.5/32                                              SR-ISIS-0   -
       21005            1.2.3.2          1/1/2
       21005            1.3.4.4(B)       2/1/3:1
-------------------------------------------------------------------------------
Total Entries : 4
-------------------------------------------------------------------------------
===============================================================================
*A:Dut-C#


*A:Dut-C# show router fp-tunnel-table 1
===============================================================================
Tunnel Table Display

Legend:
B - FRR Backup
===============================================================================
Destination                                               Protocol   Tunnel-ID
       Lbl              NextHop          Intf/Tunnel
-------------------------------------------------------------------------------
1.1.3.1/32                                                SR          -
       3                1.1.3.1          1/1/1
1.2.3.2/32                                                SR          -
       3                1.2.3.2          1/1/2:1
1.3.5.5/32                                                SR          -
       3                1.3.5.5          2/1/1
2.2.3.2/32                                                SR          -
```

```
       3                 2.2.3.2          1/1/2:2
10.20.1.1/32                                              SR-OSPF-0   -
       21011             1.1.3.1          1/1/1
       22011             1.2.3.2(B)       1/1/2:1
10.20.1.2/32                                              SR-OSPF-0   -
       22022             2.2.3.2          1/1/2:2
       24022/25044       1.3.5.5(B)       2/1/1
10.20.1.4/32                                              SR-OSPF-0   -
       25044             1.3.5.5          2/1/1
       22044             2.2.3.2          1/1/2:2
10.20.1.5/32                                              SR-OSPF-0   -
       25055             1.3.5.5          2/1/1
       24055/22044       2.2.3.2(B)       1/1/2:2
10.20.1.6/32                                              SR-OSPF-0   -
       25066             1.3.5.5          2/1/1
       24066/22044       2.2.3.2(B)       1/1/2:2
-------------------------------------------------------------------------------
Total Entries : 9
-------------------------------------------------------------------------------
===============================================================================
*A:Dut-C#

*A:Dut-F# show router fp-tunnel-table 1
===============================================================================
Tunnel Table Display
Legend:
B - FRR Backup
===============================================================================
Destination                                               Protocol   Tunnel-ID
    Lbl                  NextHop          Intf/Tunnel
-------------------------------------------------------------------------------
1.0.11.1/32                                               SR-OSPF-0   -
  30004                  1.0.26.2           1/1/3:1
  40004                  1.0.36.3(B)        1/1/4:1
1.0.22.2/32                                               SR-OSPF-0   -
  30005                  1.0.26.2           1/1/3:1
  20005/40004            1.0.36.3(B)        1/1/4:1
1.0.26.2/32                                               SR          -
  3                      1.0.26.2           1/1/3:1
  50011/60001            1.0.56.5(B)        1/1/2:1
1.0.26.2/32                                               SR          -
  3                      1.0.26.2           1/1/3:1
  20005/40004            1.0.36.3(B)        1/1/4:1
1.0.33.3/32                                               SR-OSPF-0   -
  40000                  1.0.36.3           1/1/4:1
  30998                  1.0.26.2(B)        1/1/3:1
1.0.36.3/32                                               SR          -
  3                      1.0.36.3           1/1/4:1
1.0.44.4/32                                               SR-OSPF-0   -
  30001                  1.0.26.2           1/1/3:1
  60001                  1.0.56.5(B)        1/1/2:1
1.0.55.5/32                                               SR-OSPF-0   -
  60002                  1.0.56.5           1/1/2:1
  30995                  1.0.26.2(B)        1/1/3:1
1.0.56.5/32                                               SR          -
  3                      1.0.56.5           1/1/2:1
10.20.1.1/32                                              SR-OSPF-0   -
  30010                  1.0.26.2           1/1/3:1
  40010                  1.0.36.3(B)        1/1/4:1
```

```
10.20.1.2/32                                                SR-OSPF-0    -
  30011                   1.0.26.2          1/1/3:1
  50011/60001             1.0.56.5(B)       1/1/2:1
10.20.1.3/32                                                SR-OSPF-0    -
  40006                   1.0.36.3          1/1/4:1
  20006/30004             1.0.26.2(B)       1/1/3:1
10.20.1.4/32                                                SR-OSPF-0    -
  30007                   1.0.26.2          1/1/3:1
  60007                   1.0.56.5(B)       1/1/2:1
10.20.1.5/32                                                SR-OSPF-0    -
  60008                   1.0.56.5          1/1/2:1
  50008/30001             1.0.26.2(B)       1/1/3:1
-------------------------------------------------------------------------------
Total Entries : 14
-------------------------------------------------------------------------------
===============================================================================
*A:Dut-F#


*A:Dut-C# show router  fp-tunnel-table 1 10.20.1.5/32
===============================================================================
Tunnel Table Display
Legend:
B - FRR Backup
===============================================================================
Destination                                                 Protocol   Tunnel-ID
    Lbl                   NextHop           Intf/Tunnel
-------------------------------------------------------------------------------
10.20.1.5/32                                                LDP          -
  262135                  10.10.5.5           2/1/1
  3                       10.20.1.5(B)      SR
10.20.1.5/32                                                SR-ISIS-0    -
  474390                  10.10.5.5           2/1/1
  474390/474389           10.10.12.2(B)       lag-1
-------------------------------------------------------------------------------
Total Entries : 2
-------------------------------------------------------------------------------
===============================================================================
```

icmp

Syntax **icmp** [**interface** *interface-name*]

Context show>router

Description This command displays Internet Control Message Protocol version 4 (ICMP) statistics. ICMP generates error messages (for example, ICMP destination unreachable messages) to report errors during processing and other diagnostic functions.

Parameters *interface-name* — specifies an existing IP interface name.

Values up to 32 characters

Output The following output is an example of router ICMP statistics, and Table 15 describes the fields.

Sample Output

```
*A:cses-V93# show router icmp
===============================================================================
Global ICMP Stats
===============================================================================
Received
Total                    : 0             Error                   : 0
Destination Unreachable : 0             Redirect                : 0
Echo Request             : 0             Echo Reply              : 0
TTL Expired              : 0             Source Quench           : 0
Timestamp Request        : 0             Timestamp Reply         : 0
Address Mask Request     : 0             Address Mask Reply      : 0
Parameter Problem        : 0
-------------------------------------------------------------------------------
Sent
Total                    : 0             Error                   : 0
Destination Unreachable : 0             Redirect                : 0
Echo Request             : 0             Echo Reply              : 0
TTL Expired              : 0             Source Quench           : 0
Timestamp Request        : 0             Timestamp Reply         : 0
Address Mask Request     : 0             Address Mask Reply      : 0
Parameter Problem        : 0
===============================================================================
*A:cses-V93# show router icmp interface "foo"
===============================================================================
Interface ICMP Stats
===============================================================================
Interface "foo"
-------------------------------------------------------------------------------
Received
Total                    : 0             Error                   : 0
Destination Unreachable : 0             Redirect                : 0
Echo Request             : 0             Echo Reply              : 0
TTL Expired              : 0             Source Quench           : 0
Timestamp Request        : 0             Timestamp Reply         : 0
Address Mask Request     : 0             Address Mask Reply      : 0
Parameter Problem        : 0
-------------------------------------------------------------------------------
Sent
Total                    : 0             Error                   : 0
Destination Unreachable : 0             Redirect                : 0
Echo Request             : 0             Echo Reply              : 0
TTL Expired              : 0             Source Quench           : 0
Timestamp Request        : 0             Timestamp Reply         : 0
Address Mask Request     : 0             Address Mask Reply      : 0
Parameter Problem        : 0
===============================================================================
```

Table 15 **ICMP Fields**

Label	Description
Total	The total number of all messages.
Error	The number of error messages.

Table 15 ICMP Fields (Continued)

Label	Description
Destination Unreachable	The number of message that did not reach the destination.
Redirect	The number of packet redirects.
Echo Request	The number of echo requests.
Echo Reply	The number of echo replies.
TTL Expired	The number of messages that exceeded the time to live threshold.
Source Quench	The number of source quench requests (deprecated).
Timestamp Request	The number of timestamp requests.
Timestamp Reply	The number of timestamp replies.
Address Mask Request	The number of address mask requests (deprecated).
Address Mask Reply	The number of address mask replies (deprecated).
Parameter Problem	The number of packets with a parameter problem in the IP header.

icmp6

Syntax **icmp6** [**interface** *interface-name*]

Context show>router

Description This command displays Internet Control Message Protocol Version 6 (ICMPv6) statistics. ICMP generates error messages (for example, ICMP destination unreachable messages) to report errors during processing and other diagnostic functions. ICMPv6 packets can be used in the neighbor discovery protocol and path MTU discovery.

Parameters *interface-name* — specifies an existing IP interface name.

Values up to 32 characters

Output The following output is an example of router ICMPv6 statistics, and Table 16 describes the fields.

Sample Output

```
A:SR-3# show router icmp6
===============================================================================
Global ICMPv6 Stats
===============================================================================
Received
```

```
Total                    : 0            Errors                  : 0
Destination Unreachable : 0            Redirects               : 0
Time Exceeded            : 0            Pkt Too Big             : 0
Echo Request             : 0            Echo Reply              : 0
Router Solicits          : 0            Router Advertisements   : 0
Neighbor Solicits        : 0            Neighbor Advertisements : 0
Parameter Problem        : 0
-------------------------------------------------------------------------------
Sent
Total                    : 2            Errors                  : 0
Destination Unreachable : 0            Redirects               : 0
Time Exceeded            : 0            Pkt Too Big             : 0
Echo Request             : 0            Echo Reply              : 0
Router Solicits          : 0            Router Advertisements   : 0
Neighbor Solicits        : 2            Neighbor Advertisements : 0
Parameter Problem        : 0
===============================================================================
A:SR-3#
A:SR-3# show router icmp6 interface "foo"
===============================================================================
Interface ICMPv6 Stats
===============================================================================
===============================================================================
Interface "foo"
-------------------------------------------------------------------------------
Received
Total                    : 0            Errors                  : 0
Destination Unreachable : 0            Redirects               : 0
Time Exceeded            : 0            Pkt Too Big             : 0
Echo Request             : 0            Echo Reply              : 0
Router Solicits          : 0            Router Advertisements   : 0
Neighbor Solicits        : 0            Neighbor Advertisements : 0
Parameter Problem        : 0
-------------------------------------------------------------------------------
Sent
Total                    : 2            Errors                  : 0
Destination Unreachable : 0            Redirects               : 0
Time Exceeded            : 0            Pkt Too Big             : 0
Echo Request             : 0            Echo Reply              : 0
Router Solicits          : 0            Router Advertisements   : 0
Neighbor Solicits        : 2            Neighbor Advertisements : 0
Parameter Problem        : 0
===============================================================================
A:SR-3#
```

Table 16 **ICMPv6 Fields**

Label	Description
Total	The total number of all messages.
Destination Unreachable	The number of message that did not reach the destination.
Time Exceeded	The number of messages that exceeded the time threshold.
Echo Request	The number of echo requests.

Table 16 ICMPv6 Fields (Continued)

Label	Description
Router Solicits	The number of times the local router was solicited.
Neighbor Solicits	The number of times the neighbor router was solicited.
Errors	The number of error messages.
Redirects	The number of packet redirects.
Pkt Too big	The number of packets that exceed appropriate size.
Echo Reply	The number of echo replies.
Router Advertisements	The number of times the router advertised its location.
Neighbor Advertisements	The number of times the neighbor router advertised its location.
Parameter Problem	The number of packets with a parameter problem in the IP header.

if-attribute

Syntax **if-attribute**

Context show>router

Description This command enables the context to display interface attribute related information.

srlg-group

Syntax **srlg-group** [***name***]

Context show>router>if-attribute>srlg-group

Description This command displays SRLG statistics.

Parameters *name* — only displays entries associated with the specified SRLG name

Output The following output is an example of SRLG statistics, and Table 17 describes the fields.

Sample Output

```
B:CORE2# show router if-attribute srlg-group
==================================================
Interface Srlg Groups
==================================================
Group Name              Group Value  Penalty Weight
```

```
-------------------------------------------------
1                      1            100
2                      2            200
3                      3            300
-------------------------------------------------
No. of Groups: 3
=================================================
B:CORE2#
```

Table 17 **SRLG Fields**

Label	Description
Group Name	The name of the SRLG.
Group Value	The integer value of the SRLG.
Penalty Weight	The penalty weight that is assigned to the SRLG.
No. of Groups	The total number of displayed SRLGs.

interface

Syntax **interface** [*interface-name*]

Context show>router>icmpv6

Description This command displays interface ICMPv6 statistics.

Parameters *interface-name* — only displays entries associated with the specified IP interface name

Output The following output is an example of ICMPv6 interface statistics, and Table 18 describes the fields.

Sample Output

```
B:CORE2# show router icmp6 interface net1_1_2
===============================================================================
Interface ICMPv6 Stats
===============================================================================
Interface "net1_1_2"
-------------------------------------------------------------------------------
Received
Total                    : 41            Errors                    : 0
Destination Unreachable : 0             Redirects                 : 0
Time Exceeded            : 0             Pkt Too Big               : 0
Echo Request             : 0             Echo Reply                : 0
Router Solicits          : 0             Router Advertisements     : 0
Neighbor Solicits        : 20            Neighbor Advertisements : 21
-------------------------------------------------------------------------------
Sent
Total                    : 47            Errors                    : 0
Destination Unreachable : 0             Redirects                 : 0
```

```
Time Exceeded           : 0            Pkt Too Big             : 0
Echo Request            : 0            Echo Reply              : 0
Router Solicits         : 0            Router Advertisements   : 0
Neighbor Solicits       : 27           Neighbor Advertisements : 20
===============================================================================
B:CORE2#
```

Table 18 **ICMP6 Interface Fields**

Label	Description
Total	The total number of all messages.
Destination Unreachable	The number of message that did not reach the destination.
Time Exceeded	The number of messages that exceeded the time threshold.
Echo Request	The number of echo requests.
Router Solicits	The number of times the local router was solicited.
Neighbor Solicits	The number of times the neighbor router was solicited.
Errors	The number of error messages.
Redirects	The number of packet redirects.
Pkt Too big	The number of packets that exceed appropriate size.
Echo Reply	The number of echo replies.
Router Advertisements	The number of times the router advertised its location.
Neighbor Advertisements	The number of times the neighbor router advertised its location.

interface

Syntax **interface** {{*ip-address* | *ip-int-name*} [**detail**] [*family*] | **summary** | **exclude-services**}
interface {*ip-address* | *ip-int-name*} **eth-cfm** [**detail**]
interface {*ip-address* | *ip-int-name*} **mac** [*ieee-address*]
interface {*ip-address* | *ip-int-name*} **statistics**
interface {*ip-address* | *ip-int-name*} **dist-cpu-protection** [**detail**]
interface {*ip-address* | *ip-int-name*} **policy-accounting** [*class* [*index*]]

Context show>router

Description This command displays the router IP interface table sorted by interface index.

Parameters *ip-address* — displays the interface information associated with the specified IP address

Values

ipv4-address	a.b.c.d (host bits must be 0)
ipv6-address	x:x:x:x:x:x:x:x (eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d
	x: [0 to FFFF]H
	d: [0 to 255]D

ip-int-name — displays the interface information associated with the specified IP interface name. The name can be up to 32 characters in length.

summary — displays summary IP interface information for the router

detail — displays detailed IP interface information

exclude-services — displays IP interface information, excluding IP interfaces configured for customer services. Only core network IP interfaces are displayed.

family — specifies the router IP interface family to display

Values **ipv4** — displays only those peers that have the IPv4 family enabled

Values **ipv6** — displays the peers that are IPv6-capable

eth-cfm — displays Ethernet CFM information

mac — displays information associated with the MAC address

ieee-address — displays the information associated with the specified IEEE address. The address is in the *xx-xx-xx-xx-xx-xx* or *xx:xx:xx:xx:xx:xx* format.

dist-cpu-protection — displays the Distributed CPU Protection parameters and status at the interface level

class — indicates whether to display accounting policy statistics for the source or destination class

Values source-class, dest-class

index — specifies an integer value for the accounting source or destination class index

Values 1 to 255

statistics — displays packet statistics for an interface on the router

Note: The **show router interface statistics** command also shows the MPLS statistics that are shown in using the s**how router mpls interface statistics** command. This allows the operator to see MPLS statistics from interfaces that are not added to MPLS, such as a carrier's network interfaces. Sample Output for an example of the MPLS fields that are displayed. These fields are displayed regardless of the state of MPLS.

Output **Standard IP Interface Output—**The following output is an example of standard IP interface information, and Table 19 describes the fields.

Sample Output

```
*A:mlstp-dutA# show router interface "AtoB_1"
===============================================================================
Interface Table (Router: Base)
===============================================================================
Interface-Name                   Adm         Opr(v4/v6)  Mode    Port/SapId
   IP-Address                                                    PfxState
-------------------------------------------------------------------------------
AtoB_1                           Down        Down/--     Network 1/2/3:1
   Unnumbered If[system]                                         n/a
-------------------------------------------------------------------------------
Interfaces : 1


A:ALA-A# show router interface
===============================================================================
Interface Table (Router: Base)
===============================================================================
Interface-Name                   Adm(v4/v6)  Opr(v4/v6)  Mode    Port/SapId
   IP-Address                                                    PfxState
-------------------------------------------------------------------------------
ip-100.0.0.2                     Up/Up       Up/Up       Network lag-1
   100.0.0.2/10                                                  n/a
   3FFE:1::2/64                                                  PREFERRED
   FE80::200:FF:FE00:4/64                                        PREFERRED
ip-100.128.0.2                   Up/Up       Up/Up       Network lag-2
   100.128.0.2/10                                                n/a
   3FFE:2::2/64                                                  PREFERRED
   FE80::200:FF:FE00:4/64                                        PREFERRED
ip-24.2.4.4                      Up/Up       Up/Up       Network 6/2/14
   24.2.4.4/24                                                   n/a
   3FFE::1802:404/120                                            PREFERRED
   FE80::200:FF:FE00:4/64                                        PREFERRED
system                           Up/Up       Up/Up       Network system
   200.200.200.4/32                                              n/a
   3FFE::C8C8:C804/128                                           PREFERRED
-------------------------------------------------------------------------------
Interfaces : 4
===============================================================================
A:ALA-A#

A:ALA-A# show router interface 10.10.0.3/32
===============================================================================
Interface Table
===============================================================================
Interface-Name                   Type IP-Address         Adm     Opr   Mode
-------------------------------------------------------------------------------
system                           Pri  10.10.0.3/32       Up      Up    Network
===============================================================================
A:ALA-A#

*A:Dut-C# show router 1 interface
===============================================================================
Interface Table (Service: 1)
```

```
===============================================================================
Interface-Name                   Adm         Opr(v4/v6)  Mode     Port/SapId
   IP-Address                                                     PfxState
-------------------------------------------------------------------------------
mda-1-1                          Up          Up/Down     TMS      1/1
   20.12.0.43/32                                                  n/a
mda-2-1                          Up          Up/Down     TMS      2/1
   20.12.0.44/32                                                  n/a
mda-2-2                          Up          Up/Down     TMS      2/2
   20.12.0.45/32                                                  n/a
mda-3-1                          Up          Up/Down     TMS      3/1
   20.12.0.46/32                                                  n/a
-------------------------------------------------------------------------------
Interfaces : 4
===============================================================================
A:ALA-A# show router interface to-ser1
===============================================================================
Interface Table
===============================================================================
Interface-Name                   Type IP-Address         Adm    Opr  Mode
-------------------------------------------------------------------------------
to-ser1                          Pri  10.10.13.3/24      Up     Up   Network
===============================================================================

A:ALA-A# show router interface exclude-services
===============================================================================
Interface Table
===============================================================================
Interface-Name                   Type IP-Address         Adm    Opr  Mode
-------------------------------------------------------------------------------
system                           Pri  10.10.0.3/32       Up     Up   Network
to-ser1                          Pri  10.10.13.3/24      Up     Up   Network
to-ser4                          Pri  10.10.34.3/24      Up     Up   Network
to-ser5                          Pri  10.10.35.3/24      Up     Up   Network
to-ser6                          n/a  n/a                Up     Down Network
management                       Pri  192.168.2.93/20    Up     Up   Network
===============================================================================
A:ALA-A#
```

Table 19 Standard IP Interface Field Descriptions

Label	Description
Interface-Name	The IP interface name.
Type	n/a — No IP address has been assigned to the IP interface, so the IP address type is not applicable. Pri — The IP address for the IP interface is the Primary address on the IP interface. Sec — The IP address for the IP interface is a secondary address on the IP interface.
IP-Address	The IP address and subnet mask length of the IP interface. n/a — Indicates no IP address has been assigned to the IP interface.

Table 19 **Standard IP Interface Field Descriptions (Continued)**

Label	Description
Adm	Down — The IP interface is administratively disabled. Up — The IP interface is administratively enabled.
Opr	Down — The IP interface is operationally disabled. Up — The IP interface is operationally disabled.
Mode	Network — The IP interface is a network/core IP interface. Service — The IP interface is a service IP interface.
Port/SAP Id	The physical network port or the SAP identifier associated with the IP interface.

Detailed IP Interface Output — The following output is an example of detailed IP interface information, and Table 20 describes the fields.

Sample Output

```
*A:Dut-C# show service id 10 interface "foo" detail
===============================================================================
Interface Table
===============================================================================
-------------------------------------------------------------------------------
Interface
-------------------------------------------------------------------------------
If Name          : foo
Admin State      : Up                   Oper (v4/v6)      : Up/Up
Protocols        : None
IP Addr/mask     : 1.2.3.3/24           Address Type      : Primary
IGP Inhibit      : Disabled             Broadcast Address : Host-ones
HoldUp-Time      : 0                    Track Srrp Inst   : 0
IPv6 Address     : 3ffe::102:303/120
IPv6 Addr State  : PREFERRED
CGA modifier     : (Not Specified)
HoldUp-Time      : 0                    Track Srrp Inst   : 0
Link Lcl Address : fe80::200:ff:fe00:3/64
Link Lcl State   : PREFERRED
Ignore Port State: None
-------------------------------------------------------------------------------
Details
-------------------------------------------------------------------------------
Description      : (Not Specified)
If Index         : 29                   Virt. If Index    : 29
Last Oper Chg    : 06/07/2016 15:02:00  Global If Index   : 365
Mon Oper Grp     : None
Srrp En Rtng     : Disabled             Hold time         : N/A
SAP Id           : 2/1/1:10
TOS Marking      : Trusted              If Type           : VPRN
SNTP B.Cast      : False
MAC Address      : 00:00:00:00:00:03    Mac Accounting    : Disabled
Ingress stats    : Disabled             IPv6 DAD          : Enabled
```

```
TCP MSS V4       : 0                     TCP MSS V6        : 0
ARP Timeout      : 14400s                IPv6 Nbr ReachTime: 30s
ARP Retry Timer  : 5000ms                IPv6 stale time   : 14400s
ARP Limit        : Disabled              IPv6 Nbr Limit    : Disabled
ARP Threshold    : Disabled              IPv6 Nbr Threshold: Disabled
ARP Limit Log On*: Disabled              IPv6 Nbr Log Only : Disabled
IP MTU           : (default)
IP Oper MTU      : 1500
ARP Populate     : Disabled              Host Conn Verify  : Disabled
SHCV pol IPv4    : None
Cflowd (unicast) : None                  Cflowd (multicast): None
LdpSyncTimer     : None
LSR Load Balance : system
EGR Load Balance : both
Vas If Type      : none
TEID Load Balance: Disabled
SPI Load Balance : Disabled
uRPF Chk         : disabled
uRPF Ipv6 Chk    : disabled
PTP HW Assist    : Disabled
Rx Pkts          : 87                    Rx Bytes          : 6216
Rx V4 Pkts       : N/A                   Rx V4 Bytes       : N/A
Rx V6 Pkts       : N/A                   Rx V6 Bytes       : N/A
Tx Pkts          : 42                    Tx Bytes          : 3612
Tx V4 Pkts       : 0                     Tx V4 Bytes       : 0
Tx V4 Discard Pk*: 0                     Tx V4 Discard Byt*: 0
Tx V6 Pkts       : 42                    Tx V6 Bytes       : 3612
Tx V6 Discard Pk*: 0                     Tx V6 Discard Byt*: 0
Mpls Rx Pkts     : 0                     Mpls Rx Bytes     : 0
Mpls Tx Pkts     : 0                     Mpls Tx Bytes     : 0
Proxy ARP Details
Rem Proxy ARP    : Disabled              Local Proxy ARP   : Disabled
Policies         : none

Proxy Neighbor Discovery Details
Local Pxy ND     : Disabled
Policies         : none
Secure ND Details
Secure ND        : Disabled
DHCP no local server
DHCP Details
Description  : (Not Specified)
Admin State      : Down                  Lease Populate    : 0
Gi-Addr          : 1.2.3.3*              Gi-Addr as Src Ip : Disabled
* = inferred gi-address from interface IP address
Action           : Keep                  Trusted           : Disabled
DHCP Proxy Details
Admin State      : Down
Lease Time       : N/A
Emul. Server     : Not configured
Subscriber Authentication Details
Auth Policy      : None
DHCP6 Relay Details
Description      : (Not Specified)
Admin State      : Down                  Lease Populate    : 0
Oper State       : Down                  Nbr Resolution    : Disabled
If-Id Option     : None                  Remote Id         : Disabled
Src Addr         : Not configured
Python plcy      : (Not Specified)
```

```
DHCP6 Server Details
Admin State      : Down                 Max. Lease States : 8000
ISA Tunnel redundant next-hop information
Static Next-Hop  :
Dynamic Next-Hop :
ICMP Details
Redirects        : Number - 100         Time (seconds)   - 10
Unreachables     : Number - 100         Time (seconds)   - 10
TTL Expired      : Number - 100         Time (seconds)   - 10
Parameter Problem: Number - 100         Time (seconds)   - 10
ICMP Mask Reply  : True
ICMPv6 Details
Packet Too Big   : Number - 100         Time (seconds)   - 10
Parameter Problem: Number - 100         Time (seconds)   - 10
Redirects        : Number - 100         Time (seconds)   - 10
Time Exceeded    : Number - 100         Time (seconds)   - 10
Unreachables     : Number - 100         Time (seconds)   - 10
IPCP Address Extension Details
Peer IP Addr     : Not configured
Peer Pri DNS Addr: Not configured
Peer Sec DNS Addr: Not configured
-------------------------------------------------------------------------------
Admin Groups
-------------------------------------------------------------------------------
No Matching Entries
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Srlg Groups
-------------------------------------------------------------------------------
No Matching Entries
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
QoS Queue-Group Redirection Details
-------------------------------------------------------------------------------
Ingress FP QGrp  : (none)               Egress Port QGrp  : (none)
Ing FP QGrp Inst : (none)               Egr Port QGrp Inst: (none)
-------------------------------------------------------------------------------
Interfaces : 1
===============================================================================
* indicates that the corresponding row element may have been truncated.
*A:Dut-C#
```

```
*A:Dut-C>config>router>mpls# /show router 1 interface "To_B_1" detail
===============================================================================
Interface Table (Service: 1)
===============================================================================
-------------------------------------------------------------------------------
Interface
-------------------------------------------------------------------------------
If Name          : To_B_1
Admin State      : Up                   Oper (v4/v6)      : Down/Down
Down Reason Code : assocObjNotReady
Down Reason V4   : assocObjNotReady
Down Reason V6   : assocObjNotReady ifProtoOperDown
Protocols        : OSPFv2
IP Addr/mask     : 11.11.11.1/24        Address Type      : Primary
IGP Inhibit      : Disabled             Broadcast Address : Host-ones
```

```
HoldUp-Time      : 0                    Track Srrp Inst   : 0
-------------------------------------------------------------------------------
Details
-------------------------------------------------------------------------------
Description      : (Not Specified)
If Index         : 5                    Virt. If Index    : 5
Last Oper Chg    : 07/21/2016 21:46:23  Global If Index   : 258
Mon Oper Grp     : None
Srrp En Rtng     : Disabled             Hold time         : N/A
SDP Id           : spoke-230:1
Spoke-SDP Details
Admin State      : Up                   Oper State        : Down
Hash Label       : Disabled             Hash Lbl Sig Cap  : Disabled
Oper Hash Label  : Disabled
Entropy Label    : Disabled
Peer Fault Ip    : None
Local Pw Bits      : pwNotForwarding
Peer Pw Bits       : None
Peer Vccv CV Bits  : lspPing bfdFaultDet
Peer Vccv CC Bits  : mplsRouterAlertLabel
Flags              : LabelStackLimitExceeded
TOS Marking      : Trusted              If Type           : VPRN
SNTP B.Cast      : False
MAC Address      : 0e:86:ff:00:00:00    Mac Accounting    : Disabled
Ingress stats    : Disabled             IPv6 DAD          : Enabled
TCP MSS V4       : 0                    TCP MSS V6        : 0
ARP Timeout      : 14400s               IPv6 Nbr ReachTime: 30s
ARP Retry Timer  : 5000ms               IPv6 stale time   : 14400s
ARP Limit        : Disabled             IPv6 Nbr Limit    : Disabled
ARP Threshold    : Disabled             IPv6 Nbr Threshold: Disabled
ARP Limit Log On*: Disabled             IPv6 Nbr Log Only : Disabled
IP MTU           : 1500
IP Oper MTU      : 0
ARP Populate     : Disabled             Host Conn Verify  : Disabled
SHCV pol IPv4    : None
Cflowd (unicast) : None                 Cflowd (multicast): None
LdpSyncTimer     : None
LSR Load Balance : system
EGR Load Balance : both
Vas If Type      : none
TEID Load Balance: Disabled
SPI Load Balance : Disabled
uRPF Chk         : disabled
uRPF Ipv6 Chk    : disabled
PTP HW Assist    : Disabled
Rx Pkts          : 0                    Rx Bytes          : 0
Rx V4 Pkts       : N/A                  Rx V4 Bytes       : N/A
Rx V6 Pkts       : N/A                  Rx V6 Bytes       : N/A
Tx Pkts          : 22                   Tx Bytes          : 1662
Tx V4 Pkts       : 0                    Tx V4 Bytes       : 0
Tx V4 Discard Pk*: 0                    Tx V4 Discard Byt*: 0
Tx V6 Pkts       : 0                    Tx V6 Bytes       : 0
Tx V6 Discard Pk*: 0                    Tx V6 Discard Byt*: 0
Mpls Rx Pkts     : 0                    Mpls Rx Bytes     : 0
Mpls Tx Pkts     : 0                    Mpls Tx Bytes     : 0
Proxy ARP Details
Rem Proxy ARP    : Disabled             Local Proxy ARP   : Disabled
Policies         : none
Proxy Neighbor Discovery Details
```

```
Local Pxy ND     : Disabled
Policies         : none
DHCP no local server
DHCP Details
Description  : (Not Specified)
Admin State      : Down                 Lease Populate    : 0
Gi-Addr          : 11.11.11.1*          Gi-Addr as Src Ip : Disabled
* = inferred gi-address from interface IP address
Action           : Keep                 Trusted           : Disabled
DHCP Proxy Details
Admin State      : Down
Lease Time       : N/A
Emul. Server     : Not configured
Subscriber Authentication Details
Auth Policy      : None
DHCP6 Relay Details
Description      : (Not Specified)
Admin State      : Down                 Lease Populate    : 0
Oper State       : Down                 Nbr Resolution    : Disabled
If-Id Option     : None                 Remote Id         : Disabled
Src Addr         : Not configured
Python plcy      : (Not Specified)
DHCP6 Server Details
Admin State      : Down                 Max. Lease States : 8000
ISA Tunnel redundant next-hop information
Static Next-Hop  :
Dynamic Next-Hop :
ICMP Details
Redirects        : Number - 100         Time (seconds)   - 10
Unreachables     : Number - 100         Time (seconds)   - 10
TTL Expired      : Number - 100         Time (seconds)   - 10
Parameter Problem: Number - 100         Time (seconds)   - 10
ICMP Mask Reply  : True
ICMPv6 Details
Packet Too Big   : Number - 100         Time (seconds)   - 10
Parameter Problem: Number - 100         Time (seconds)   - 10
Redirects        : Number - 100         Time (seconds)   - 10
Time Exceeded    : Number - 100         Time (seconds)   - 10
Unreachables     : Number - 100         Time (seconds)   - 10
IPCP Address Extension Details
Peer IP Addr     : Not configured
Peer Pri DNS Addr: Not configured
Peer Sec DNS Addr: Not configured
-------------------------------------------------------------------------------
Admin Groups
-------------------------------------------------------------------------------
No Matching Entries
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Srlg Groups
-------------------------------------------------------------------------------
No Matching Entries
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
QoS Queue-Group Redirection Details
-------------------------------------------------------------------------------
Ingress FP QGrp  : (none)               Egress Port QGrp  : (none)
Ing FP QGrp Inst : (none)               Egr Port QGrp Inst: (none)
===============================================================================
```

```
* indicates that the corresponding row element may have been truncated.
```

Table 20 **Detailed IP Interface Field Descriptions**

Label	Description
If Name	The IP interface name.
Admin State	Down — The IP interface is administratively disabled. Up — The IP interface is administratively enabled.
Oper State	Down — The IP interface is operationally disabled. Up — The IP interface is operationally enabled.
IP Addr/mask	The IP address and subnet mask length of the IP interface. Not Assigned — Indicates no IP address has been assigned to the IP interface.
IPV6 Addr	The IPv6 address of the interface.
If Index	The interface index of the IP router interface.
Virt If Index	The virtual interface index of the IP router interface.
Last Oper Change	The last change in operational status.
Global If Index	The global interface index of the IP router interface.
Sap ID	The SAP identifier.
TOS Marker	The TOS byte value in the logged packet.
If Type	Network — The IP interface is a network/core IP interface. Service — The IP interface is a service IP interface.
SNTP B.cast	Displays if the **broadcast-client** global parameter is configured.
IES ID	The IES identifier.
QoS Policy	The QoS policy ID associated with the IP interface.
MAC Address	The MAC address of the interface.
Arp Timeout	The ARP timeout for the interface, in seconds, which is the time an ARP entry is maintained in the ARP cache without being refreshed.
ICMP Mask Reply	False — The IP interface will not reply to a received ICMP mask request. True — The IP interface will reply to a received ICMP mask request.
Arp Populate	Displays whether ARP is enabled or disabled.

Table 20 Detailed IP Interface Field Descriptions (Continued)

Label	Description
Host Conn Verify	The host connectivity verification.
LdpSyncTimer	Specifies the IGP/LDP sync timer value.
uRPF Chk	Specifies whether unicast RPF (uRPF) Check is enabled on this interface.
uRPF Iv6 Chk	Specifies whether unicast RPF (uRPF) Check IPv6 is enabled on this interface.
PTP HW Assist	Specifies whether the PTP Hardware Assist function is enabled on this interface.
Cflowd	Specifies the type of Cflowd analysis that is applied to the interface. acl — ACL Cflowd analysis is applied to the interface. interface — Interface Cflowd analysis is applied to the interface. none — No Cflowd analysis is applied to the interface.

Statistics IP Interface Output — The following output is an example of router IP interface statistics when **enable-interface-statistics** is enabled, and Table 21 describes the fields.

Sample Output

```
A:ALA-A# show router interface “to_ixia” statistics
===============================================================================
Interface Statistics
===============================================================================
If Name          : to_Ixia
Admin State      : Up                      Oper (v4/v6)      : Up/Up
Rx Pkts          : 6244                    Rx Bytes          : 599424
Rx V4 Pkts       : 3122                    Rx V4 Bytes       : 299712
Rx V6 Pkts       : 3122                    Rx V6 Bytes       : 299712
Tx Pkts          : 0                       Tx Bytes          : 0
Tx V4 Pkts       : 0                       Tx V4 Bytes       : 0
Tx V4 Discard Pk*: 0                       Tx V4 Discard Byt*: 0
Tx V6 Pkts       : 0                       Tx V6 Bytes       : 0
Tx V6 Discard Pk*: 0                       Tx V6 Discard Byt*: 0
uRPF Chk Fail Pk*: 6244                    uRPF Fail Bytes   : 487032
uRPF Fail V4 Pk  : 3122                    uRPF Fail V4 Byt  : 243516
uRPF Fail V6 Pk  : 3122                    uRPF Fail V6 Byt  : 243516
Mpls Rx Pkts     : 0                       Mpls Rx Bytes     : 0
Mpls Tx Pkts     : 0                       Mpls Tx Bytes     : 0
===============================================================================
```

Table 21 **Statistics IP Interface Fields**

Label	Description
Ifname	The interface name.
Admin State	The administrative status of the router interface.
Oper	The operational status of the router instance.

Summary IP Interface Output — The following output is an example of summary IP information, and Table 22 describes the fields.

Sample Output

```
A:ALA-A# show router interface summary
===============================================================================
Router Summary (Interfaces)
===============================================================================
Instance  Router Name                    Interfaces    Admin-Up   Oper-Up
-------------------------------------------------------------------------------
1         Base                           7             7          5
===============================================================================
```

Table 22 **Summary IP Interface Fields**

Label	Description
Instance	The router instance number.
Router Name	The name of the router instance.
Interfaces	The number of IP interfaces in the router instance.
Admin-Up	The number of administratively enabled IP interfaces in the router instance.
Oper-Up	The number of operationally enabled IP interfaces in the router instance.

routes

Syntax **routes alternative**

Context show:router>isis

Description This command displays IS-IS route information.

Output The following output is an example of IS-IS route information.

Sample Output

```
*A:SRR# show router isis routes 1.1.1.0/24
===============================================================================
Route Table
===============================================================================
Prefix[Flags]                     Metric     Lvl/Typ    Ver.   SysID/Hostname
  NextHop                          MT         AdminTag
-------------------------------------------------------------------------------
1.1.1.0/24 [L]                    7540       1/Int.     6109   SRL
   60.60.1.1                       0           0
-------------------------------------------------------------------------------
No. of Routes: 1
Flags: L = LFA nexthop available
===============================================================================
*A:SRR#
*A:SRR# show router isis routes 1.1.1.0/24 alternative
===============================================================================
Route Table
===============================================================================
Prefix[Flags]                     Metric     Lvl/Typ    Ver.   SysID/Hostname
  NextHop                          MT         AdminTag
Alt-Nexthop                       Alt-Metric Alt-Type
-------------------------------------------------------------------------------
1.1.1.0/24                        7550       1/Int.     6114   SRL
   60.60.1.1                       0           0
   11.22.12.4 (LFA)                16784764    linkProtection
-------------------------------------------------------------------------------
No. of Routes: 1
Flags: LFA = Loop-Free Alternate nexthop
===============================================================================
*A:SRR#

*A:Dut-B# show router isis routes
============================================================================
Route Table
============================================================================
Prefix [Flags]                   Metric     Lvl/Typ    Ver.   SysID/Hostname
  NextHop                          MT         AdminTag
----------------------------------------------------------------------------
10.20.1.2/32                      0          1/Int.     3      Dut-B
   0.0.0.0                         0           0
10.20.1.3/32 [L]                  10         2/Int.     2      Dut-C
   10.20.3.3                       0           0
10.20.1.4/32                      10         2/Int.     3      Dut-D
   10.20.4.4                       0           0
10.20.1.5/32                      20         2/Int.     3      Dut-C
   10.20.3.3                       0           0
10.20.1.6/32                      20         2/Int.     3      Dut-D
   10.20.4.4                       0           0
10.20.3.0/24                      10         1/Int.     3      Dut-B
   0.0.0.0                         0           0
10.20.4.0/24                      10         1/Int.     3      Dut-B
   0.0.0.0                         0           0
10.20.5.0/24                      20         2/Int.     2      Dut-C
   10.20.3.3                       0           0
10.20.6.0/24                      20         2/Int.     4      Dut-D
   10.20.4.4                       0           0
10.20.9.0/24                      20         2/Int.     3      Dut-D
```

```
   10.20.4.4                       0           0
10.20.10.0/24                     30          2/Int.     3      Dut-C
   10.20.3.3                       0           0
-----------------------------------------------------------------------------
Routes : 11
Flags: L = LFA nexthop available
=============================================================================
*A:Dut-B#

*A:Dut-B# show router isis routes alternative

=============================================================================
Route Table
=============================================================================
Prefix [Flags]                   Metric     Lvl/Typ    Ver.   SysID/Hostname
  NextHop                          MT         AdminTag
Alt-Nexthop                    Alt-Metric
-----------------------------------------------------------------------------
10.20.1.2/32                      0           1/Int.     3      Dut-B
   0.0.0.0                         0           0
10.20.1.3/32                      10          2/Int.     2      Dut-C
   10.20.3.3                       0           0
   10.20.3.3 (lfa)                15
10.20.1.4/32                      10          2/Int.     3      Dut-D
   10.20.4.4                       0           0
10.20.1.5/32                      20          2/Int.     3      Dut-C
   10.20.3.3                       0           0
10.20.1.6/32                      20          2/Int.     3      Dut-D
   10.20.4.4                       0           0
10.20.3.0/24                      10          1/Int.     3      Dut-B
   0.0.0.0                         0           0
10.20.4.0/24                      10          1/Int.     3      Dut-B
   0.0.0.0                         0           0
10.20.5.0/24                      20          2/Int.     2      Dut-C
   10.20.3.3                       0           0
10.20.6.0/24                      20          2/Int.     4
4      Dut-D
   10.20.4.4                       0           0
10.20.9.0/24                      20          2/Int.     3      Dut-D
   10.20.4.4                       0           0
10.20.10.0/24                     30          2/Int.     3      Dut-C
   10.20.3.3                       0           0
-----------------------------------------------------------------------------
Routes : 11
Flags: LFA = Loop-Free Alternate nexthop
=============================================================================
*A:Dut-B#
```

bindings

Syntax **bindings active**

Context show>router>ldp

Description This command displays LDP bindings information.

Output The following output is an example of LDP bindings information.

Sample Output

```
*A:Dut-A# show router ldp bindings active

========================================================================
Legend: U - Label In Use,  N - Label Not In Use, W - Label Withdrawn
        WP - Label Withdraw Pending, BU - Alternate For Fast Re-Route
        (S) - Static       (M) - Multi-homed Secondary Support
        (B) - BGP Next Hop (BU) - Alternate Next-hop for Fast Re-Route
========================================================================
LDP IPv4 Prefix Bindings (Active)
========================================================================
Prefix                 Op   IngLbl    EgrLbl    EgrIntf/LspId  EgrNextHop
------------------------------------------------------------------------
10.20.1.1/32           Pop  131071      --        --             --
10.20.1.2/32           Push   --      131071    1/1/1          10.10.1.2
10.20.1.2/32           Swap 131070    131071    1/1/1          10.10.1.2
10.20.1.2/32           Push   --      262141BU  1/1/2          10.10.2.3
10.20.1.2/32           Swap 131070    262141BU  1/1/2          10.10.2.3
10.20.1.3/32           Push   --      131069BU  1/1/1          10.10.1.2
10.20.1.3/32           Swap 131069    131069BU  1/1/1          10.10.1.2
10.20.1.3/32           Push   --      262143    1/1/2          10.10.2.3
10.20.1.3/32           Swap 131069    262143    1/1/2          10.10.2.3
10.20.1.4/32           Push   --      131068    1/1/1          10.10.1.2
10.20.1.4/32           Swap 131068    131068    1/1/1          10.10.1.2
10.20.1.4/32           Push   --      262140BU  1/1/2          10.10.2.3
10.20.1.4/32           Swap 131068    262140BU  1/1/2          10.10.2.3
10.20.1.5/32           Push   --      131067BU  1/1/1          10.10.1.2
10.20.1.5/32           Swap 131067    131067BU  1/1/1          10.10.1.2
10.20.1.5/32           Push   --      262139    1/1/2          10.10.2.3
10.20.1.5/32           Swap 131067    262139    1/1/2          10.10.2.3
10.20.1.6/32           Push   --      131066    1/1/1          10.10.1.2
10.20.1.6/32           Swap 131066    131066    1/1/1          10.10.1.2
10.20.1.6/32           Push   --      262138BU  1/1/2          10.10.2.3
10.20.1.6/32           Swap 131066    262138BU  1/1/2          10.10.2.3
------------------------------------------------------------------------

-------------------------------------------------------------------------------
No. of IPv4 Prefix Active Bindings: 10
===============================================================================

===============================================================================
LDP IPv6 Prefix Bindings (Active)
===============================================================================
Prefix                                      Op              IngLbl    EgrLbl
EgrNextHop                                  EgrIf/LspId
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP Generic IPv4 P2MP Bindings (Active)
===============================================================================
P2MP-Id                                     Interface
RootAddr                                    Op              IngLbl    EgrLbl
EgrNH                                       EgrIf/LspId
```

```
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP Generic IPv6 P2MP Bindings (Active)
===============================================================================
P2MP-Id                                     Interface
RootAddr                                    Op              IngLbl    EgrLbl
EgrNH                                       EgrIf/LspId
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP In-Band-SSM IPv4 P2MP Bindings (Active)
===============================================================================
Source
Group                                       Interface
RootAddr                                    Op              IngLbl    EgrLbl
EgrNH                                       EgrIf/LspId
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP In-Band-SSM IPv6 P2MP Bindings (Active)
===============================================================================
Source
Group                                       Interface
RootAddr                                    Op              IngLbl    EgrLbl
EgrNH                                       EgrIf/LspId
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP In-Band-VPN-SSM IPv4 P2MP Bindings (Active)
===============================================================================
Source
Group                                       RD              Op
RootAddr                                    Interface       IngLbl    EgrLbl
EgrNH                                       EgrIf/LspId
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP In-Band-VPN-SSM IPv6 P2MP Bindings (Active)
===============================================================================
Source
Group                                       RD              Op
RootAddr                                    Interface       IngLbl    EgrLbl
EgrNH                                       EgrIf/LspId
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================
```

```
*A:Dut-A# show router ldp bindings

========================================================================
LDP Bindings (IPv4 LSR ID 1.1.1.1:0)
             (IPv6 LSR ID ::[0])
===============================================================================
Legend: U - Label In Use, N - Label Not In Use, W - Label Withdrawn
        S - Status Signaled Up,  D - Status Signaled Down
        E - Epipe Service, V - VPLS Service, M - Mirror Service
        A - Apipe Service, F - Fpipe Service, I - IES Service, R - VPRN service
        P - Ipipe Service, WP - Label Withdraw Pending, C - Cpipe Service
        BU - Alternate For Fast Re-Route, TLV - (Type, Length: Value)
===============================================================================
LDP IPv4 Prefix Bindings
========================================================================
Prefix             Peer            IngLbl     EgrLbl EgrIntf/    EgrNextHop
                                                     LspId
------------------------------------------------------------------------
10.20.1.1/32       10.20.1.2       131071U     --     --          --
10.20.1.1/32       10.20.1.3       131071U     --     --          --
10.20.1.2/32       10.20.1.2         --       131071 1/1/1       10.10.1.2
10.20.1.2/32       10.20.1.3       131070U    262141 1/1/2       10.10.2.3
10.20.1.3/32       10.20.1.2       131069U    131069 1/1/1       10.10.1.2
10.20.1.3/32       10.20.1.3         --       262143 1/1/2       10.10.2.3
10.20.1.4/32       10.20.1.2       131068N    131068 1/1/1       10.10.1.2
10.20.1.4/32       10.20.1.3       131068BU    262140 1/1/2       10.10.2.3
10.20.1.5/32       10.20.1.2       131067U    131067 1/1/1       10.10.1.2
10.20.1.5/32       10.20.1.3       131067N    262139 1/1/2       10.10.2.3
10.20.1.6/32       10.20.1.2       131066N    131066 1/1/1       10.10.1.2
10.20.1.6/32       10.20.1.3       131066BU   262138 1/1/2       10.10.2.3
------------------------------------------------------------------------
No. of IPv4 Prefix Bindings: 12
========================================================================

===============================================================================
LDP IPv6 Prefix Bindings
===============================================================================
Prefix                                        IngLbl                    EgrLbl
Peer                                          EgrIntf/LspId
EgrNextHop
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP Generic IPv4 P2MP Bindings
===============================================================================
P2MP-Id
RootAddr                                      Interface       IngLbl    EgrLbl
EgrNH                                         EgrIf/LspId
Peer
-------------------------------------------------------------------------------
100
1.1.1.1                                       Unknw             --      131051
90.90.90.2                                    1/1/6
2.2.2.2:0

104
1.1.1.1                                       Unknw             --      131050
```

```
90.90.90.2                                  1/1/6
2.2.2.2:0

600
1.1.1.1                                     Unknw            --       131049
90.90.90.2                                  1/1/6
2.2.2.2:0

700
1.1.1.1                                     Unknw            --       131048
90.90.90.2                                  1/1/6
2.2.2.2:0

800
1.1.1.1                                     Unknw            --       131047
90.90.90.2                                  1/1/6
2.2.2.2:0

900
1.1.1.1                                     Unknw            --       131046
90.90.90.2                                  1/1/6
2.2.2.2:0

1500
1.1.1.1                                     Unknw            --       131045
90.90.90.2                                  1/1/6
2.2.2.2:0

100
6.6.6.6                                     Unknw            --       131044
90.90.90.2                                  1/1/6
2.2.2.2:0

900
6.6.6.6                                     Unknw            --       131043
90.90.90.2                                  1/1/6
2.2.2.2:0

-------------------------------------------------------------------------------
No. of Generic IPv4 P2MP Bindings: 9
===============================================================================

===============================================================================
LDP Generic IPv6 P2MP Bindings
===============================================================================
P2MP-Id
RootAddr                                    Interface        IngLbl    EgrLbl
EgrNH                                       EgrIf/LspId
Peer
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP In-Band-SSM IPv4 P2MP Bindings
===============================================================================
Source
Group
RootAddr                                    Interface        IngLbl    EgrLbl
```

```
EgrNH                                          EgrIf/LspId
Peer
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP In-Band-SSM IPv6 P2MP Bindings
===============================================================================
Source
Group
RootAddr                                       Interface       IngLbl    EgrLbl
EgrNH                                          EgrIf/LspId
Peer
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================

===============================================================================
LDP In-Band-VPN-SSM IPv4 P2MP Bindings
===============================================================================
Source
Group                                          RD
RootAddr                                       Interface         IngLbl    EgrLbl
EgrNH                                          EgrIf/LspId
Peer
-------------------------------------------------------------------------------
1.1.1.1
225.0.0.1                                     1.1.1.1:100
3.3.3.3                                       Unknwn             --         100
60.60.60.1                                    1/1/1
2.2.2.2:100

1.1.1.1
225.0.0.1                                     1.1.1.1:100
3.3.3.3                                       Unknwn             --         100
60.60.60.1                                    1/1/1
2.2.2.2:100

1.1.1.1
225.0.0.1                                     1.1.1.1:100
3.3.3.3                                       Unknwn             --         100
60.60.60.1                                    1/1/1
2.2.2.2:100

-------------------------------------------------------------------------------
No. of In-Band-VPN-SSM IPv4 P2MP Bindings: 3
===============================================================================

===============================================================================
LDP In-Band-VPN-SSM IPv6 P2MP Bindings
===============================================================================
===============================================================================
Source
Group                                          RD
RootAddr                                       Interface         IngLbl    EgrLbl
EgrNH                                          EgrIf/LspId
Peer
-------------------------------------------------------------------------------
```

```
1.1.1.1
225.0.0.1                                  1.1.1.1:100
2000::3000                                 Unknwn              --         100
60.60.60.1                                 1/1/1
2.2.2.2:100

1.1.1.1
225.0.0.1                                  1.1.1.1:100
2000::3000                                 Unknwn              --         100
60.60.60.1                                 1/1/1
2.2.2.2:100

1.1.1.1
225.0.0.1                                  1.1.1.1:100
2000::3000                                 Unknwn              --         100
60.60.60.1                                 1/1/1
2.2.2.2:100

-------------------------------------------------------------------------------
No. of In-Band-VPN-SSM IPv6 P2MP Bindings: 3
===============================================================================

===============================================================================
LDP Service FEC 128 Bindings
===============================================================================
Type                                          VCId       SDPId      IngLbl  LMTU
Peer                                          SvcId                 EgrLbl  RMTU
-------------------------------------------------------------------------------
?-Eth                                         100        R. Src       --    None
2.2.2.2:0                                     Ukwn                  131023D 986

?-Eth                                         500        R. Src       --    None
2.2.2.2:0                                     Ukwn                  131022D 1386

?-Eth                                         2001       R. Src       --    None
2.2.2.2:0                                     Ukwn                  131019D 986

?-Eth                                         2003       R. Src       --    None
2.2.2.2:0                                     Ukwn                  131017D 986

?-Ipipe                                       1800       R. Src       --    None
2.2.2.2:0                                     Ukwn                  131014D 1486

-------------------------------------------------------------------------------
No. of VC Labels: 5
===============================================================================

===============================================================================
LDP Service FEC 129 Bindings
===============================================================================
SAII                                            AGII        IngLbl    LMTU
TAII                                            Type        EgrLbl    RMTU
Peer                                            SvcId       SDPId
-------------------------------------------------------------------------------
No Matching Entries Found
===============================================================================
```

mvpn

Syntax **mvpn**

Context show>router router-instance

Description This command displays multicast VPN related information. The router instance must be specified.

Output The following output is an example of MVPN information for the router-instance.

Sample Output

```
*A:Dut-C# show router 1 mvpn
===============================================================================
MVPN 1 configuration data
===============================================================================
signaling           : Bgp                     auto-discovery     : Enabled
UMH Selection       : Highest-Ip              intersite-shared   : Enabled
vrf-import          : N/A
vrf-export          : N/A
vrf-target          : target:1:1
C-Mcast Import RT   : target:10.20.1.3:2

ipmsi               : pim-asm 224.1.1.1
admin status        : Up                      three-way-hello    : N/A
hello-interval      : N/A                     hello-multiplier   : 35 * 0.1
tracking support    : Disabled                Improved Assert    : N/A

spmsi               : pim-ssm 225.0.0.0/32
join-tlv-packing    : N/A
data-delay-interval: 3 seconds
data-threshold      : 224.0.0.0/4 --> 1 kbps

===============================================================================
```

neighbor

Syntax **neighbor** [*ip-int-name* | *ip-address* | **mac** *ieee-mac-address* | **summary**]

Context show>router

Description This command displays information about the IPv6 neighbor cache.

Parameters *ip-int-name* — specify the IP interface name

ip-address — specify the address of the IPv6 interface address

mac ieee-mac-address — specify the MAC address

summary — displays summary neighbor information

Output **Neighbor Output —** The following output is an example of IPv6 neighbor information, and Table 23 describes the fields.

Sample Output

```
B:CORE2# show router neighbor
===============================================================================
Neighbor Table (Router: Base)
===============================================================================
IPv6 Address                                   Interface
   MAC Address                State         Expiry          Type         RTR
-------------------------------------------------------------------------------
FE80::203:FAFF:FE78:5C88                       net1_1_2
   00:16:4d:50:17:a3          STALE         03h52m08s       Dynamic      Yes
FE80::203:FAFF:FE81:6888                       net1_2_3
   00:03:fa:1a:79:22          STALE         03h29m28s       Dynamic      Yes
-------------------------------------------------------------------------------
No. of Neighbor Entries: 2
===============================================================================
B:CORE2#
```

Table 23 **Neighbor Fields**

Label	Description
IPv6 Address	Displays the IPv6 address.
Interface	Displays the name of the IPv6 interface name.
MAC Address	Specifies the link-layer address.
State	Displays the current administrative state.
Exp	Displays the number of seconds until the entry expires.
Type	Displays the type of IPv6 interface.
Interface	Displays the interface name.
Rtr	Specifies whether a neighbor is a router.
Mtu	Displays the MTU size.

network-domains

Syntax **network-domains** [**detail**] [*network-domain-name*]

Context show>router

Description This command displays network-domains information.

Parameters *detail* — displays detailed network-domains information

network-domain-name — displays information for a specific network domain

Output The following output is an example of network domain information.

Sample

```
*A:Dut-T>config>router# show router network-domains
===============================================================================
Network Domain Table
===============================================================================
Network Domain                   Description
-------------------------------------------------------------------------------
net1                             Network domain 1
default                          Default Network Domain
-------------------------------------------------------------------------------
Network Domains : 2
===============================================================================
*A:Dut-T>config>router#


*A:Dut-T>config>router# show router network-domains detail
===============================================================================
Network Domain Table (Router: Base)
===============================================================================
-------------------------------------------------------------------------------
Network Domain                  : net1
-------------------------------------------------------------------------------
Description                     : Network domain 1
No. Of Ifs Associated           : 2
No. Of SDPs Associated          : 0

-------------------------------------------------------------------------------
Network Domain                  : default
-------------------------------------------------------------------------------
Description                     : Default Network Domain
No. Of Ifs Associated           : 3
No. Of SDPs Associated          : 0
===============================================================================
*A:Dut-T>config>router#


*A:Dut-T>config>router# show router network-domains "net1" interface-association
===============================================================================
Interface Network Domain Association Table
===============================================================================
Interface Name                Port             Network Domain
-------------------------------------------------------------------------------
intf1                         1/2/2            net1
intf2                         6/1/2            net1
-------------------------------------------------------------------------------
Interfaces : 2
===============================================================================
*A:Dut-T>config>router#


*A:Dut-T>config>service# show router network-domains "net1" sdp-association
===============================================================================
SDP Network Domain Association Table
===============================================================================
SDP Id                           Network Domain
-------------------------------------------------------------------------------
100                              net1
-------------------------------------------------------------------------------
```

```
SDPs : 1
===============================================================================
*A:Dut-T>config>service#
```

origin-validation

Syntax **origin-validation**

Context show>router

Description This command enables the context to display origin validation information.

database

Syntax **database** [*family*] [*ip-prefix/ip-prefix-length*] [**upto** *prefix-length2*][**origin-as** *as-number*]
database [*family*] [*ip-prefix/ip-prefix-length*] {**longer**}
database {**summary**}
database [*family*] [{**static**}

Context show>router>origin-validation

Description This command displays database information.

Parameters *family* — specify the type of routing information to be displayed

Values **ipv4** — displays IPv4 entries
ipv6 — displays IPv6 entries

ip-prefix/ip-prefix-length — displays routes only matching the specified IP address and length

Values 64 characters maximum length

prefix-length2 — displays routes matching up to the specified length

Values 1 to 128

origin-as *as-number* **—** specify the origin AS number

Values *as-number* — 0 to 4294967295

longer — displays routes matching the *ip-prefix***/***ip-prefix-length* and routes with longer masks

summary — displays database summary information

static — displays static routes

Output The following output is an example of database information.

Sample Output

```
A:Dut-C# show router origin-validation database
```

```
===============================================================================
Static and Dynamic VRP Database Entries
===============================================================================
Prefix Range [Flags]                                                Origin AS
   Session IP [Flags]
-------------------------------------------------------------------------------
10.0.0.0/16-24 [Static-V]                                           65001
    -
172.16.0.0/12-12 [Dynamic]                                          65002
    192.168.1.1 [B]
-------------------------------------------------------------------------------
No. of Vrp Database Entries: 2
-------------------------------------------------------------------------------
Flags: B = Base instance session
       M = Management instance session
       Static-V = Static-Valid; Static-I = Static-Invalid
===============================================================================

A:Dut-C# show router origin-validation database summary
===============================================================================
Static and Dynamic VRP Database Summary
===============================================================================
Type                                    IPv4 Routes        IPv6 Routes
-------------------------------------------------------------------------------
192.168.1.1-B                           1                  0
Static                                  1                  0
==============================================================================
```

rpki-session

Syntax **rpki-session** [*ip-address*] [**detail**]

Context show>router>origin-validation

Description This command displays RPKI session information.

Parameters *ip-address* **—** displays RPKI session information for the specified IP address

Values

ipv4-address:	a.b.c.d
ipv6-address	x:x:x:x:x:x:x:x
	x:x:x:x:x:x:d.d.d.d
	where:
	x: [0 to FFFF]H
	d: [0 to 255]D
	interface: 32 chars max, and mandatory for link local addresses.

detail — displays the longer, more detailed version of the output

Output The following output is an example of RPKI session information.

Sample Output

```
A:Dut-C# show router origin-validation rpki-session detail
===============================================================================
Rpki Session Information
===============================================================================
IP Address         : 192.168.1.1
-------------------------------------------------------------------------------
Port               : 323                 Oper State         : established
UpTime             : 0d 00:57:41         Flaps              : 0
Active IPv4 records: 17023               Active IPv6 records: 2515
Admin State        : Up                  Local Address      : n/a
Admin State        : Up                  Local Address      : 192.0.2.2
Hold Time          : 120                 Refresh Time       : 60
Stale Route Time   : 3600                Connect Retry      : 120
Serial ID          : 41690               Session ID         : 1452020198
===============================================================================
No. of Rpki-Sessions : 1
===============================================================================
```

policy

Syntax **policy** [*name* | **damping** | **prefix-list** *name* | **as-path** *name* | **community** *name* | **admin**]

Context show>router

Description This command displays policy-related information.

Parameters **name —** specify an existing policy-statement name

damping — specify damping to display route damping profiles

prefix-list *name* **—** specify a prefix list name to display the route policy entries

as-path *name* **—** specify the route policy AS path name to display route policy entries

community *name* **—** specify a route policy community name to display information about a particular community member

admin — specify the **admin** keyword to display the entities configured in the **config>router>policy-options** context

Output The following output is an example of router policy information, and Table 24 describes the fields.

Sample Output

```
B:CORE2# show router policy
===============================================================================
Route Policies
===============================================================================
Policy                           Description
```

```
-------------------------------------------------------------------------------
fromStatic
-------------------------------------------------------------------------------
Policies : 1
===============================================================================
B:CORE2#
```

Table 24 **Policy Fields**

Label	Description
Policy	The policy name.
Description	Displays the description of the policy.

policy-edits

Syntax **policy-edits**

Context show>router

Description This command displays edited policy information.

route-table

Syntax **route-table** [*family*] [*ip-prefix*[/*prefix-length*] [**longer** | **exact** | **protocol** *protocol-name*] [**all**]] [**next-hop-type** *type*] [**qos**] [**alternative**] [**accounting-class**]
route-table [**family**] **summary**
route-table *tunnel-endpoints* [**ip-prefix**[**/prefix-length**]] [**longer** | **exact**] [**detail**]
route-table [**<family>**] [**<ip-prefix**[**/prefix-length**]**>**] [**longer** | **exact** | **protocol** **<protocol-name>**] **extensive** [**all**]

Context show>router

Description This command displays the active routes in the routing table.

If no command line arguments are specified, all routes are displayed, sorted by prefix.

Parameters *family* — specify the type of routing information to be distributed by this peer group

Values
ipv4 — displays only those BGP peers that have the IPv4 family enabled and not those capable of exchanging IP-VPN routes
ipv6 — displays the BGP peers that are IPv6 capable
mcast-ipv4 — displays the BGP peers that are IPv4 multicast capable
mcast-ipv6 — displays multicast IPv6 route table

ip-prefix[*/prefix-length*] **—** displays routes only matching the specified *ip-address* and length

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-prefix:	a.b.c.d (host bits must be set to 0)	
ipv4-prefix-length:		0 to 32
ipv6	ipv6-prefix[/pref*:	x:x:x:x:x:x:x:x (eight 16-bit pieces)
		x:x:x:x:x:x:d.d.d.d
		x: [0 to FFFF]H
		d: [0 to 255]D
	prefix-length:	1 to 128ipv6

Values The following values apply to the 7450 ESS:

ipv4-prefix:	a.b.c.d (host bits must be set to 0)
ipv4-prefix-length:	0 to 32

longer — displays routes matching the *ip-prefix/mask* and routes with longer masks

exact — displays the exact route matching the *ip-prefix/mask* masks

protocol *protocol-name* **—** displays routes learned from the specified protocol

Values local, sub-mgmt, managed, static, ospf, ospf3, isis, rip, aggregate, bgp, bgp-vpn

summary — displays a route table summary information

tunnel-endpoints — specifies to include tunnel endpoint information

next-hop-type tunneled — displays only the tunneled next-hops. For each route entry, the tunnel owner and tunnel ID is shown

Output **Standard Route Table Output —** The following output is an example of standard route table information, and Table 25 describes the fields.

Sample Output

```
*A:Dut-B#config>service>vprn# show router 1 route-table

===============================================================================
Route Table (Service: 1)
===============================================================================
Dest Prefix[Flags]                            Type    Proto     Age         Pref
      Next Hop[Interface Name]                                    Metric
-------------------------------------------------------------------------------
10.0.0.0/30                                   Local   Local     02h09m23s   0
       to_4007                                                    0
10.0.0.8/30                                   Remote  BGP VPN   00h06m38s   170
```

```
       1.1.1.9 (tunneled)                                          0
11.0.0.8/30                                  Remote   BGP VPN   00h06m38s  170
       1.1.1.9 (tunneled)                                          0
192.168.0.0/16 [E]                           Remote   BGP VPN   00h06m38s  170
       1.1.1.9 (tunneled)                                          0
192.168.0.0/16 [E]                           Remote   BGP VPN   00h06m38s  170
       2.1.1.9 (tunneled)                                          0
-------------------------------------------------------------------------------
No. of Routes: 4
Flags: L = LFA nexthop available    B = BGP backup route available
       E = best-external BGP route available
       n = Number of times nexthop is repeated
===============================================================================


*A:Dut-B#config>service>vprn# show router 1 route-table alternative

===============================================================================
Route Table (Service: 1)
===============================================================================
Dest Prefix[Flags]                           Type     Proto     Age        Pref
      Next Hop[Interface Name]                                    Metric
      Alt-NextHop                                                Alt-
                                                                Metric
-------------------------------------------------------------------------------
10.0.0.0/30                                  Local    Local     02h17m23s  0
       to_4007                                                     0
10.0.0.8/30                                  Remote   BGP VPN   00h14m37s  170
       1.1.1.9 (tunneled)                                          0
11.0.0.8/30                                  Remote   BGP VPN   00h14m37s  170
       1.1.1.9 (tunneled)                                          0
192.168.0.0/16                               Remote   BGP VPN   00h14m37s  170
       1.1.1.9 (tunneled)                                          0
192.168.0.0/16 (Backup)                      Remote   BGP VPN   00h14m37s  170
       2.1.1.9 (tunneled)                                          0
192.168.0.0/16 (Best-ext)                    Remote   BGP       00h24m37s  170
       10.0.0.9                                                    0
-------------------------------------------------------------------------------
No. of Routes: 5
Flags: Backup = BGP backup route  LFA = Loop-Free Alternate nexthop
       Best-ext = best-external BGP route
       n = Number of times nexthop is repeated
===============================================================================

*A:Dut-B# show router route-table
============================================================================
Route Table (Router: Base)
============================================================================
Dest Prefix[Flags] Type Proto Age Pref
Next Hop[Interface Name] Metric
----------------------------------------------------------------------------
10.10.1.0/24 Local Local 00h01m25s 0
ip-10.10.1.2 0
10.10.2.0/24 [L] Remote ISIS 00h00m58s 15
10.10.12.3 13
10.10.3.0/24 Local Local 00h01m25s 0
ip-10.10.3.2 0
10.10.4.0/24 Local Local 00h01m25s 0
ip-10.10.4.2 0
```

```
10.10.5.0/24 [L] Remote ISIS 00h00m58s 15
10.10.12.3 13
10.10.6.0/24 [L] Remote ISIS 00h00m58s 15
10.10.4.4 20
10.10.9.0/24 [L] Remote ISIS 00h00m58s 15
10.10.4.4 20
10.10.10.0/24 [L] Remote ISIS 00h00m58s 15
10.10.12.3 23
10.10.11.0/24 [L] Remote ISIS 00h00m58s 15
10.10.12.3 13
10.10.12.0/24 Local Local 00h01m25s 0
ip-10.10.12.2 0
10.20.1.1/32 [L] Remote ISIS 00h00m58s 15
10.10.1.1 10
10.20.1.2/32 Local Local 00h01m25s 0
system 0
10.20.1.3/32 [L] Remote ISIS 00h00m58s 15
10.10.12.3 3
10.20.1.4/32 [L] Remote ISIS 00h00m58s 15
10.10.4.4 10
10.20.1.5/32 [L] Remote ISIS 00h00m58s 15
10.10.12.3 13
10.20.1.6/32 [L] Remote ISIS 00h00m58s 15
10.10.4.4 20
-------------------------------------------------------------------------------
No. of Routes: 16
Flags: L = LFA nexthop available B = BGP backup route available
===============================================================================

*A:Dut-B# show router route-table alternative
===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix[Flags] Type Proto Age Pref
Next Hop[Interface Name] Metric
Alt-NextHop Alt-Metric
-------------------------------------------------------------------------------
10.10.1.0/24 Local Local 00h02m28s 0
ip-10.10.1.2 0
10.10.2.0/24 Remote ISIS 00h02m01s 15
10.10.12.3 13
10.10.1.1 (LFA) 20
10.10.3.0/24 Local Local 00h02m27s 0
ip-10.10.3.2 0
10.10.4.0/24 Local Local 00h02m28s 0
ip-10.10.4.2 0
10.10.5.0/24 Remote ISIS 00h02m01s 15
10.10.12.3 13
10.10.1.1 (LFA) 20
10.10.6.0/24 Remote ISIS 00h02m01s 15
10.10.4.4 20
10.10.12.3 (LFA) 13
10.10.9.0/24 Remote ISIS 00h02m01s 15
10.10.4.4 20
10.10.12.3 (LFA) 13
10.10.10.0/24 Remote ISIS 00h02m01s 15
10.10.12.3 23
10.10.4.4 (LFA) 20
10.10.11.0/24 Remote ISIS 00h02m01s 15
```

```
10.10.12.3 13
10.10.1.1 (LFA) 20
10.10.12.0/24 Local Local 00h02m28s 0
ip-10.10.12.2 0
10.20.1.1/32 Remote ISIS 00h02m01s 15
10.10.1.1 10
10.10.12.3 (LFA) 13
10.20.1.2/32 Local Local 00h02m28s 0
system 0
10.20.1.3/32 Remote ISIS 00h02m05s 15
10.10.12.3 3
10.10.1.1 (LFA) 20
10.20.1.4/32 Remote ISIS 00h02m05s 15
10.10.4.4 10
10.10.12.3 (LFA) 13
10.20.1.5/32 Remote ISIS 00h02m05s 15
10.10.12.3 13
10.10.4.4 (LFA) 20
10.20.1.6/32 Remote ISIS 00h02m05s 15
10.10.4.4 20
10.10.12.3 (LFA) 23
----------------------------------------------------------------------------
No. of Routes: 16
Flags: Backup = BGP backup routeLFA = Loop-Free Alternate nexthop
============================================================================


*A:Dut-C# show router route-table 1.1.1.1/32

===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix                              Type    Proto    Age         Pref
       Next Hop[Interface Name]                                 Metric
-------------------------------------------------------------------------------
1.1.1.1/32                               Remote  BGP      00h00m09s   170
       10.20.1.1 (tunneled:RSVP:1)                              0
-------------------------------------------------------------------------------
No. of Routes: 1
===============================================================================



A:ALA# show router route-table
===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix                              Type    Proto
Age         Pref
       Next Hop[Interface Name]                                 Metric
-------------------------------------------------------------------------------
11.2.103.0/24                            Remote  OSPF
00h59m02s   10
       21.2.4.2                                                 2
11.2.103.0/24                            Remote  OSPF
00h59m02s   10
       22.2.4.2                                                 2
11.2.103.0/24                            Remote  OSPF
00h59m02s   10
```

```
       23.2.4.2                                              2
11.2.103.0/24                        Remote  OSPF
00h59m02s   10
       24.2.4.2                                              2
11.2.103.0/24                        Remote  OSPF
00h59m02s   10
       100.0.0.1                                             2
11.2.103.0/24                        Remote  OSPF
00h59m02s   10
       100.128.0.1                                           2
11.4.101.0/24                        Local   Local    02h14m29s   0
...
-------------------------------------------------------------------------------
A:ALA#

B:ALA-B# show router route-
table 100.10.0.0 exact ==============================================================
==================
Route Table (Router: Base) ==========================================================
======================
Dest Address Next Hop Type Proto Age Metric Pref
-------------------------------------------------------------------------------
 100.10.0.0/16 Black Hole Remote Static 00h03m17s 1 5
-------------------------------------------------------------------------------
No. of Routes: 1 ===================================================================
============
B:ALA-B#


A:ALA-A# show router route-table 10.10.0.4
===============================================================================
Route Table
===============================================================================
Dest Address       Next Hop        Type    Protocol    Age       Metric  Pref
-------------------------------------------------------------------------------
10.10.0.4/32       10.10.34.4      Remote  OSPF        3523      1001    10
-------------------------------------------------------------------------------
A:ALA-A#


A:ALA-A# show router route-table 10.10.0.4/32 longer
===============================================================================
Route Table
===============================================================================
Dest Address       Next Hop        Type    Protocol    Age       Metric  Pref
-------------------------------------------------------------------------------
10.10.0.4/32       10.10.34.4      Remote  OSPF        3523      1001    10
-------------------------------------------------------------------------------
No. of Routes: 1
===============================================================================
+ : indicates that the route matches on a longer prefix
A:ALA-A#

*A:Dut-C# show router route-table

===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix[Flags]                           Type    Proto    Age         Pref
```

```
      Next Hop[Interface Name]                                  Metric
-------------------------------------------------------------------------------
1.1.2.0/24                                     Remote  ISIS     00h44m24s   15
       1.1.3.1                                                       20
1.1.2.0/24                                     Remote  ISIS     00h44m24s   15
       1.2.3.2                                                       20
1.1.3.0/24                                     Local   Local    00h44m30s   0
       to_Dut-A                                                      0
1.1.9.0/24                                     Remote  ISIS     00h44m16s   15
       1.1.3.1                                                       20
1.2.3.0/24                                     Local   Local    00h44m30s   0
       to_Dut-B                                                      0
1.2.9.0/24                                     Remote  ISIS     00h43m55s   160
       1.2.3.2                                                       10
10.12.0.0/24                                   Local   Local    00h44m29s   0
       itfToArborCP_02                                               0
10.20.1.1/32                                   Remote  ISIS     00h44m24s   15
       1.1.3.1                                                       10
10.20.1.2/32                                   Remote  ISIS     00h44m28s   15
       1.2.3.2                                                       10
10.20.1.3/32                                   Local   Local    00h44m32s   0
       system                                                        0
20.12.0.43/32                                  Remote  Static   00h44m31s   5
       vprn1:mda-1-1                                                 1
20.12.0.44/32                                  Remote  Static   00h44m31s   5
       vprn1:mda-2-1                                                 1
20.12.0.45/32                                  Remote  Static   00h44m31s   5
       vprn1:mda-2-2                                                 1
20.12.0.46/32                                  Remote  Static   00h44m30s   5
       vprn1:mda-3-1                                                 1
100.0.0.1/32                                   Remote  TMS      00h34m39s   167
       vprn1:mda-1-1                                                 0
100.0.0.1/32                                   Remote  TMS      00h34m39s   167
       vprn1:mda-3-1                                                 0
138.203.71.202/32                              Remote  Static   00h44m29s   5
       10.12.0.2                                                     1
-------------------------------------------------------------------------------
No. of Routes: 17
Flags: L = LFA nexthop available    B = BGP backup route available
       n = Number of times nexthop is repeated
===============================================================================
A:ALA-A# show router route-table protocol ospf
===============================================================================
Route Table
===============================================================================
Dest Address       Next Hop        Type    Protocol    Age       Metric  Pref
-------------------------------------------------------------------------------
10.10.0.1/32       10.10.13.1      Remote  OSPF        65844     1001    10
10.10.0.2/32       10.10.13.1      Remote  OSPF        65844     2001    10
10.10.0.4/32       10.10.34.4      Remote  OSPF        3523      1001    10
10.10.0.5/32       10.10.35.5      Remote  OSPF        1084022   1001    10
10.10.12.0/24      10.10.13.1      Remote  OSPF        65844     2000    10
10.10.15.0/24      10.10.13.1      Remote  OSPF        58836     2000    10
10.10.24.0/24      10.10.34.4      Remote  OSPF        3523      2000    10
10.10.25.0/24      10.10.35.5      Remote  OSPF        399059    2000    10
10.10.45.0/24      10.10.34.4      Remote  OSPF        3523      2000    10
-------------------------------------------------------------------------------
A:ALA-A#
```

```
show router route-table 131.132.133.134/32 next-hop-type tunneled

Route Table (Router: Base)
========================================================================
Dest Prefix                               Type        Proto    Age               Pre
f
       Next Hop[Interface Name]                                Metric
------------------------------------------------------------------------
131.132.133.134/32                  Remote  OSPF    00h02m09s   10
       66.66.66.66                                                    10
       Next-hop type: tunneled, Owner: RSVP, Tunnel-ID: <out-ifindex-from-route>
------------------------------------------------------------------------
No. of Routes: 1
========================================================================
*A:Dut-B# show router route-table next-hop-type tunneled

===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix                                  Type    Proto    Age         Pref
       Next Hop[Interface Name]                                   Metric
-------------------------------------------------------------------------------
10.10.5.0/24                                 Remote  OSPF     00h02m20s   10
       10.20.1.5 (tunneled:RSVP:1)                                1100
10.10.10.0/24                                Remote  OSPF     00h02m20s   10
       10.20.1.5 (tunneled:RSVP:1)                                1100
10.20.1.5/32                                 Remote  OSPF     00h02m20s   10
       10.20.1.5 (tunneled:RSVP:1)                                100
10.20.1.6/32                                 Remote  OSPF     00h02m20s   10
       10.20.1.5 (tunneled:RSVP:1)                                1100
-------------------------------------------------------------------------------
No. of Routes: 4
===============================================================================


*A:Dut-B# show router route-table 10.20.1.5/32 next-hop-type tunneled

===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix                                  Type    Proto    Age         Pref
       Next Hop[Interface Name]                                   Metric
-------------------------------------------------------------------------------
10.20.1.5/32                                 Remote  OSPF     00h03m55s   10
       10.20.1.5 (tunneled:RSVP:1)                                100
-------------------------------------------------------------------------------
No. of Routes: 1
===============================================================================
*A:Dut-C# show router route-table protocol tms

===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix[Flags]                           Type    Proto    Age         Pref
     Next Hop[Interface Name]                                   Metric
-------------------------------------------------------------------------------
100.0.0.1/
32                                   Remote  TMS      00h23m07s   167       vprn1:mda
-2-1                                                 0
```

```
-------------------------------------------------------------------------------
No. of Routes: 1
Flags: L = LFA nexthop available    B = BGP backup route available
     n = Number of times nexthop is repeated
===============================================================================
*A:Dut-C#
*A:Dut-C# show router route-table summary

===============================================================================
Route Table Summary (Router: Base)
===============================================================================
                                   Active                   Available
-------------------------------------------------------------------------------
     Static                        5                        5
     Direct                        12                       12
     Host                          0                        11
     BGP                           0                        0
     BGP (Backup)                  0                        0
     VPN Leak                      0                        0
     OSPF                          0                        0
     ISIS                          6                        6
     ISIS (LFA)                    0                        0
     RIP                           0                        0
     LDP                           0                        0
     Aggregate                     0                        0
     Sub Mgmt                      0                        0
     Managed                       0                        0
     NAT                           0                        0
     TMS                           1                        1
-------------------------------------------------------------------------------
     Total                         24                       35
===============================================================================
     NOTE: ISIS LFA routes and BGP Backup routes are not counted towards the total.


*A:Dut-C# show router route-table ipv6 3ffe::10:20:1:4/128
===============================================================================
IPv6 Route Table (Router: Base)
===============================================================================
Dest Prefix[Flags]                             Type    Proto     Age        Pref
      Next Hop[Interface Name]                                    Metric
-------------------------------------------------------------------------------
3ffe::10:20:1:4/128                            Remote  ISIS      00h12m48s  15
       fe80::205e:1ff:fe01:1-"ip-10.10.5.3"                         20
3ffe::10:20:1:4/128                            Remote  ISIS      00h12m48s  15
       fe80::6629:ffff:fe00:141-"ip-10.10.12.3"                     20
-------------------------------------------------------------------------------
No. of Routes: 2
Flags: n = Number of times nexthop is repeated
       B = BGP backup route available
       L = LFA nexthop available
       S = Sticky ECMP requested
===============================================================================
*A:Dut-C>config>router>static-route-entry#


*A:Dut-C# show router route-table ipv6 3ffe::10:20:1:4/128 extensive
===============================================================================
Route Table (Router: Base)
```

```
===============================================================================
Dest Prefix            : 3ffe::10:20:1:4/128
  Protocol             : ISIS
  Age                  : 00h12m55s
  Preference           : 15
  Next-Hop             : fe80::205e:1ff:fe01:1-"ip-10.10.5.3"
    Interface          : ip-10.10.5.3
    QoS                : Priority=n/c, FC=n/c
    Source-Class       : 0
    Dest-Class         : 0
    Metric             : 20
    ECMP-Weight        : N/A
  Next-Hop             : fe80::6629:ffff:fe00:141-"ip-10.10.12.3"
    Interface          : ip-10.10.12.3
    QoS                : Priority=n/c, FC=n/c
    Source-Class       : 0
    Dest-Class         : 0
    Metric             : 20
    ECMP-Weight        : N/A
-------------------------------------------------------------------------------
No. of Destinations: 1
===============================================================================


*A:Dut-C# show router route-table ipv6 3ffe::10:20:1:4/128 all
===============================================================================
IPv6 Route Table (Router: Base)
===============================================================================
Dest Prefix[Flags]                           Type    Proto     Age         Pref
      Next Hop[Interface Name]                        Active    Metric
-------------------------------------------------------------------------------
3ffe::10:20:1:4/128                          Remote  ISIS      00h13m00s  15
       fe80::205e:1ff:fe01:1-"ip-10.10.5.3"           Y            20
3ffe::10:20:1:4/128                          Remote  ISIS      00h13m00s  15
       fe80::6629:ffff:fe00:141-"ip-10.10.12.3"       Y            20
3ffe::10:20:1:4/128                          Remote  ISIS(1)   00h13m09s  15
       fe80::205e:1ff:fe01:1-"ip-10.10.5.3"           N            20
3ffe::10:20:1:4/128                          Remote  ISIS(1)   00h13m09s  15
       fe80::6629:ffff:fe00:141-"ip-10.10.12.3"       N            20
-------------------------------------------------------------------------------
No. of Routes: 4
Flags: n = Number of times nexthop is repeated
       B = BGP backup route available
       L = LFA nexthop available
       S = Sticky ECMP requested
       E = Inactive best-external BGP route
===============================================================================


*A:Dut-C# show router route-table ipv6 3ffe::10:20:1:4/128 all extensive
===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix            : 3ffe::10:20:1:4/128
  Protocol             : ISIS
  Age                  : 00h13m06s
  Preference           : 15
  Next-Hop             : fe80::205e:1ff:fe01:1-"ip-10.10.5.3"
    Interface          : ip-10.10.5.3
```

```
    Active              : Yes
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 20
    ECMP-Weight         : N/A
  Next-Hop              : fe80::6629:ffff:fe00:141-"ip-10.10.12.3"
    Interface           : ip-10.10.12.3
    Active              : Yes
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 20
    ECMP-Weight         : N/A
-------------------------------------------------------------------------------
Dest Prefix             : 3ffe::10:20:1:4/128
  Protocol              : ISIS (1)
  Age                   : 00h13m15s
  Preference            : 15
  Next-Hop              : fe80::205e:1ff:fe01:1-"ip-10.10.5.3"
    Interface           : ip-10.10.5.3
    Active              : No
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 20
    ECMP-Weight         : N/A
  Next-Hop              : fe80::6629:ffff:fe00:141-"ip-10.10.12.3"
    Interface           : ip-10.10.12.3
    Active              : No
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 20
    ECMP-Weight         : N/A
-------------------------------------------------------------------------------
No. of Destinations: 2
===============================================================================
```

Table 25 **Standard Route Table Fields**

Label	**Description**
Dest Address	The route destination address and mask.
Next Hop	The next hop IP address for the route destination.
Type	Local The route is a local route.
	Remote The route is a remote route.
Protocol	The protocol through which the route was learned.

Table 25 **Standard Route Table Fields (Continued)**

Label	Description
Age	The route age in seconds for the route.
Metric	The route metric value for the route.
Pref	The route preference value for the route.
No. of Routes	The number of routes displayed in the list.

Summary Route Table Output — Summary output for the route table displays the number of active routes and the number of routes learned by the router by protocol. Total active and available routes are also displayed.

The following output is an example of summary route table information.

Sample Output

```
A:ALA-A# show router route-table summary
===============================================================================
Route Table Summary
===============================================================================
                              Active                   Available
-------------------------------------------------------------------------------
Static                        1                        1
Direct                        6                        6
BGP                           0                        0
OSPF                          9                        9
ISIS                          0                        0
RIP                           0                        0
Aggregate                     0                        0
-------------------------------------------------------------------------------
Total                         16                      16
===============================================================================
A:ALA-A#

*A:SRR# show router route-table summary
===============================================================================
Route Table Summary (Router: Base)
===============================================================================
                              Active                   Available
-------------------------------------------------------------------------------
Static                        6                        6
Direct                        1698                     1698
Host                          0                        1477
BGP                           0                        0
BGP (Backup)                  0                        0
VPN Leak                      0                        0
OSPF                          0                        0
ISIS                          3296                     6383
ISIS (LFA)                    472                      1499
RIP                           0                        0
LDP                           6                        6
Aggregate                     0                        0
```

```
Sub Mgmt                      0                        0
Managed                       0                        0
NAT                           0                        0
TMS                           0                        0
-------------------------------------------------------------------------------
Total                         5006                     9570
===============================================================================
NOTE: ISIS LFA routes and BGP Backup routes are not counted towards the total.
*A:SRR#
*A:Dut-C>config>router>mpls>lsp# show router route-table 10.0.0.2/32 extensive

===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix             : 10.0.0.2/32
  Protocol              : OSPF (1)
  Age                   : 00h02m40s
  Preference            : 150
  Next-Hop              : 1.0.0.3 (RSVP tunnel:94)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 10
    ECMP-Weight         : 20
  Next-Hop              : 1.0.0.3 (RSVP tunnel:61442)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 10
    ECMP-Weight         : 1
-------------------------------------------------------------------------------
No. of Destinations: 1
===============================================================================
*A:Dut-C>config>router>static-route-entry>indirect>tunnel-next-
hop# show router route-table 10.1.0.5/32 extensive

===============================================================================
Route Table (Router: Base)
===============================================================================
Dest Prefix             : 10.1.0.5/32
  Protocol              : STATIC
  Age                   : 00h00m11s
  Preference            : 5
  Next-Hop              : 1.0.0.2 (RSVP tunnel:128)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 1
    ECMP-Weight         : 18
  Next-Hop              : 1.0.0.2 (RSVP tunnel:132)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 1
    ECMP-Weight         : 2
  Next-Hop              : 1.0.0.3 (RSVP tunnel:94)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
```

```
    Metric              : 1
    ECMP-Weight         : 7
  Next-Hop              : 1.0.0.3 (RSVP tunnel:61442)
    QoS                 : Priority=n/c, FC=n/c
    Source-Class        : 0
    Dest-Class          : 0
    Metric              : 1
    ECMP-Weight         : 2
-------------------------------------------------------------------------------
No. of Destinations: 1
===============================================================================
```

rtr-advertisement

Syntax **rtr-advertisement** [**interface** *interface-name*] [**prefix** *ipv6-prefix*[*/prefix-length*]]
rtr-advertisement [**conflicts**]

Context show>router

Description This command displays router advertisement information.

If no command line arguments are specified, all routes are displayed, sorted by prefix.

Parameters *interface-name* **—** Maximum 32 characters.

ipv6-prefix[*/prefix-length*] **—** displays routes only matching the specified *ip-address* and length and only applies to the 7750 SR and 7950 XRS

Values

ipv6	ipv6-prefix[/pref*:	x:x:x:x:x:x:x:x (eight 16-bit pieces)
		x:x:x:x:x:x:d.d.d.d
		x: [0 to FFFF]H
		d: [0 to 255]D
	prefix-length:	1 to 128

Output **Router-Advertisement Table Output —** The following output is an example of router advertisement information, and Table 26 describes the fields.

Sample Output

```
A:Dut-A# show router rtr-advertisement
=======================================================================
Router Advertisement
=======================================================================
-------------------------------------------------------------------------------
Interface: interfaceNetworkNonDefault
-------------------------------------------------------------------------------
Rtr Advertisement Tx : 8              Last Sent            : 00h01m28s
Nbr Solicitation Tx  : 83             Last Sent            : 00h00m17s
Nbr Advertisement Tx : 74             Last Sent            : 00h00m25s
```

```
Rtr Advertisement Rx : 8               Rtr Solicitation Rx  : 0
Nbr Advertisement Rx : 83              Nbr Solicitation Rx  : 74
-------------------------------------------------------------------------------
Server1              : 2001:db8::1
Server2              : N/A
Server3              : N/A
Server4              : N/A
Rdnss-lifetime       : 1200            Include-dns          : yes
-------------------------------------------------------------------------------
Max Advert Interval  : 601             Min Advert Interval  : 201
Managed Config       : TRUE            Other Config         : TRUE
Reachable Time       : 00h00m00s400ms  Router Lifetime      : 00h30m01s
Retransmit Time      : 00h00m00s400ms  Hop Limit            : 63
Link MTU             : 1500

Prefix: 211::/120
Autonomous Flag      : FALSE           On-link flag         : FALSE
Preferred Lifetime   : 07d00h00m       Valid Lifetime       : 30d00h00m

Prefix: 231::/120
Autonomous Flag      : FALSE           On-link flag         : FALSE
Preferred Lifetime   : 49710d06h       Valid Lifetime       : 49710d06h

Prefix: 241::/120
Autonomous Flag      : TRUE            On-link flag         : TRUE
Preferred Lifetime   : 00h00m00s       Valid Lifetime       : 00h00m00s

Prefix: 251::/120
Autonomous Flag      : TRUE            On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m       Valid Lifetime       : 30d00h00m
-------------------------------------------------------------------------------
Advertisement from: FE80::200:FF:FE00:2
Managed Config       : FALSE           Other Config         : FALSE
Reachable Time       : 00h00m00s0ms    Router Lifetime      : 00h30m00s
Retransmit Time      : 00h00m00s0ms    Hop Limit            : 64
Link MTU             : 0
-------------------------------------------------------------------------------
Interface: interfaceServiceNonDefault
-------------------------------------------------------------------------------
Rtr Advertisement Tx : 8               Last Sent            : 00h06m41s
Nbr Solicitation Tx  : 166             Last Sent            : 00h00m04s
Nbr Advertisement Tx : 143             Last Sent            : 00h00m05s
Rtr Advertisement Rx : 8               Rtr Solicitation Rx  : 0
Nbr Advertisement Rx : 166             Nbr Solicitation Rx  : 143
-------------------------------------------------------------------------------
Max Advert Interval  : 601             Min Advert Interval  : 201
Managed Config       : TRUE            Other Config         : TRUE
Reachable Time       : 00h00m00s400ms  Router Lifetime      : 00h30m01s
Retransmit Time      : 00h00m00s400ms  Hop Limit            : 63
Link MTU             : 1500

Prefix: 23::/120
Autonomous Flag      : FALSE           On-link flag         : FALSE
Preferred Lifetime   : infinite        Valid Lifetime       : infinite

Prefix: 24::/120
Autonomous Flag      : TRUE            On-link flag         : TRUE
Preferred Lifetime   : 00h00m00s       Valid Lifetime       : 00h00m00s
```

```
Prefix: 25::/120
Autonomous Flag      : TRUE              On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m         Valid Lifetime       : 30d00h00m
-------------------------------------------------------------------------------
Advertisement from: FE80::200:FF:FE00:2
Managed Config       : FALSE             Other Config         : FALSE
Reachable Time       : 00h00m00s0ms      Router Lifetime      : 00h30m00s
Retransmit Time      : 00h00m00s0ms      Hop Limit            : 64
Link MTU             : 0

Prefix: 2::/120
Autonomous Flag      : TRUE              On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m         Valid Lifetime       : 30d00h00m

Prefix: 23::/120
Autonomous Flag      : TRUE              On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m         Valid Lifetime       : 30d00h00m

Prefix: 24::/119
Autonomous Flag      : TRUE              On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m         Valid Lifetime       : 30d00h00m

Prefix: 25::/120
Autonomous Flag      : TRUE              On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m         Valid Lifetime       : infinite

Prefix: 231::/120
Autonomous Flag      : TRUE              On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m         Valid Lifetime       : 30d00h00m
-------------------------------------------------------------------------------
...
A:Dut-A#
```

Table 26 **Router Advertisement Table Fields**

Label	Description
Rtr Advertisement Tx/ Last Sent	The number of router advertisements sent and time since they were sent.
Nbr Solicitation Tx	The number of neighbor solicitations sent and time since they were sent.
Nbr Advertisement Tx	The number of neighbor advertisements sent and time since they were sent.
Rtr Advertisement Rx	The number of router advertisements received and time since they were received.
Nbr Advertisement Rx	The number of neighbor advertisements received and time since they were received.
Max Advert Interval	The maximum interval between sending router advertisement messages.

Table 26 **Router Advertisement Table Fields (Continued)**

Label	Description
Managed Config	True Indicates that DHCPv6 has been configured.
	False Indicates that DHCPv6 is not available for address configuration.
Reachable Time	The time, in milliseconds, that a node assumes a neighbor is reachable after receiving a reachability confirmation.
Retransmit Time	The time, in milliseconds, between retransmitted neighbor solicitation messages.
Link MTU	The MTU number the nodes use for sending packets on the link.
Rtr Solicitation Rx	The number of router solicitations received and time since they were received.
Nbr Solicitation Rx	The number of neighbor solicitations received and time since they were received.
Min Advert Interval	The minimum interval between sending ICMPv6 neighbor discovery router advertisement messages.
Other Config	True Indicates there are other stateful configurations.
	False Indicates there are no other stateful configurations.
Router Lifetime	Displays the router lifetime in seconds.
Hop Limit	Displays the current hop limit.

Router-Advertisement Conflicts Output — The following output is an example of router advertisement conflicts, and Table 27 describes the fields.

Sample Output

```
A:Dut-A# show>router# rtr-advertisement conflicts
===============================================================================
Router Advertisement
===============================================================================
Interface: interfaceNetworkNonDefault
-------------------------------------------------------------------------------
Advertisement from: FE80::200:FF:FE00:2
Managed Config     : FALSE [TRUE]
Other Config       : FALSE [TRUE]
Reachable Time     : 00h00m00s0ms [00h00m00s400ms]
Router Lifetime    : 00h30m00s [00h30m01s]
```

```
Retransmit Time    : 00h00m00s0ms [00h00m00s400ms]
Hop Limit          : 64 [63]
Link MTU           : 0 [1500]

Prefix not present in neighbor router advertisement
Prefix: 211::/120
Autonomous Flag      : FALSE            On-link flag         : FALSE
Preferred Lifetime   : 07d00h00m        Valid Lifetime       : 30d00h00m

Prefix not present in neighbor router advertisement
Prefix: 231::/120
Autonomous Flag      : FALSE            On-link flag         : FALSE
Preferred Lifetime   : 49710d06h        Valid Lifetime       : 49710d06h

Prefix not present in neighbor router advertisement
Prefix: 241::/120
Autonomous Flag      : TRUE             On-link flag         : TRUE
Preferred Lifetime   : 00h00m00s        Valid Lifetime       : 00h00m00s

Prefix not present in neighbor router advertisement
Prefix: 251::/120
Autonomous Flag      : TRUE             On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m        Valid Lifetime       : 30d00h00m
-------------------------------------------------------------------------------
Interface: interfaceServiceNonDefault
-------------------------------------------------------------------------------
Advertisement from: FE80::200:FF:FE00:2
Managed Config     : FALSE [TRUE]
Other Config       : FALSE [TRUE]
Reachable Time     : 00h00m00s0ms [00h00m00s400ms]
Router Lifetime    : 00h30m00s [00h30m01s]
Retransmit Time    : 00h00m00s0ms [00h00m00s400ms]
Hop Limit          : 64 [63]
Link MTU           : 0 [1500]

Prefix not present in own router advertisement
Prefix: 2::/120
Autonomous Flag      : TRUE             On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m        Valid Lifetime       : 30d00h00m

Prefix: 23::/120
Autonomous Flag    : TRUE [FALSE]
On-link flag       : TRUE [FALSE]
Preferred Lifetime: 07d00h00m [infinite]
Valid Lifetime     : 30d00h00m [infinite]

Prefix not present in own router advertisement
Prefix: 24::/119
Autonomous Flag      : TRUE             On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m        Valid Lifetime       : 30d00h00m

Prefix not present in neighbor router advertisement
Prefix: 24::/120
Autonomous Flag      : TRUE             On-link flag         : TRUE
Preferred Lifetime   : 00h00m00s        Valid Lifetime       : 00h00m00s

Prefix: 25::/120
Valid Lifetime     : infinite [30d00h00m]
```

```
Prefix not present in own router advertisement
Prefix: 231::/120
Autonomous Flag      : TRUE             On-link flag         : TRUE
Preferred Lifetime   : 07d00h00m        Valid Lifetime       : 30d00h00m
===============================================================================
A:Dut-A#
```

Table 27 Router-Advertisement Conflicts Fields

Label	Description
Advertisement from	The address of the advertising router.
Reachable Time	The time, in milliseconds, that a node assumes a neighbor is reachable after receiving a reachability confirmation.
Router Lifetime	Displays the router lifetime in seconds.
Retransmit Time	The time, in milliseconds, between retransmitted neighbor solicitation messages.
Hop Limit	Displays the current hop limit
Link MTU	The MTU number the nodes use for sending packets on the link.

static-arp

Syntax **static-arp** [*ip-addr* | *ip-int-name* | **mac** *ieee-mac-addr*]

Context show>router

Description This command displays the router static ARP table sorted by IP address. If no options are present, all ARP entries are displayed.

Parameters *ip-addr* — only displays static ARP entries associated with the specified IP address

ip-int-name — only displays static ARP entries associated with the specified IP interface name

mac *ieee-mac-addr* **—** only displays static ARP entries associated with the specified MAC address

Output **Static ARP Table Output —** The following output is an example of static AARP table information, and Table 28 describes the output fields.

Sample Output

```
A:ALA-A# show router static-arp
===============================================================================
ARP Table
===============================================================================
IP Address      MAC Address       Age      Type Interface
```

```
-------------------------------------------------------------------------------
10.200.0.253    00:00:5a:40:00:01 00:00:00 Sta  to-ser1
12.200.1.1      00:00:5a:01:00:33 00:00:00 Inv  to-ser1a
-------------------------------------------------------------------------------
No. of ARP Entries: 1
===============================================================================
A:ALA-A#


A:ALA-A# show router static-arp 12.200.1.1
===============================================================================
ARP Table
===============================================================================
IP Address      MAC Address       Age      Type Interface
-------------------------------------------------------------------------------
12.200.1.1      00:00:5a:01:00:33 00:00:00 Inv  to-ser1

===============================================================================
A:ALA-A#


A:ALA-A# show router static-arp to-ser1
===============================================================================
ARP Table
===============================================================================
IP Address      MAC Address       Age      Type Interface
-------------------------------------------------------------------------------
10.200.0.253    00:00:5a:40:00:01 00:00:00 Sta  to-
ser1
===============================================================================
A:ALA-A#


A:ALA-A# show router static-arp mac 00:00:5a:40:00:01
===============================================================================
ARP Table
===============================================================================
IP Address      MAC Address       Age      Type Interface
-------------------------------------------------------------------------------
10.200.0.253    00:00:5a:40:00:01 00:00:00 Sta  to-
ser1
===============================================================================
A:ALA-A#
```

Table 28 **Static ARP Table Fields**

Label	Description
IP Address	The IP address of the static ARP entry.
MAC Address	The MAC address of the static ARP entry.
Age	The age of the ARP entry. Static ARPs always have 00:00:00 for the age.

Table 28 Static ARP Table Fields (Continued)

Label	Description
Type	Inv The ARP entry is an inactive static ARP entry (invalid).
	Sta The ARP entry is an active static ARP entry.
Interface	The IP interface name associated with the ARP entry.
No. of ARP Entries	The number of ARP entries displayed in the list.

static-route

Syntax **static-route** [**family**] [[*ip-prefix* **/***mask*] **|** [**preference** *preference*] **|** [**next-hop** *ip-address*] **|** tag tag]

Context show>router

Description This command displays the static entries in the routing table. If no options are present, all static routes are displayed sorted by prefix.

Parameters **family —** specify the type of routing information to be distributed by this peer group

Values **ipv4** — displays only those BGP peers that have the IPv4 family enabled and not those capable of exchanging IP-VPN routes
ipv6 — displays the BGP peers that are IPv6 capable
mcast-ipv4 — displays the BGP peers that are IPv4 multicast capable

ip-prefix **/***mask* **—** displays static routes only matching the specified *ip-prefix* and *mask*

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-prefix:	a.b.c.d (host bits must be 0)	
	ipv4-prefix-length:	0 to 32
ipv6-prefix:	x:x:x:x:x:x:x:x (eight 16-bit pieces)	
	x:x:x:x:x:x:d.d.d.d	
	x:	[0 to FFFF]H
	d:	[0 to 255]D
	ipv6-prefix-length:	0 to 128

Values The following values apply to the 7450 ESS:

ipv4-prefix:	a.b.c.d (host bits must be 0)
ipv4-prefix-length:	0 to 32

preference *preference* **—** only displays static routes with the specified route preference

Values 0 to 65535

next-hop *ip-address* **—** only displays static routes with the specified next hop IP address

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-address:	a.b.c.d (host bits must be 0)	
ipv6-address:	x:x:x:x:x:x:x:x (eight 16-bit pieces)	
	x:x:x:x:x:x:d.d.d.d	
	x:	[0 to FFFF]H
	d:	[0 to 255]D

Values The following values apply to the 7450 ESS:

ipv4-address: a.b.c.d (host bits must be 0)

tag *tag* **—** displays the tag used to add a 32-bit integer tag to the static route. The tag is used in route policies to control distribution of the route into other protocols.

Values 1 to 4294967295

Output **Static Route Output —** The following output is an example of static route information, and Table 29 describes the fields.

Sample Output

```
A:ALA-A# show router static-route
===============================================================================
Route Table
===============================================================================
IP Addr/mask       Pref Metric Type Nexthop              Interface        Active
-------------------------------------------------------------------------------
192.168.250.0/24   5    1      ID   10.200.10.1          to-ser1               Y
192.168.252.0/24   5    1      NH   10.10.0.254          n/a                   N
192.168.253.0/24   5    1      NH   to-ser1              n/a                   N
192.168.253.0/24   5    1      NH   10.10.0.254          n/a                   N
192.168.254.0/24   4    1      BH   black-hole           n/a                   Y
===============================================================================
A:ALA-A#


A:ALA-A# show router static-route 192.168.250.0/24
===============================================================================
Route Table
===============================================================================
IP Addr/mask       Pref Metric Type Nexthop              Interface        Active
-------------------------------------------------------------------------------
192.168.250.0/24   5    1      ID   10.200.10.1          to-ser1               Y
===============================================================================
A:ALA-A#


A:ALA-A# show router static-route preference 4
```

```
===============================================================================
Route Table
===============================================================================
IP Addr/mask       Pref Metric Type Nexthop              Interface       Active
-------------------------------------------------------------------------------
192.168.254.0/24   4    1      BH   black-hole           n/a                  Y
===============================================================================
A:ALA-A#


A:ALA-A# show router static-route next-hop 10.10.0.254
===============================================================================
Route Table
===============================================================================
IP Addr/mask       Pref Metric Type Nexthop              Interface       Active
-------------------------------------------------------------------------------
192.168.253.0/24   5    1      NH   10.10.0.254          n/a                  N
===============================================================================
A:ALA-A#



===============================================================================
Static Route Table (Router: Base)  Family: IPv6
===============================================================================
Prefix           : 3ffe::10:10:14:0/120
Nexthop          : 3ffe::10:20:1:6
Type             : Indirect
Interface        : n/a                               Active            : Y
Prefix List      : n/a                               Prefix List Type  : n/a
Metric           : 1                                 Preference        : 5
Source Class     : 0                                 Dest Class        : 0
Admin  State     : Up                                Tag               : 0
Creation Origin  : manual
BFD              : disabled
Community        :
CPE-check        : disabled
Tunnel Resolution: any                               Disallow-IGP      : disabled
RSVP-TE Tunnels  : disabled                          LDP Tunnels       : disabled
SR-ISIS Tunnels  : disabled                          SR-OSPF Tunnels   : disabled
SR-TE Tunnels    : disabled
-------------------------------------------------------------------------------
Prefix           : 3ffe::10:10:14:0/120
Nexthop          : 3ffe::20:20:1:6
Type             : Indirect
Interface        : n/a                               Active            : Y
Prefix List      : n/a                               Prefix List Type  : n/a
Metric           : 1                                 Preference        : 5
Source Class     : 0                                 Dest Class        : 0
Admin  State     : Up                                Tag               : 0
Creation Origin  : manual
BFD              : disabled
Community        :
CPE-check        : disabled
Tunnel Resolution: any                               Disallow-IGP      : disabled
RSVP-TE Tunnels  : disabled                          LDP Tunnels       : disabled
SR-ISIS Tunnels  : disabled                          SR-OSPF Tunnels   : disabled
SR-TE Tunnels    : disabled
-------------------------------------------------------------------------------
Prefix           : 3ffe::10:10:14:0/120
```

```
Nexthop          : 3ffe::20:20:1:5
Type             : Indirect
Interface        : n/a                             Active           : Y
Prefix List      : n/a                             Prefix List Type : n/a
Metric           : 1                               Preference       : 5
Source Class     : 0                               Dest Class       : 0
Admin  State     : Up                              Tag              : 0
Creation Origin  : manual
BFD              : disabled
Community        :
CPE-check        : disabled
Tunnel Resolution: any                             Disallow-IGP     : disabled
RSVP-TE Tunnels  : disabled                        LDP Tunnels      : disabled
SR-ISIS Tunnels  : disabled                        SR-OSPF Tunnels  : disabled
SR-TE Tunnels    : disabled
-------------------------------------------------------------------------------
Prefix           : 3ffe::10:10:14:0/120
Nexthop          : 3ffe::10:20:1:5
Type             : Indirect
Interface        : n/a                             Active           : Y
Prefix List      : n/a                             Prefix List Type : n/a
Metric           : 1                               Preference       : 5
Source Class     : 0                               Dest Class       : 0
Admin  State     : Up                              Tag              : 0
Creation Origin  : manual
BFD              : disabled
Community        :
CPE-check        : disabled
Tunnel Resolution: filter                          Disallow-IGP     : disabled
RSVP-TE Tunnels  : disabled                        LDP Tunnels      : disabled
SR-ISIS Tunnels  : enabled                         SR-OSPF Tunnels  : disabled
SR-TE Tunnels    : disabled
-------------------------------------------------------------------------------
No. of Static Routes: 4
===============================================================================
*A:Dut-C#
```

Table 29 **Static Route Fields**

Label	Description
IP Addr/mask	The static route destination address and mask.
Pref	The route preference value for the static route.
Metric	The route metric value for the static route.

Table 29 Static Route Fields (Continued)

Label	Description
Type	BH The static route is a black hole route. The nexthop for this type of route is black-hole.
	ID The static route is an indirect route, where the nexthop for this type of route is the non-directly connected next hop.
	NH The route is a static route with a directly connected next hop. The Nexthop for this type of route is either the next hop IP address or an egress IP interface name.
Next Hop	The next hop for the static route destination.
Protocol	The protocol through which the route was learned.
Interface	The egress IP interface name for the static route. n/a indicates there is no current egress interface because the static route is inactive or a black hole route.
Active	N The static route is inactive; for example, the static route is disabled or the next hop IP interface is down.
	Y The static route is active.
No. of Routes	The number of routes displayed in the list.

The following output is an example static route information for the 7750 SR and 7950 XRS:

```
*A:sim1# show router static-route 10.10.0.0/16 detail
===============================================================================
Static Route Table (Router: Base)            Family : [IPv4|MCast-IPv4|IPv6]
===============================================================================
Network : 3FFD:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFE3/
120  Type : [Nexthop|Indirect|Blackhole]
Nexthop : [address | LSP label & name]                 Nexthop type: [IP|LDP|RSVP-
TE]
Interface :
Metric  : 1              Prefence :  5
Active  : [Y|N]       Admin State : [Up|Down]
Tag :
BFD: [enable|disabled]

CPE-check: [enabled|disabled]     State: [Up|Down]
```

```
Target   : <address>
Interval : [value | n/a]       Drop Count : <value>
Log      : [Y|N]
CPE Host Up/Dn Time : 0d 16:32:28
CPE Echo Req Tx  : 0    CPE Echo Reply Rx: 0
CPE Up Transitions  : 0    CPE Down Transitions : 0
CPE TTL : 13
===============================================================================
A:sim1#

*A:CPM133>config>router# show router static-route 3.3.3.3/32 detail

===============================================================================
Static Route Table (Router: Base)  Family: IPv4
===============================================================================
Prefix           : 3.3.3.3/32
Nexthop          : n/a
Type             : Blackhole                    Nexthop Type      : IP
Interface        : n/a                          Active            : Y
Prefix List      : n/a                          Prefix List Type  : n/a
Metric           : 1                            Preference        : 5
Admin  State     : Up                           Tag               : 0
BFD              : disabled                     Community         : 100:33
CPE-check        : disabled
-------------------------------------------------------------------------------
No. of Static Routes: 1

===============================================================================
*A:Dut-C> show router static-route  10.1.0.5/32 detail

===============================================================================
Static Route Table (Router: Base)  Family: IPv4 ==================================
===========================================
Prefix           : 10.1.0.5/32
Nexthop          : 1.0.0.2
Indirect         : Type
Interface        : n/a                          Active            : Y
Prefix List      : n/a                          Prefix List Type  : n/a
Metric           : 1                            Preference        : 5
Source Class     : 0                            Dest Class        : 0
Admin  State     : Up                           Tag               : 0
Creation Origin  : manual
BFD              : disabled
Community        :
CPE-check        : disabled
Tunnel Resolution: filter                       Disallow-IGP      : disabled
RSVP-TE Tunnels  : enabled                      LDP Tunnels       : disabled
-------------------------------------------------------------------------------
No. of Static Routes: 1

===============================================================================
```

service-prefix

Syntax **service-prefix**

Context show>router

Description This command displays the address ranges reserved by this node for services sorted by prefix.

Output **Service Prefix Output —** The following output is an example of service prefix information, and Table 30 describes the fields.

Sample Output

```
A:ALA-A# show router service-prefix
=================================================
Address Ranges reserved for Services
=================================================
IP Prefix                Mask      Exclusive
-------------------------------------------------
172.16.1.0               24        true
172.16.2.0               24        false
=================================================
A:ALA-A#
```

Table 30 **Service Prefix Fields**

Label	Description
IP Prefix	The IP prefix of the range of addresses included in the range for services.
Mask	The subnet mask length associated with the IP prefix.
Exclusive	false — Addresses in the range are not exclusively for use for service IP addresses. true — Addresses in the range are exclusively for use for service IP addresses and cannot be assigned to network IP interfaces.

sgt-qos

Syntax **sgt-qos**

Context show>router

Description This command displays self-generated traffic QoS related information.

application

Syntax **application** [*app-name*] [**dscp** | **dot1p**]

Context show>router>sgt-qos

Description This command displays application QoS settings.

Parameters *app-name* — The specific application.

Values arp, bgp, cflowd, dhcp, dns, ftp, icmp, igmp, isis, ldp, mld, msdp, ndis, ntp, ospf, pimradius, rip, rsvpsnmp, snmp-notification, srrp, ssh, syslog, tacplus, telnet, tftp, traceroute, vrrp, pppoe

dscp-map

Syntax **dscp-map** [*dscp-name*]

Context show>router>sgt-qos

Description This command displays DSCP to FC mappings.

Parameters *dscp-name* — The specific DSCP name.

Values be, ef, cp1, cp2, cp3, cp4, cp5, cp6, cp7, cp9, cs1, cs2, cs3, cs4, cs5, nc1, nc2, af11, af12, af13, af21, af22, af23, af31, af32, af33, af41, af42, af43, cp11, cp13, cp15, cp17, cp19, cp21, cp23, cp25, cp27, cp29, cp31, cp33, cp35, cp37, cp39, cp41, cp42, cp43, cp44, cp45, cp47, cp49, cp50, cp51, cp52, cp53, cp54, cp55, cp57, cp58, cp59, cp60, cp61, cp62, cp63

status

Syntax **status**

Context show>router

Description This command displays the router status.

Output **Router Status Output —** The following output is an example of router status information, and Table 31 describes the fields.

There are multiple instances of OSPF. OSPF-0 is persistent. OSPF-1 through OSPF-31 are present when that particular OSPF instance is configured.

Sample Output

```
*A:Performance# show router status
===============================================================
Router Status (Router: Base)
===============================================================
                         Admin State         Oper State
---------------------------------------------------------------
Router                   Up                  Up
```

```
OSPFv2-0                 Up                  Up
RIP                      Up                  Up
ISIS                     Up                  Up
MPLS                     Not configured      Not configured
RSVP                     Not configured      Not configured
LDP                      Not configured      Not configured
BGP                      Up                  Up
IGMP                     Not configured      Not configured
PIM                      Not configured      Not configured
OSPFv3                   Not configured      Not configured
MSDP                     Not configured      Not configured
Max Routes               No Limit
Total IPv4 Routes        244285
Total IPv6 Routes        0
Max Multicast Routes     No Limit
Total Multicast Routes   PIM not configured
ECMP Max Routes          1
Triggered Policies       No
=================================================================
*A:Performance#
```

Table 31 Router Status Fields

Label	Description
Router	The administrative and operational states for the router.
OSPF	The administrative and operational states for the OSPF protocol.
RIP	The administrative and operational states for RIP.
ISIS	The administrative and operational states for the IS-IS protocol.
MPLS	The administrative and operational states for the MPLS protocol.
RSVP	The administrative and operational states for RSVP.
LDP	The administrative and operational states for LDP.
BGP	The administrative and operational states for BGP.
IGMP	The administrative and operational states for IGMP.
MLD	The administrative and operational states for the MLD protocol.
PIM	The administrative and operational states for the PIM protocol.
OSPFv3	The administrative and operational states for the OSPFv3 protocol.
MSDP	The administrative and operational states for MSDP.
Max Routes	The maximum number of routes configured for the system.
Total Routes	The total number of routes in the route table.

Table 31 Router Status Fields (Continued)

Label	Description
ECMP Max Routes	The number of ECMP routes configured for path sharing.
service-id	state — Current single SFM state start — Last time this vRtr went into overload, after having respected the hold-off time interval — How long the vRtr remained or is in overload
ICMP Tunneling	No — ICMP tunneling is disabled. Yes — TICMP tunneling is enabled.
VPRN Local TTL Propagate	inherit — VPRN instance is to inherit the global configuration none — TTL of IP packet is not propagated into the VC or transport label stack vc-only — TTL of the IP packet is propagated into the VC label and not into the labels in the transport label stack al — TTL of the IP packet is propagated into the VC label and all labels in the transport label stack
VPRN Transit TTL Propag*	inherit — VPRN instance is to inherit the global configuration none — TTL of IP packet is not propagated into the VC or transport label stack vc-only — TTL of the IP packet is propagated into the VC label and not into the labels in the transport label stack al — TTL of the IP packet is propagated into the VC label and all labels in the transport label stack
Label Route Local TTL P*	all — TTL of the IP packet is propagated into all labels of the transport label stack none — TTL of the IP packet is not propagated into the transport label stack
Label Route Transit TTL*	all — TTL of the IP packet is propagated into all labels of the transport label stack none — TTL of the IP packet is not propagated into the transport label stack
LSR Label Route TTL Pro*	all — TTL of the swapped label is propagated into all labels of the transport label stack none — TTL of the swapped label is not propagated into the transport label stack
Triggered Policies	No — Triggered route policy re-evaluation is disabled. Yes — Triggered route policy re-evaluation is enabled.

7450 ESS Router Status Output—The following output is an example of router status information for the 7450 ESS:

Sample Output

```
*A:Performance# configure router ospf [1..31] shutdown
*A:Performance# show router status
===============================================================
Router Status (Router: Base)
===============================================================
                         Admin State         Oper State
---------------------------------------------------------------
Router                   Up                  Up
OSPFv2-0                 Up                  Up
OSPFv2-1                 Down                Down
OSPFv2-2                 Down                Down
OSPFv2-3                 Down                Down
OSPFv2-4                 Down                Down
OSPFv2-5                 Down                Down
OSPFv2-6                 Down                Down
OSPFv2-7                 Down                Down
OSPFv2-8                 Down                Down
OSPFv2-9                 Down                Down
OSPFv2-10                Down                Down
OSPFv2-11                Down                Down
OSPFv2-12                Down                Down
OSPFv2-13                Down                Down
OSPFv2-14                Down                Down
OSPFv2-15                Down                Down
OSPFv2-16                Down                Down
OSPFv2-17                Down                Down
OSPFv2-18                Down                Down
OSPFv2-19                Down                Down
OSPFv2-20                Down                Down
OSPFv2-21                Down                Down
OSPFv2-22                Down                Down
OSPFv2-23                Down                Down
OSPFv2-24                Down                Down
OSPFv2-25                Down                Down
OSPFv2-26                Down                Down
OSPFv2-27                Down                Down
OSPFv2-28                Down                Down
OSPFv2-29                Down                Down
OSPFv2-30                Down                Down
OSPFv2-31                Down                Down
RIP                      Up                  Up
ISIS                     Up                  Up
MPLS                     Not configured      Not configured
RSVP                     Not configured      Not configured
LDP                      Not configured      Not configured
BGP                      Up                  Up
IGMP                     Not configured      Not configured
PIM                      Not configured      Not configured
OSPFv3                   Not configured      Not configured
MSDP                     Not configured      Not configured
Max Routes               No Limit
Total IPv4 Routes        244277
```

```
Max Multicast Routes     No Limit
Total Multicast Routes   PIM not configured
ECMP Max Routes          1
Single SFM Overload      Enabled            hold-off 30 sec
Single SFM State         normal
Single SFM Start         004 19:03:39.680
Single SFM Interval      0d 00:16:06
Reassembly ISA-BB group  Not configured
Ipv6 Nbr Reachab. time   Not configured                     30
Triggered Policies       No
===============================================================
*A:Performance#
```

Router Status Output for 7750 SR and 7950 XRS—The following output is an example of router status information for the 7750 SR and 7950 XRS:

Sample Output

```
*A:Performance# configure router ospf [1..31] shutdown
*A:Performance# show router status
===============================================================
Router Status (Router: Base)
===============================================================
                         Admin State        Oper State
---------------------------------------------------------------
Router                   Up                 Up
OSPFv2-0                 Up                 Up
OSPFv2-1                 Down               Down
OSPFv2-2                 Down               Down
OSPFv2-3                 Down               Down
OSPFv2-4                 Down               Down
OSPFv2-5                 Down               Down
OSPFv2-6                 Down               Down
OSPFv2-7                 Down               Down
OSPFv2-8                 Down               Down
OSPFv2-9                 Down               Down
OSPFv2-10                Down               Down
OSPFv2-11                Down               Down
OSPFv2-12                Down               Down
OSPFv2-13                Down               Down
OSPFv2-14                Down               Down
OSPFv2-15                Down               Down
OSPFv2-16                Down               Down
OSPFv2-17                Down               Down
OSPFv2-18                Down               Down
OSPFv2-19                Down               Down
OSPFv2-20                Down               Down
OSPFv2-21                Down               Down
OSPFv2-22                Down               Down
OSPFv2-23                Down               Down
OSPFv2-24                Down               Down
OSPFv2-25                Down               Down
OSPFv2-26                Down               Down
OSPFv2-27                Down               Down
OSPFv2-28                Down               Down
OSPFv2-29                Down               Down
```

```
OSPFv2-30                Down               Down
OSPFv2-31                Down               Down
RIP                      Up                 Up
ISIS                     Up                 Up
MPLS                     Not configured     Not configured
RSVP                     Not configured     Not configured
LDP                      Not configured     Not configured
BGP                      Up                 Up
IGMP                     Not configured     Not configured
PIM                      Not configured     Not configured
OSPFv3                   Not configured     Not configured
MSDP                     Not configured     Not configured
Max Routes               No Limit
Total IPv4 Routes        244277
Total IPv6 Routes        0
Max Multicast Routes     No Limit
Total Multicast Routes   PIM not configured
ECMP Max Routes          1
Single SFM Overload      Enabled            hold-off 30 sec
Single SFM State         normal
Single SFM Start         004 19:03:39.680
Single SFM Interval      0d 00:16:06
Reassembly ISA-BB group  Not configured
Ipv6 Nbr Reachab. time   Not configured                    30
Triggered Policies       No
=================================================================
*A:Performance#
```

TTL Propagation and ICMP Tunneling—The following output is an example of TTL propagation and ICMP tunneling configurations, first in base router and then in a VPRN service.

Sample Output

```
*A:Performance# show router status
=================================================================
Router Status (Router: Base)
=================================================================
                         Admin State        Oper State
-----------------------------------------------------------------
Router                   Up                 Up
OSPFv2-0                 Up                 Up
OSPFv2-2                 Down                              Down
RIP                      Not configured                    Not configured
RIP-NG                   Not configured                    Not configured
ISIS-0                   Up                                Up
ISIS-1024                Down                              Down
MPLS                     Down                              Down
RSVP                     Down                              Down
LDP                      Up                                Down
BGP                      Up                                Down
IGMP
MLD
PIM
PIMv4
PIMv6
OSPFv3
```

```
MSDP

Max IPv4 Routes          No Limit
Max IPv6 Routes          No Limit
Total IPv4 Routes        0
Total IPv6 Routes        0
Max Multicast Routes     No Limit
Total IPv4 Mcast Routes  PIM not configured
Total IPv6 Mcast Routes  PIM not configured
ECMP Max Routes          1
Mcast Info Policy        default
Triggered Policies       No
LDP Shortcut             Disabled
Single SFM Overload      Disabled
IP Fast Reroute          Disabled
ICMP Tunneling           Disabled
Reassembly ISA-BB group  Not configured
ICMP Tunneling           Disabled
Ipv6 Nbr Reachab. time   Not configured                     30
IPv6 Nbr stale time (s)  14400
VPRN Local TTL Propagate vc-only
VPRN Transit TTL Propag* vc-only
Label Route Local TTL P* none
Label Route Transit TTL* none
LSR Label Route TTL Pro* none
===============================================================================
* indicates that the corresponding row element may have been truncated.
*B:bkvm31#
```

VPRN TTL Propagation and ICMP Tunneling—The following output is an example of TTL propagation and ICMP tunneling configurations in a VPRN service. The ttl-propagation has been specified as local and all for VPRN service 5001.

Sample Output

```
*A:Dut-A# configure service vprn 5001 ttl-propagate local all
*A:Dut-A# show router 5001 status

===============================================================================
Router Status (Service: 5001)
===============================================================================
                         Admin State                        Oper State
-------------------------------------------------------------------------------
Router                   Up                                 Up
OSPFv2                   Not configured                     Not configured
RIP                      Not configured                     Not configured
RIP-NG                   Not configured                     Not configured
ISIS                     Not configured                     Not configured
MPLS                     Not configured                     Not configured
RSVP                     Not configured                     Not configured
LDP                      Not configured                     Not configured
BGP                      Not configured                     Not configured
IGMP                     Not configured                     Not configured
MLD                      Not configured                     Not configured
PIM                      Not configured                     Not configured
PIMv4                    Not configured                     Not configured
```

```
PIMv6                    Not configured                    Not configured
OSPFv3                   Not configured                    Not configured
MSDP                     Not configured                    Not configured

Max IPv4 Routes          No Limit
Max IPv6 Routes          No Limit
Total IPv4 Routes        2
Total IPv6 Routes        2
Max Multicast Routes     No Limit
Total IPv4 Mcast Routes  PIM not configured
Total IPv6 Mcast Routes  PIM not configured
ECMP Max Routes          1
Mcast Info Policy        default
Triggered Policies       No
GRT Lookup               Disabled
Local Management         Disabled
Single SFM Overload      Disabled
IP Fast Reroute          Disabled
ICMP Tunneling           Disabled
Reassembly ISA-BB group  Not configured
ICMP Tunneling           Disabled
Ipv6 Nbr Reachab. time   Not configured                    30
VPRN Local TTL Propagate all
VPRN Transit TTL Propag* inherit (vc-only)
===============================================================================
* indicates that the corresponding row element may have been truncated.
*A:Dut-A#
```

tms

Syntax **tms routes**

Context show>router router-instance

Description This command displays Threat Management Services (TMS) related information. The router instance must be specified.

Output The following output is an example of TMS information.

Sample Output

```
show router <router-instance> tms routes
-------------------------------------------
*A:Dut-C# show router 1 tms routes

===============================================================================
TMS Routes (IPv4)
===============================================================================
Status    Network                                      Next Hop[Interface Name]
-------------------------------------------------------------------------------
Active    100.0.0.1/32                                 mda-2-1
Inactive  101.0.0.1/32                                 mda-2-1
Inactive  102.0.0.1/32                                 mda-2-1
Inactive  103.0.0.1/32                                 mda-2-1
Inactive  104.0.0.1/32                                 mda-2-1
```

```
Inactive  105.0.0.1/32                                   mda-2-1
Inactive  106.0.0.1/32                                   mda-2-1
Inactive  107.0.0.1/32                                   mda-2-1
Inactive  108.0.0.1/32                                   mda-2-1
Inactive  109.0.0.1/32                                   mda-2-1
-------------------------------------------------------------------------------
No. of Routes: 10
===============================================================================
*A:Dut-C# show router 1 tms routes

===============================================================================
TMS Routes (IPv4)
===============================================================================
Status    Network                                        Next Hop[Interface Name]
-------------------------------------------------------------------------------
Active    100.0.0.1/32                                   mda-2-1
-------------------------------------------------------------------------------
No. of Routes: 1
===============================================================================
```

tunnel-table

Syntax **tunnel-table summary** [**ipv4** | **ipv6**]
tunnel-table [**protocol** *protocol*] {**ipv4** | **ipv6**}
tunnel-table [*ip-prefix*[**/***mask*]] [**alternative**] [**ipv4** | **ipv6**] [**detail**]
tunnel-table mpls-tp
tunnel-table [*ip-prefix*[**/***mask*]] **protocol** *protocol* [**detail**]
tunnel-table [*ip-prefix*[**/***mask*]] **sdp** *sdp-id*

Context show>router

Description This command displays tunnel table information. Auto-bind GRE tunnels are not displayed in **show** command output. GRE tunnels are not the same as SDP tunnels that use the GRE encapsulation type. When the **auto-bind** command is used when configuring a VPRN service, it means the MP-BGP NH resolution is referring to the core routing instance for IP reachability. For a VPRN service this object specifies the lookup to be used by the routing instance if no SDP to the destination exists.

Parameters *ip-address*[*/mask*] — displays the specified tunnel table's destination IP address and mask

protocol *protocol* **—** displays protocol information

Values bgp, ldp, rsvp, sdp, ospf, isis, sr-te, fpe

sdp *sdp-id* **—** displays information pertaining to the specified SDP

Values 1 to 17407

summary — displays summary tunnel table information

detail — displays detailed tunnel table information

alternative — displays Backup Route details

mpls-tp — displays MPLS-TP information

ipv4 — displays information for IPv4 entries only

ipv6 — displays information for IPv6 entries only

Output **Tunnel Table Output —** The following output is an example of tunnel table information, and Table 32 describes the fields.

Sample Output

```
*A:Dut-D>config>service>vpls# show router tunnel-table sdp 17407
=======================================================================
Tunnel Table (Router: Base)
===============================================================================
Destination        Owner Encap TunnelId  Pref     Nexthop        Metric
-----------------------------------------------------------------------
127.0.68.0/32      sdp   MPLS  17407     5        127.0.68.0     0
=======================================================================
*A:Dut-D# show service id 1 sdp 17407:4294967294 detail
=======================================================================
Service Destination Point (Sdp Id : 17407:4294967294) Details
=======================================================================
-------------------------------------------------------------------------------
 Sdp Id 17407:4294967294  -(not applicable)
-----------------------------------------------------------------------
Description     : (Not Specified)
SDP Id             : 17407:4294967294         Type              : VplsPmsi
Split Horiz Grp    : (Not Specified)
VC Type            : Ether                    VC Tag            : n/a
Admin Path MTU     : 9194                     Oper Path MTU     : 9194
Delivery           : MPLS
Far End            : not applicable
Tunnel Far End     : n/a                      LSP Types         : None
Hash Label         : Disabled                 Hash Lbl Sig Cap  : Disabled
Oper Hash Label    : Disabled

Admin State        : Up                       Oper State        : Up
Acct. Pol          : None                     Collect Stats     : Disabled
Ingress Label      : 0                        Egress Label      : 3
Ingr Mac Fltr-Id   : n/a                      Egr Mac Fltr-Id   : n/a
Ingr IP Fltr-Id    : n/a                      Egr IP Fltr-Id    : n/a
Ingr IPv6 Fltr-Id  : n/a                      Egr IPv6 Fltr-Id  : n/a
Admin ControlWord  : Not Preferred            Oper ControlWord  : False
Last Status Change : 12/14/2012 12:42:22      Signaling         : None
Last Mgmt Change   : 12/14/2012 12:42:19      Force Vlan-Vc     : Disabled
Endpoint           : N/A                      Precedence        : 4
PW Status Sig      : Enabled
Class Fwding State : Down
Flags              : None
Time to RetryReset : never                    Retries Left      : 3
Mac Move           : Blockable                Blockable Level   : Tertiary
Local Pw Bits      : None
Peer Pw Bits       : None
Peer Fault Ip      : None
Peer Vccv CV Bits  : None
Peer Vccv CC Bits  : None
Application Profile: None
Max Nbr of MAC Addr: No Limit                 Total MAC Addr    : 0
Learned MAC Addr   : 0                        Static MAC Addr   : 0
```

```
MAC Learning       : Enabled               Discard Unkwn Srce: Disabled
MAC Aging          : Enabled
BPDU Translation   : Disabled
L2PT Termination   : Disabled
MAC Pinning        : Disabled
Ignore Standby Sig : False                 Block On Mesh Fail: False
Oper Group         : (none)                Monitor Oper Grp  : (none)
Rest Prot Src Mac  : Disabled
Auto Learn Mac Prot: Disabled              RestProtSrcMacAct : Disable

Ingress Qos Policy : (none)                Egress Qos Policy : (none)
Ingress FP QGrp    : (none)                Egress Port QGrp  : (none)
Ing FP QGrp Inst   : (none)                Egr Port QGrp Inst: (none)

-----------------------------------------------------------------------
ETH-CFM SDP-Bind specifics
-----------------------------------------------------------------------
V-MEP Filtering    : Disabled

KeepAlive Information :
Admin State        : Disabled              Oper State        : Disabled
Hello Time         : 10                    Hello Msg Len     : 0
Max Drop Count     : 3                     Hold Down Time    : 10

Statistics            :
I. Fwd. Pkts.      : 0                     I. Dro. Pkts.     : 0
I. Fwd. Octs.      : 0                     I. Dro. Octs.     : 0
E. Fwd. Pkts.      : 2979761               E. Fwd. Octets    : 476761760

-----------------------------------------------------------------------
Control Channel Status
-----------------------------------------------------------------------
PW Status          : disabled              Refresh Timer     : <none>
Peer Status Expire : false                 Clear On Timeout  : true

MCAC Policy Name   :
MCAC Max Unconst BW: no limit              MCAC Max Mand BW  : no limit
MCAC In use Mand BW: 0                     MCAC Avail Mand BW: unlimited
MCAC In use Opnl BW: 0                     MCAC Avail Opnl BW: unlimited

-----------------------------------------------------------------------
RSVP/Static LSPs
-----------------------------------------------------------------------
Associated LSP List :
No LSPs Associated

-----------------------------------------------------------------------
Class-based forwarding :
-----------------------------------------------------------------------
Class forwarding   : Disabled              EnforceDSTELspFc  : Disabled
Default LSP        : Uknwn                 Multicast LSP     : None

=======================================================================
FC Mapping Table
=======================================================================
FC Name             LSP Name
-----------------------------------------------------------------------
No FC Mappings
```

```
-----------------------------------------------------------------------
Stp Service Destination Point specifics
-----------------------------------------------------------------------
Stp Admin State    : Down                   Stp Oper State    : Down
Core Connectivity  : Down
Port Role          : N/A                    Port State        : Forwarding
Port Number        : 0                      Port Priority     : 128
Port Path Cost     : 10                     Auto Edge         : Enabled
Admin Edge         : Disabled               Oper Edge         : N/A
Link Type          : Pt-pt                  BPDU Encap        : Dot1d
Root Guard         : Disabled               Active Protocol   : N/A
Last BPDU from     : N/A
Designated Bridge  : N/A                    Designated Port Id: N/A

Fwd Transitions    : 0                      Bad BPDUs rcvd    : 0
Cfg BPDUs rcvd     : 0                      Cfg BPDUs tx      : 0
TCN BPDUs rcvd     : 0                      TCN BPDUs tx      : 0
TC bit BPDUs rcvd  : 0                      TC bit BPDUs tx   : 0
RST BPDUs rcvd     : 0                      RST BPDUs tx      : 0
-----------------------------------------------------------------------
Number of SDPs : 1
-----------------------------------------------------------------------
=======================================================================


*A:Dut-C# show router tunnel-table sdp 17407
========================================================================
Tunnel Table (Router: Base)

========================================================================

Destination        Owner Encap TunnelId  Pref     Nexthop        Metric

------------------------------------------------------------------------

127.0.68.0/32      sdp   MPLS  17407     5        127.0.68.0     0

========================================================================


A:ALA-A>config>service# show router tunnel-
table ==================================================================================
=
Tunnel Table ===================================================================
DestinationOwnerEncapTunnel IdPrefNexthopMetric
--------------------------------------------------------------------------------
10.0.0.1/32 sdp GRE 10 5 10.0.0.1 0
10.0.0.1/32 sdp GRE 21 5 10.0.0.1 0
10.0.0.1/32 sdp GRE 31 5 10.0.0.1 0
10.0.0.1/32 sdp GRE 41 5 10.0.0.1 0
================================================================================
A:ALA-A>config>service#


A:ALA-A>config>service#  show router tunnel-table summary
================================================================================
Tunnel Table Summary (Router: Base)
```

```
===============================================================================
                              Active                   Available
-------------------------------------------------------------------------------
LDP                           1                        1
SDP                           1                        1
===============================================================================
A:ALA-A>config>service#

A:Dut-C# show router tunnel-table

===============================================================================
Tunnel Table (Router: Base)
===============================================================================
Destination       Owner     Encap TunnelId  Pref     Nexthop        Metric
-------------------------------------------------------------------------------
4.0.0.1/32        isis (0)  MPLS  524309    11       1.3.4.4        10
10.20.1.2/32      isis (0)  MPLS  524312    11       1.2.3.2        10
10.20.1.4/32      isis (0)  MPLS  524310    11       1.3.4.4        10
10.20.1.5/32      isis (0)  MPLS  524311    11       1.2.3.2        20
-------------------------------------------------------------------------------
Flags: B = BGP backup route available
       E = inactive best-
external BGP route =================================================================
==============
A:Dut-C#


*A:Dut-C> show router  tunnel-table
===============================================================================
IPv4 Tunnel Table (Router: Base)
===============================================================================
Destination       Owner     Encap TunnelId  Pref     Nexthop        Metric
-------------------------------------------------------------------------------
10.20.1.1/32      ldp       MPLS  65546     9        10.10.2.1      10
10.20.1.2/32      ldp       MPLS  65545     9        10.10.12.2     3
10.20.1.2/32      isis (0)  MPLS  524318    11       10.10.12.2     3
10.20.1.4/32      isis (0)  MPLS  524316    11       10.10.11.4     10
10.20.1.5/32      ldp       MPLS  65547     9        10.10.5.5      10
10.20.1.5/32      isis (0)  MPLS  524315    11       10.10.5.5      10
10.20.1.6/32      isis (0)  MPLS  524317    11       10.10.11.4     20
-------------------------------------------------------------------------------
Flags: B = BGP backup route available
       E = inactive best-external BGP route
===============================================================================


A:Dut-C# show router tunnel-table detail

===============================================================================
Tunnel Table (Router: Base)
===============================================================================
Destination      : 7.1.126.2/32
NextHop          : 110.20.1.5
Tunnel Flags     : is-over-tunnel
Age              : 01h27m59s
CBF Classes      : (Not Specified)
Owner            : ldp                    Encap            : MPLS
Tunnel ID        : 66389                  Preference       : 9
Tunnel Label     : 243909                 Tunnel Metric    : 1
```

```
Tunnel MTU       : 9186
-------------------------------------------------------------------------------


-------------------------------------------------------------------------------
Destination      : 10.20.1.22/32
NextHop          : 120.1.17.7
Tunnel Flags     : (Not Specified)
Age              : 01h29m15s
CBF Classes      : (Not Specified)
Owner            : rsvp                  Encap            : MPLS
Tunnel ID        : 13                    Preference       : 7
Tunnel Label     : 249809                Tunnel Metric    : 2000
Tunnel MTU       : 9190
LSP ID           : 44032                 Bypass Label     : 0
LSP Bandwidth    : 0                     LSP Weight       : 0
-------------------------------------------------------------------------------
Destination      : 10.20.1.22/32
NextHop          : 120.1.18.7
Tunnel Flags     : exclude-for-lfa
Age              : 00h01m47s
CBF Classes      : default-lsp
Owner            : rsvp                  Encap            : MPLS
Tunnel ID        : 243                   Preference       : 7
Tunnel Label     : 249872                Tunnel Metric    : 2000
Tunnel MTU       : 9190
LSP ID           : 44032                 Bypass Label     : 0
LSP Bandwidth    : 0                     LSP Weight       : 0
-------------------------------------------------------------------------------
Destination      : 10.20.1.22/32
NextHop          : 120.1.18.7
Tunnel Flags     : exclude-for-lfa
Age              : 00h00m38s
CBF Classes      : af l1 ef nc
Owner            : rsvp                  Encap            : MPLS
Tunnel ID        : 244                   Preference       : 7
Tunnel Label     : 249905                Tunnel Metric    : 2000
Tunnel MTU       : 9190
LSP ID           : 45568                 Bypass Label     : 0
LSP Bandwidth    : 0                     LSP Weight       : 0
-------------------------------------------------------------------------------
Destination      : 10.20.1.22/32
NextHop          : 120.1.17.7
Tunnel Flags     : exclude-for-lfa
Age              : 00h00m21s
CBF Classes      : h2
Owner            : rsvp                  Encap            : MPLS
Tunnel ID        : 245                   Preference       : 7
Tunnel Label     : 250063                Tunnel Metric    : 2000
Tunnel MTU       : 9190
LSP ID           : 39936                 Bypass Label     : 0
LSP Bandwidth    : 0                     LSP Weight       : 0
-------------------------------------------------------------------------------
Destination      : 10.20.1.22/32
NextHop          : 120.1.18.7
Tunnel Flags     : exclude-for-lfa
Age              : 01h29m40s
CBF Classes      : ef default-lsp
Owner            : rsvp                  Encap            : MPLS
```

```
Tunnel ID        : 246                Preference       : 7
Tunnel Label     : 250024             Tunnel Metric    : 2000
Tunnel MTU       : 9190
LSP ID           : 38400              Bypass Label     : 0
LSP Bandwidth    : 0                  LSP Weight       : 0
-------------------------------------------------------------------------------


-------------------------------------------------------------------------------
Destination      : 211.1.0.254/32
NextHop          : 110.20.1.4
Tunnel Flags     : is-over-tunnel
Age              : 01h28m38s
CBF Classes      : (Not Specified)
Owner            : bgp                Encap            : MPLS
Tunnel ID        : 264115             Preference       : 12
Tunnel Label     : 260512             Tunnel Metric    : 1000
Tunnel MTU       : 9186
-------------------------------------------------------------------------------
Number of tunnel-table entries          : 2866
Number of tunnel-table entries with LFA : 0
===============================================================================

A:Dut-C#


*B:Dut-B>config>router>mpls>lsp# show router tunnel-table  ipv6 protocol isis
===============================================================================
IPv6 Tunnel Table (Router: Base)
===============================================================================
Destination                           Owner     Encap TunnelId   Pref
Nexthop                                               Metric
-------------------------------------------------------------------------------
2001::a14:103/128                     isis (0)  MPLS  524355     11
fe80::c7b:1ff:fe01:1-"B_to_D"                         20
2001::a14:104/128                     isis (0)  MPLS  524354     11
fe80::c7b:1ff:fe01:1-"B_to_D"                         10
2001::a14:105/128                     isis (0)  MPLS  524356     11
fe80::c7f:2ff:fe01:1-"B_to_E"                         10
2001::a14:106/128                     isis (0)  MPLS  524357     11
fe80::c7b:1ff:fe01:1-"B_to_D"                         20
-------------------------------------------------------------------------------
Flags: B = BGP backup route available
       E = inactive best-external BGP route
===============================================================================


*B:Dut-B>config>router>mpls>lsp# show router tunnel-table  ipv6 detail
===============================================================================
Tunnel Table (Router: Base)
===============================================================================
Destination      : 2001::a14:103/128
NextHop          : 2001::a14:103
Tunnel Flags     : (Not Specified)
Age              : 00h02m20s
CBF Classes      : (Not Specified)
Owner            : sdp                Encap            : MPLS
Tunnel ID        : 230                Preference       : 5
Tunnel Label     :  -                 Tunnel Metric    : 0
```

```
Tunnel MTU       : 1578               Max Label Stack  : 1
-------------------------------------------------------------------------------
Destination      : 2001::a14:103/128
NextHop          : fe80::c7b:1ff:fe01:1-"B_to_D"
Tunnel Flags     : (Not Specified)
Age              : 00h02m15s
CBF Classes      : (Not Specified)
Owner            : ldp                Encap            : MPLS
Tunnel ID        : 65567              Preference       : 9
Tunnel Label     : 262136             Tunnel Metric    : 200
Tunnel MTU       : 1582               Max Label Stack  : 1
-------------------------------------------------------------------------------
Destination      : 2001::a14:103/128
NextHop          : fe80::c7b:1ff:fe01:1-"B_to_D"
Tunnel Flags     : exclude-for-igpshortcuts
Age              : 00h02m23s
CBF Classes      : (Not Specified)
Owner            : isis (0)           Encap            : MPLS
Tunnel ID        : 524355             Preference       : 11
Tunnel Label     : 18563              Tunnel Metric    : 20
Tunnel MTU       : 1582               Max Label Stack  : 1
-------------------------------------------------------------------------------
Destination      : 2001::a14:104/128
NextHop          : fe80::c7b:1ff:fe01:1-"B_to_D"
Tunnel Flags     : (Not Specified)
Age              : 00h02m20s
CBF Classes      : (Not Specified)
Owner            : ldp                Encap            : MPLS
Tunnel ID        : 65568              Preference       : 9
Tunnel Label     : 262143             Tunnel Metric    : 100
Tunnel MTU       : 1582               Max Label Stack  : 1
-------------------------------------------------------------------------------
Destination      : 2001::a14:104/128
NextHop          : fe80::c7b:1ff:fe01:1-"B_to_D"
Tunnel Flags     : exclude-for-igpshortcuts
Age              : 00h02m32s
CBF Classes      : (Not Specified)
Owner            : isis (0)           Encap            : MPLS
Tunnel ID        : 524354             Preference       : 11
Tunnel Label     : 18564              Tunnel Metric    : 10
Tunnel MTU       : 1582               Max Label Stack  : 1
-------------------------------------------------------------------------------
Destination      : 2001::a14:105/128
NextHop          : fe80::c7f:2ff:fe01:1-"B_to_E"
Tunnel Flags     : (Not Specified)
Age              : 00h02m15s
CBF Classes      : (Not Specified)
Owner            : ldp                Encap            : MPLS
Tunnel ID        : 65569              Preference       : 9
Tunnel Label     : 262143             Tunnel Metric    : 100
Tunnel MTU       : 1582               Max Label Stack  : 1
-------------------------------------------------------------------------------
Destination      : 2001::a14:105/128
NextHop          : fe80::c7f:2ff:fe01:1-"B_to_E"
Tunnel Flags     : exclude-for-igpshortcuts
Age              : 00h02m32s
CBF Classes      : (Not Specified)
Owner            : isis (0)           Encap            : MPLS
Tunnel ID        : 524356             Preference       : 11
```

```
Tunnel Label      : 18565                 Tunnel Metric    : 10
Tunnel MTU        : 1582                  Max Label Stack  : 1
-------------------------------------------------------------------------------
Destination       : 2001::a14:106/128
NextHop           : fe80::c7b:1ff:fe01:1-"B_to_D"
Tunnel Flags      : (Not Specified)
Age               : 00h02m16s
CBF Classes       : (Not Specified)
Owner             : ldp                   Encap            : MPLS
Tunnel ID         : 65570                 Preference       : 9
Tunnel Label      : 262133                Tunnel Metric    : 200
Tunnel MTU        : 1582                  Max Label Stack  : 1
-------------------------------------------------------------------------------
Destination       : 2001::a14:106/128
NextHop           : fe80::c7b:1ff:fe01:1-"B_to_D"
Tunnel Flags      : exclude-for-igpshortcuts
Age               : 00h02m24s
CBF Classes       : (Not Specified)
Owner             : isis (0)              Encap            : MPLS
Tunnel ID         : 524357                Preference       : 11
Tunnel Label      : 18566                 Tunnel Metric    : 20
Tunnel MTU        : 1582                  Max Label Stack  : 1
-------------------------------------------------------------------------------
Number of tunnel-table entries          : 9
Number of tunnel-table entries with LFA : 0
===============================================================================
```

Table 32 **Tunnel Table Fields**

Label	Description
Destination	The route’s destination address and mask.
Owner	Specifies the tunnel owner.
Encap	Specifies the tunnel’s encapsulation type.
Tunnel ID	Specifies the tunnel (SDP) identifier.
Pref	Specifies the route preference for routes learned from the configured peer(s).
Nexthop	The next hop for the route’s destination.
Metric	The route metric value for the route.
CBF Classes	The forwarding classes and/or **default-lsp** option assigned to this tunnel

2.14.2.1.1 L2TP Show Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

l2tp

Syntax **l2tp**

Context show>router

Description This command enables the context to display L2TP related information.

eth-tunnel

Syntax **eth-tunnel** [**group** *tunnel-group-name* [**vc-id** *vc-id*]]

Context show>router>l2tp

Description This command displays information about configured L2TPv3 Ethernet tunnels. These Ethernet tunnels are the L2TPv3 sessions setup between the local private L2 SAP and the far end device.

If this command is executed without any parameters, then a list of all configured Ethernet tunnels are displayed.

If this command is executed with a tunnel group name or a VC-ID, then a detailed view of the associated Ethernet tunnel is displayed.

Parameters *tunnel-group-name* — Specifies the configured tunnel group name used for the associated Ethernet tunnel

vc-id — Specifies the VC-ID for the L2TPv3 Ethernet tunnel

Values 0 to 4294967295

Output The following output is an example of L2TPv3 Ethernet tunnel information

Sample Output

```
A:Dut-A# show router 200 l2tp eth-tunnel
===============================================================================
L2TPv3 Ethernet Tunnel Summary
===============================================================================
Tunnel Group name                                                VC ID
-------------------------------------------------------------------------------
v3-group-1                                                       100
-------------------------------------------------------------------------------
No. of ethernet tunnels: 1
===============================================================================

A:Dut-A# show router 200 l2tp eth-tunnel group "v3-group-1"
===============================================================================
L2TPv3 Ethernet Tunnel Status
===============================================================================
Group Name          : v3-group-1
VC ID               : 100
Local Conn ID       : 221122308
```

```
Ctrl Conn ID       : 221118464
Matches Cfg        : true
Down Reason        : N/A
Reconnect Time (s) : N/A
Remaining Time (s) : N/A
SAP ID             : tunnel-1.private:100
SAP Service ID     : 100
-------------------------------------------------------------------------------
No. of ethernet tunnels: 1
===============================================================================
```

group

Syntax **group** [*tunnel-group-name* [**statistics**]]

Context show>router>l2tp

Description This command displays L2TP group operational information.

Parameters *tunnel-group-name* — displays information for the specified tunnel group

statistics — displays statistics for the specified tunnel group

Output The following output is an example of L2TP group operational information.

Sample Output

```
*A:Dut-C# show router l2tp group
===============================================================================
L2TP Groups
===============================================================================
Group Name       Ses Limit Ses Assign    State  Tun Active Ses Active
                                                  Tun Total  Ses Total
-------------------------------------------------------------------------------
isp1.group-1
                       131071    existingFirst active     1          1
                                                          1          1
isp1.group-2
                       131071    weighted      active     2          5
                                                          3          8
-------------------------------------------------------------------------------
No. of L2TP Groups: 2
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp group isp1.group-2
===============================================================================
Group Name: isp1.group-2
===============================================================================
Conn ID                       Loc-Tu-ID Rem-Tu-ID State              Ses Active
  Group                                                              Ses Total
    Assignment
-------------------------------------------------------------------------------
143523840                     2190      17525     established        2
```

```
  isp1.group-2                                                    3
    isp1.tunnel-3
236912640                     3615      58919     closedByPeer       0
  isp1.group-2                                                    2
    isp1.tunnel-2
658178048                     10043     33762     draining           3
  isp1.group-2                                                    3
    isp1.tunnel-2
-------------------------------------------------------------------------------
No. of tunnels: 3
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp group isp1.group-2 statistics
Group Name: isp1.group-2
-------------------------------------------------------------------------------
              Attempts   Failed     Failed-Aut           Active     Total
-------------------------------------------------------------------------------
Tunnels       3          0          0                    2          3
Sessions      8          0          N/A                  5          8
-------------------------------------------------------------------------------

-------------------------------------------------------------------------------
              Pkt-Ctl               Pkt-Err              Octets
-------------------------------------------------------------------------------
Rx            51                    0                    1224
Tx            51                    0                    2796
-------------------------------------------------------------------------------
*A:Dut-C#
```

peer

Syntax **peer** *ip-address* [**statistics**] [{**udp-port** *port* | **ip**}]
peer [**draining**] [{**blacklisted** | **selectable** | **unreachable**}]

Context show>router>l2tp

Description This command displays information regarding all configured L2TP peers.

If this command is executed without specifying a peer IP address, then a list of all L2TP peers are listed along with the type of transport used and statistics on the total number of tunnels and sessions, as well as the number of active tunnels and sessions.

If this command is executed with a specific peer IP address, than a detailed view for that peer is displayed.

Parameters *ip-address* — Specifies the L2TP peer address

statistics — displays the statistics for the given IP address

port — Specifies the UDP port for the L2TP peer. This parameter is only supported with L2TPv2 peers.

ip — Displays peers using IP transport

draining — Displays only peers with draining tunnels

blacklisted — Displays peers that are blacklisted

selectable — Displays peers that are selectable

unreachable — Displays peers that are deemed unreachable

Output The following output is an example of L2TP peer operational information.

Sample Output

```
A:Dut-A# show router 200 l2tp peer
===============================================================================
L2TP Peers
===============================================================================
Peer IP                                            Port  Tun Active Ses Active
                                      Drain Reachability Tun Total  Ses Total
-------------------------------------------------------------------------------
10.1.1.2                                           ip    1          1
                                                         1          1
-------------------------------------------------------------------------------
No. of peers: 1
===============================================================================

A:Dut-A# show router 200 l2tp peer 10.1.1.2 ip
===============================================================================
Peer IP: 10.1.1.2
===============================================================================
Roles capab/actual: LAC LNS / -  -      Draining          : false
Tunnels           : 1                   Tunnels Active    : 1
Sessions          : 1                   Sessions Active   : 1
Reachability      : reachable           Time Unreachable  : N/A
===============================================================================
Conn ID    Loc-Tu-ID Rem-Tu-ID State              Blacklist-state   Ses Active
  Group                                                             Ses Total
    Assignment
-------------------------------------------------------------------------------
221118464  3374      0         established        not-blacklisted   1
  v3-group-
1                                                        1
    tun-1-l2tp-v3
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================

*A:Fden-Dut2-BSA2# show router l2tp peer 10.0.0.1 statistics

===============================================================================
Peer IP: 10.0.0.1
===============================================================================
tunnels                                                   : 1
tunnels active                                            : 1
sessions                                                  : 1
sessions active                                           : 1

rx ctrl octets                                            : 541
rx ctrl packets                                           : 5
tx ctrl octets                                            : 272
```

```
tx ctrl packets                                         : 5
tx error packets                                        : 0
rx error packets                                        : 0
rx accepted msg                                         : 4
rx duplicate msg                                        : 0
rx out of window msg                                    : 0

acceptedMsgType
  StartControlConnectionRequest                         : 1
  StartControlConnectionConnected                       : 1
  IncomingCallRequest                                   : 1
  IncomingCallConnected                                 : 1
  ZeroLengthBody                                        : 1
originalTransmittedMsgType
  StartControlConnectionReply                           : 1
  IncomingCallReply                                     : 1
  ZeroLengthBody                                        : 3

last cleared time                                       : N/A
===============================================================================
```

session

Syntax **session connection-id** *connection-id* [**detail**]
session [**detail**] [**session-id** *session-id* (v2)] [**state** *session-state*] [**peer** *ip-address*] [**group** *group-name*] [**assignment-id** *assignment-id*] [**local-name** *local-host-name*] [**remote-name** *remote-host-name*] [**tunnel-id** *tunnel-id* (*v2*)]
session [**detail**] [**state** *session-state*] [**peer** *ip-address*] [**group** *group-name*] [**assignment-id** *assignment-id*] [**local-name** *local-host-name*] [**remote-name** *remote-host-name*] [**control-connection-id** *connection-id* (*v3*)]

Context show>router>l2tp

Description This command displays L2TP session operational information.

Parameters **connection-id** *connection-id* **—** specifies the identification number for a Layer Two Tunneling Protocol connection

Values 1 to 429496729

detail — displays detailed L2TP session information

session-id *session-id* (v2) **—** specifies the identification number for a Layer Two Tunneling Protocol session

Values 1 to 65535

state *session-state* **—** specifies the values to identify the operational state of the L2TP session

Values closed, closed-by-peer, established, idle, wait-reply, wait-tunnel

peer *ip-address* **—** specifies the IP address of the peer

Values The following values apply to the 7750 SR:

ipv4-address	a.b.c.d (host bits must be 0)
ipv6-address	x:x:x:x:x:x:x:x[-interface]
	x:x:x:x:x:x:d.d.d.d[-interface]
	x: [0 to FFFF]H
	d: [0 to 255]D
	interface: 32 characters maximum, mandatory for link local addresses

Values The following values apply to the 7450 ESS:

ipv4-address: a.b.c.d (host bits must be 0)

group *group-name* **—** specifies a string to identify a Layer Two Tunneling Protocol Tunnel group

assignment-id *assignment-id* **—** specifies a string that distinguishes this Layer Two Tunneling Protocol tunnel

local-name *local-host-name* **—** specifies the host name used by this system during the authentication phase of tunnel establishment

remote-name *remote-host-name* **—** specifies a string that is compared to the host name used by the tunnel peer during the authentication phase of tunnel establishment

tunnel-id *tunnel-id (v2)* **—** specifies the local identifier of this Layer Two Tunneling Protocol tunnel, when L2TP version 2 is used

Values 1 to 65535

control-connection-id *connection-id (v3*) **—** specifies an identification number for a Layer Two Tunneling Protocol session

Values 1 to 429496729

Output The following output is an example of L2TP session operational information.

Sample Output

```
*A:Dut-C# show router l2tp session
===============================================================================
L2TP Session Summary
===============================================================================
ID                  Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
143524786           143523840           2190        946         established
143526923           143523840           2190        3083        established
143531662           143523840           2190        7822        closed
236926987           236912640           3615        14347       closed
236927915           236912640           3615        15275       closed
379407426           379387904           5789        19522       established
658187773           658178048           10043       9725        established
658198275           658178048           10043       20227       established
658210606           658178048           10043       32558       established
-------------------------------------------------------------------------------
```

```
No. of sessions: 9
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session state established
===============================================================================
L2TP Session Summary
===============================================================================
ID                  Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
143524786           143523840           2190        946         established
143526923           143523840           2190        3083        established
379407426           379387904           5789        19522       established
658187773           658178048           10043       9725        established
658198275           658178048           10043       20227       established
658210606           658178048           10043       32558       established
-------------------------------------------------------------------------------
No. of sessions: 6
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session state closed detail
===============================================================================
L2TP Session Status
===============================================================================
Connection ID : 143531662
State         : closed
Tunnel Group  : isp1.group-2
Assignment ID : isp1.tunnel-3
Error Message : Terminated by PPPoE: RX PADT

Control Conn ID   : 143523840           Remote Conn ID    : 1148557524
Tunnel ID         : 2190                Remote Tunnel ID  : 17525
Session ID        : 7822                Remote Session ID : 39124
Time Started      : 04/17/2009 18:44:37
Time Established  : 04/17/2009 18:44:37 Time Closed       : 04/17/2009 18:44:50
CDN Result        : generalError        General Error     : noError
-------------------------------------------------------------------------------
===============================================================================
L2TP Session Status
===============================================================================
Connection ID : 236926987
State         : closed
Tunnel Group  : isp1.group-2
Assignment ID : isp1.tunnel-2
Error Message : tunnel was closed

Control Conn ID   : 236912640           Remote Conn ID    : 3861360381
Tunnel ID         : 3615                Remote Tunnel ID  : 58919
Session ID        : 14347               Remote Session ID : 44797
Time Started      : 04/17/2009 18:41:55
Time Established  : 04/17/2009 18:41:55 Time Closed       : 04/17/2009 18:43:20
CDN Result        : generalError        General Error     : noError
-------------------------------------------------------------------------------
===============================================================================
L2TP Session Status
===============================================================================
```

```
Connection ID : 236927915
State         : closed
Tunnel Group  : isp1.group-2
Assignment ID : isp1.tunnel-2
Error Message : tunnel was closed

Control Conn ID   : 236912640           Remote Conn ID    : 3861317210
Tunnel ID         : 3615                Remote Tunnel ID  : 58919
Session ID        : 15275               Remote Session ID : 1626
Time Started      : 04/17/2009 18:41:03
Time Established  : 04/17/2009 18:41:03 Time Closed       : 04/17/2009 18:43:20
CDN Result        : generalError        General Error     : noError
-------------------------------------------------------------------------------
No. of sessions: 3
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session session-id 946
===============================================================================
L2TP Session Summary
===============================================================================
ID                  Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
143524786           143523840           2190        946         established
-------------------------------------------------------------------------------
No. of sessions: 1
===============================================================================
*A:Dut-C# show router l2tp session connection-id 143524786 detail
===============================================================================
L2TP Session Status
===============================================================================
Connection ID : 143524786
State         : established
Tunnel Group  : isp1.group-2
Assignment ID : isp1.tunnel-3
Error Message : N/A

Control Conn ID   : 143523840           Remote Conn ID    : 1148528691
Tunnel ID         : 2190                Remote Tunnel ID  : 17525
Session ID        : 946                 Remote Session ID : 10291
Time Started      : 04/17/2009 18:42:01
Time Established  : 04/17/2009 18:42:01 Time Closed       : N/A
CDN Result        : noError             General Error     : noError
-------------------------------------------------------------------------------
*A:Dut-C#


*A:Dut-C# show router l2tp session group isp1.group-2
===============================================================================
L2TP Session Summary
===============================================================================
ID                  Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
143524786           143523840           2190        946         established
143526923           143523840           2190        3083        established
143531662           143523840           2190        7822        closed
236926987           236912640           3615        14347       closed
236927915           236912640           3615        15275       closed
```

```
658187773           658178048           10043       9725        established
658198275           658178048           10043       20227       established
658210606           658178048           10043       32558       established
-------------------------------------------------------------------------------
No. of sessions: 8
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session tunnel-id 2190 state closed detail
===============================================================================
L2TP Session Status
===============================================================================
Connection ID : 143531662
State         : closed
Tunnel Group  : isp1.group-2
Assignment ID : isp1.tunnel-3
Error Message : Terminated by PPPoE: RX PADT

Control Conn ID   : 143523840           Remote Conn ID    : 1148557524
Tunnel ID         : 2190                Remote Tunnel ID  : 17525
Session ID        : 7822                Remote Session ID : 39124
Time Started      : 04/17/2009 18:44:37
Time Established  : 04/17/2009 18:44:37 Time Closed       : 04/17/2009 18:44:50
CDN Result        : generalError        General Error     : noError
-------------------------------------------------------------------------------
No. of sessions: 1
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session assignment-id isp1.tunnel-2
===============================================================================
L2TP Session Summary
===============================================================================
ID                  Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
236926987           236912640           3615        14347       closed
236927915           236912640           3615        15275       closed
658187773           658178048           10043       9725        established
658198275           658178048           10043       20227       established
658210606           658178048           10043       32558       established
-------------------------------------------------------------------------------
No. of sessions: 5
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session assignment-id isp1.tunnel-2 state established
===============================================================================
L2TP Session Summary
===============================================================================
ID                  Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
658187773           658178048           10043       9725        established
658198275           658178048           10043       20227       established
658210606           658178048           10043       32558       established
-------------------------------------------------------------------------------
No. of sessions: 3
```

```
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session control-connection-id 658178048
===============================================================================
L2TP Session Summary
===============================================================================
ID                Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
658187773         658178048           10043       9725        established
658198275         658178048           10043       20227       established
658210606         658178048           10043       32558       established
-------------------------------------------------------------------------------
No. of sessions: 3
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session peer 10.10.20.100
===============================================================================
L2TP Session Summary
===============================================================================
ID                Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
236926987         236912640           3615        14347       closed
236927915         236912640           3615        15275       closed
658187773         658178048           10043       9725        established
658198275         658178048           10043       20227       established
658210606         658178048           10043       32558       established
-------------------------------------------------------------------------------
No. of sessions: 5
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session peer 10.10.20.100 state closed detail
===============================================================================
L2TP Session Status
===============================================================================
Connection ID : 236926987
State         : closed
Tunnel Group  : isp1.group-2
Assignment ID : isp1.tunnel-2
Error Message : tunnel was closed

Control Conn ID   : 236912640           Remote Conn ID    : 3861360381
Tunnel ID         : 3615                Remote Tunnel ID  : 58919
Session ID        : 14347               Remote Session ID : 44797
Time Started      : 04/17/2009 18:41:55
Time Established  : 04/17/2009 18:41:55 Time Closed       : 04/17/2009 18:43:20
CDN Result        : generalError        General Error     : noError
-------------------------------------------------------------------------------
===============================================================================
L2TP Session Status
===============================================================================
Connection ID : 236927915
State         : closed
Tunnel Group  : isp1.group-2
```

```
Assignment ID : isp1.tunnel-2
Error Message : tunnel was closed

Control Conn ID   : 236912640          Remote Conn ID    : 3861317210
Tunnel ID         : 3615               Remote Tunnel ID  : 58919
Session ID        : 15275              Remote Session ID : 1626
Time Started      : 04/17/2009 18:41:03
Time Established  : 04/17/2009 18:41:03 Time Closed       : 04/17/2009 18:43:20
CDN Result        : generalError       General Error     : noError
-------------------------------------------------------------------------------
No. of sessions: 2
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session local-name lac1.wholesaler.com
===============================================================================
L2TP Session Summary
===============================================================================
ID                  Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
143524786           143523840           2190        946         established
143526923           143523840           2190        3083        established
143531662           143523840           2190        7822        closed
236926987           236912640           3615        14347       closed
236927915           236912640           3615        15275       closed
379407426           379387904           5789        19522       established
658187773           658178048           10043       9725        established
658198275           658178048           10043       20227       established
658210606           658178048           10043       32558       established
-------------------------------------------------------------------------------
No. of sessions: 9
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp session local-name lac1.wholesaler.com remote-
name lns.retailer1.net
===============================================================================
L2TP Session Summary
===============================================================================
ID                  Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
379407426           379387904           5789        19522       established
-------------------------------------------------------------------------------
No. of sessions: 1
===============================================================================
*A:Dut-C#


*A:Fden-Dut2-BSA2# show router l2tp session connection-id 600407016
===============================================================================
L2TP Session Summary
===============================================================================
ID                  Control Conn ID     Tunnel-ID   Session-ID  State
-------------------------------------------------------------------------------
600407016           600375296           9161        31720       established
  simon@base.lac.base.lns
  interface: gi_base_lns_base_lac
```

```
  service-id: 100
  ip-address: 10.100.2.1
===============================================================================


*A:Fden-Dut2-BSA2# show router l2tp session connection-id 600407016 detail
===============================================================================
L2TP Session Status
===============================================================================

Connection ID: 600407016
State        : established
Tunnel Group : base_lns_base_lac
Assignment ID: t1
Error Message: N/A

Control Conn ID   : 600375296           Remote Conn ID    : 1026712216
Tunnel ID         : 9161                Remote Tunnel ID  : 15666
Session ID        : 31720               Remote Session ID : 25240
Time Started      : 02/02/2010 09:08:54
Time Established  : 02/02/2010 09:08:54 Time Closed       : N/A
CDN Result        : noError             General Error     : noError
-------------------------------------------------------------------------------

PPP information

Service Id           : 100
Interface            : gi_base_lns_base_lac
LCP State            : opened
IPCP State           : opened
IPv6CP State         : initial
PPP MTU              : 1492
PPP Auth-Protocol    : chap
PPP User-Name        : simon@base.lac.base.lns

Subscriber Origin    : radius
Strings Origin       : radius
IPCP Info Origin     : radius
IPv6CP Info Origin   : none

Subscriber           : "simon"
Sub-Profile-String   : "sub1"
SLA-Profile-String   : "sla1"
ANCP-String          : ""
Int-Dest-Id          : ""
App-Profile-String   : ""
Category-Map-Name    : ""

IP Address           : 10.100.2.1
Primary DNS          : N/A
Secondary DNS        : N/A
Primary NBNS         : N/A
Secondary NBNS       : N/A
Address-Pool         : N/A

IPv6 Prefix          : N/A
IPv6 Del.Pfx.        : N/A
Primary IPv6 DNS     : N/A
Secondary IPv6 DNS   : N/A
```

```
Circuit-Id           : (Not Specified)
Remote-Id            : (Not Specified)

Session-Timeout      : N/A
Radius Class         : (Not Specified)
Radius User-Name     : simon@base.lac.base.lns
```

statistics

Syntax **statistics**

Context show>router>l2tp

Description This command displays L2TP statistics.

Output The following output is an example of L2TP statistics information.

Sample Output

```
*A:Dut-C# show router l2tp statistics
===============================================================================
L2TP Statistics
===============================================================================
Tunnels                                 Sessions
-------------------------------------------------------------------------------
Active             : 3                  Active             : 6

Setup history since 04/17/2009 18:38:41

Total              : 4                  Total              : 9
Failed             : 0                  Failed             : 0
Failed Auth        : 0
===============================================================================
*A:Dut-C#
```

tunnel

Syntax **tunnel** [**statistics**] [**detail**] [**peer** *ip-address*] [**state** *tunnel-state*] [**remote-connection-id** *remote-connection-id* (*v3*)] [**group** *group-name*] [**assignment-id** *assignment-id*] [**local-name** *host-name*] [**remote-name** *host-name*]
tunnel [**statistics**] [**detail**] [**peer** *ip-address*] [**state** *tunnel-state*] [**remote-tunnel-id** *remote-tunnel-id* (*v2*)] [**group** *group-name*] [**assignment-id** *assignment-id*] [**local-name** *host-name*] [**remote-name** *host-name*]
tunnel tunnel-id *tunnel-id* (*v2*) [**statistics**] [**detail**]
tunnel connection-id *connection-id* (*v3*) [**statistics**] [**detail**]

Context show>router>l2tp

Description This command displays L2TP tunnel operational information.

Parameters **statistics —** displays L2TP tunnel statistics

detail — displays detailed L2TP tunnel information

peer ***i****p-address* **—** displays information for the the IP address of the peer

state *tunnel-state* **—** displays the operational state of the tunnel

remote-connection-id *remote-connection-id (v3)* **—** displays information for the specified remote connection ID

group *group-name* **—** displays L2TP tunnel information for the specified tunnel group

assignment-id *assignment-id* **—** specifies a string that distinguishes this Layer Two Tunneling Protocol tunnel

local-name *host-name* **—** specifies a local host name used by this system

remote-name *host-name* **—** specifies a remote host name used by this system

connection-id *connection-id* **—** specifies the identification number for a Layer Two Tunneling Protocol connection

Values 1 to 429496729

detail — displays detailed L2TP session information

session-id *session-id* (v2) **—** displays information for the specified the L2TP session

Values 1 to 65535

state *session-state* **—** displays the operational state of the L2TP session

Values closed, closed-by-peer, draining, drained, established, established-idle, idle, wait-reply, wait-conn

peer *ip-address* **—** displays information for the specified peer IP address

Values The following values apply to the 7750 SR:

ipv4-address	a.b.c.d (host bits must be 0)
ipv6-address	x:x:x:x:x:x:x:x[-interface]
	x:x:x:x:x:x:d.d.d.d[-interface]
	x: [0 to FFFF]H
	d: [0 to 255]D
	interface: 32 characters maximum, mandatory for link local addresses

Values The following values apply to the 7450 ESS:
ipv4-address: a.b.c.d (host bits must be 0)

tunnel-id *tunnel-id (v2)* **—** displays information for the specified ID of a L2TP tunnel.
In L2TP version 2, it is the 16-bit tunnel ID

Values 1 to 65535

control-connection-id *connection-id (v3*) **—** displays information for the specified ID of a L2TP tunnel. In L2TP version 3, it is the 32-bit control connection ID

Values 1 to 429496729

Output The following output is an example of L2TP tunnel operational information.

Sample Output

```
*A:Dut-C# show router l2tp tunnel
===============================================================================
Conn ID                      Loc-Tu-ID Rem-Tu-ID State              Ses Active
  Group                                                             Ses Total
    Assignment
-------------------------------------------------------------------------------
143523840                    2190      17525     established        2
  isp1.group-2                                                      3
    isp1.tunnel-3
236912640                    3615      58919     closedByPeer       0
  isp1.group-2                                                      2
    isp1.tunnel-2
379387904                    5789      4233      established        1
  isp1.group-1                                                      1
    isp1.tunnel-1
658178048                    10043     33762     draining           3
  isp1.group-2                                                      3
    isp1.tunnel-2
-------------------------------------------------------------------------------
No. of tunnels: 4
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp tunnel state closed-by-peer detail
===============================================================================
L2TP Tunnel Status
===============================================================================
Connection ID : 236912640
State         : closedByPeer
IP            : 10.20.1.3
Peer IP       : 10.10.20.100
Name          : lac1.wholesaler.com
Remote Name   : lns2.retailer1.net
Assignment ID : isp1.tunnel-2
Group Name    : isp1.group-2
Error Message : Goodbye!

                                        Remote Conn ID    : 3861315584
Tunnel ID         : 3615                Remote Tunnel ID  : 58919
UDP Port          : 1701                Remote UDP Port   : 1701
Preference        : 100
Hello Interval (s): infinite
Idle TO (s)       : 60                  Destruct TO (s)   : 7200
Max Retr Estab    : 5                   Max Retr Not Estab: 5
Session Limit     : 1000                AVP Hiding        : never
Transport Type    : udpIp               Challenge         : never
Time Started      : 04/17/2009 18:41:03 Time Idle         : 04/17/2009 18:43:20
Time Established  : 04/17/2009 18:41:03 Time Closed       : 04/17/2009 18:43:20
```

```
Stop CCN Result   : generalReq          General Error     : noError
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp tunnel state established
===============================================================================
Conn ID                      Loc-Tu-ID Rem-Tu-ID State              Ses Active
  Group                                                             Ses Total
    Assignment
-------------------------------------------------------------------------------
143523840                    2190      17525     established        2
  isp1.group-2                                                      3
    isp1.tunnel-3
379387904                    5789      4233      established        1
  isp1.group-1                                                      1
    isp1.tunnel-1
-------------------------------------------------------------------------------
No. of tunnels: 2
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp tunnel tunnel-id 2190 statistics
===============================================================================
L2TP Tunnel Statistics
===============================================================================
Connection ID: 143523840
-------------------------------------------------------------------------------
              Attempts   Failed                          Active     Total
-------------------------------------------------------------------------------
Sessions      3          0                               2          3
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
              Rx                                         Tx
-------------------------------------------------------------------------------
Ctrl Packets  47                                         47
Ctrl Octets   954                                        1438
Error Packets 0                                          0
-------------------------------------------------------------------------------
*A:Dut-C#


*A:Dut-C# show router l2tp tunnel connection-id 143523840 statistics
===============================================================================
L2TP Tunnel Statistics
===============================================================================
Connection ID: 143523840
-------------------------------------------------------------------------------
              Attempts   Failed                          Active     Total
-------------------------------------------------------------------------------
Sessions      3          0                               2          3
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
              Rx                                         Tx
-------------------------------------------------------------------------------
Ctrl Packets  48                                         48
```

```
Ctrl Octets   974                                       1450
Error Packets 0                                         0
-------------------------------------------------------------------------------
*A:Dut-C#


*A:Dut-C# show router l2tp tunnel remote-tunnel-id 17525 detail
===============================================================================
L2TP Tunnel Status
===============================================================================
Connection ID : 143523840
State         : established
IP            : 10.20.1.3
Peer IP       : 10.10.20.101
Name          : lac1.wholesaler.com
Remote Name   : lns3.retailer1.net
Assignment ID : isp1.tunnel-3
Group Name    : isp1.group-2
Error Message : N/A

                                        Remote Conn ID    : 1148518400
Tunnel ID         : 2190                Remote Tunnel ID  : 17525
UDP Port          : 1701                Remote UDP Port   : 1701
Preference        : 100
Hello Interval (s): 300
Idle TO (s)       : 0                   Destruct TO (s)   : 7200
Max Retr Estab    : 5                   Max Retr Not Estab: 5
Session Limit     : 1000                AVP Hiding        : never
Transport Type    : udpIp               Challenge         : never
Time Started      : 04/17/2009 18:41:14 Time Idle         : N/A
Time Established  : 04/17/2009 18:41:14 Time Closed       : N/A
Stop CCN Result   : noError             General Error     : noError
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp tunnel remote-connection-id 1148518400 statistics
===============================================================================
L2TP Tunnel Statistics
===============================================================================
Connection ID: 143523840
-------------------------------------------------------------------------------
              Attempts   Failed                         Active     Total
-------------------------------------------------------------------------------
Sessions      3          0                              2          3
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
              Rx                                        Tx
-------------------------------------------------------------------------------
Ctrl Packets  50                                        50
Ctrl Octets   1014                                      1474
Error Packets 0                                         0
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================
*A:Dut-C#
```

```
*A:Dut-C# show router l2tp tunnel peer 10.10.20.100 state closed-by-peer detail
===============================================================================
L2TP Tunnel Status
===============================================================================
Connection ID : 236912640
State         : closedByPeer
IP            : 10.20.1.3
Peer IP       : 10.10.20.100
Name          : lac1.wholesaler.com
Remote Name   : lns2.retailer1.net
Assignment ID : isp1.tunnel-2
Group Name    : isp1.group-2
Error Message : Goodbye!

                                        Remote Conn ID    : 3861315584
Tunnel ID         : 3615                Remote Tunnel ID  : 58919
UDP Port          : 1701                Remote UDP Port   : 1701
Preference        : 100
Hello Interval (s): infinite
Idle TO (s)       : 60                  Destruct TO (s)   : 7200
Max Retr Estab    : 5                   Max Retr Not Estab: 5
Session Limit     : 1000                AVP Hiding        : never
Transport Type    : udpIp               Challenge         : never
Time Started      : 04/17/2009 18:41:03 Time Idle         : 04/17/2009 18:43:20
Time Established  : 04/17/2009 18:41:03 Time Closed       : 04/17/2009 18:43:20
Stop CCN Result   : generalReq          General Error     : noError
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp tunnel group isp1.group-2
===============================================================================
Conn ID                      Loc-Tu-ID Rem-Tu-ID State              Ses Active
  Group                                                             Ses Total
    Assignment
-------------------------------------------------------------------------------
143523840                    2190      17525     established        2
  isp1.group-2                                                      3
    isp1.tunnel-3
236912640                    3615      58919     closedByPeer       0
  isp1.group-2                                                      2
    isp1.tunnel-2
658178048                    10043     33762     draining           3
  isp1.group-2                                                      3
    isp1.tunnel-2
-------------------------------------------------------------------------------
No. of tunnels: 3
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp tunnel assignment-id isp1.tunnel-
3 state established statistics
===============================================================================
L2TP Tunnel Statistics
===============================================================================
```

```
Connection ID: 143523840
-------------------------------------------------------------------------------
              Attempts   Failed                             Active     Total
-------------------------------------------------------------------------------
Sessions      3          0                                  2          3
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
              Rx                                            Tx
-------------------------------------------------------------------------------
Ctrl Packets  66                                            66
Ctrl Octets   1310                                          1690
Error Packets 0                                             0
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================
*A:Dut-C#


*A:Dut-C# show router l2tp tunnel local-name lac1.wholesaler.com remote-
name lns2.retailer1.net state draining
===============================================================================
Conn ID                      Loc-Tu-ID Rem-Tu-ID State             Ses Active
  Group                                                            Ses Total
    Assignment
-------------------------------------------------------------------------------
658178048                    10043     33762     draining          3
  isp1.group-2                                                     3
    isp1.tunnel-2
-------------------------------------------------------------------------------
No. of tunnels: 1
===============================================================================
*A:Dut-C#


*A:Fden-Dut2-BSA2# show router l2tp tunnel connection-id 600375296 statistics
===============================================================================
L2TP Tunnel Statistics
===============================================================================

Connection ID: 600375296

-------------------------------------------------------------------------------
             Attempts   Failed                             Active     Total
-------------------------------------------------------------------------------
Sessions     1          0                                  1          1
-------------------------------------------------------------------------------

-------------------------------------------------------------------------------
                Rx                                          Tx
-------------------------------------------------------------------------------
Ctrl Packets    6                                           6
Ctrl Octets     553                                         292
Error Packets   0                                           0
-------------------------------------------------------------------------------

-------------------------------------------------------------------------------
             Accepted   Duplicate                          Out-Of-Wnd
-------------------------------------------------------------------------------
Fsm Messages 4          0                                  0
```

```
-------------------------------------------------------------------------------

-------------------------------------------------------------------------------
             Unsent Max Unsent Cur                       Ack Max    Ack Cur
-------------------------------------------------------------------------------
Q Length     1          0                                1          0
-------------------------------------------------------------------------------

Window Size Cur                                          : 4
acceptedMsgType
  StartControlConnectionRequest                          : 1
  StartControlConnectionConnected                        : 1
  IncomingCallRequest                                    : 1
  IncomingCallConnected                                  : 1
  ZeroLengthBody                                         : 3
originalTransmittedMsgType
  StartControlConnectionReply                            : 1
  Hello                                                  : 2
  IncomingCallReply                                      : 1
  ZeroLengthBody                                         : 3

last cleared time                                        : N/A
===============================================================================
```

On LAC (master node after switchover)

```
===============================================================================
L2TP Tunnel Status
===============================================================================

Connection ID: 11206656
State        : established
IP           : 10.124.0.9
UDP          : 1701
Peer IP      : 10.124.0.3
Peer UDP     : 1701
Tx dst-IP    : 10.124.0.3
Tx dst-UDP   : 1701
Rx src-IP    : 10.124.0.3
Rx src-UDP   : 1701
Name         : mc-lac
Remote Name  : mc-lns
Assignment ID: t1
Group Name   : mc-lac
Acct. Policy : l2tp-base
Error Message: N/A

                                         Remote Conn ID    : 429260800
Tunnel ID         : 171                 Remote Tunnel ID  : 6550
Preference        : 50                  Receive Window    : 64
Hello Interval (s): infinite
Idle TO (s)       : infinite            Destruct TO (s)   : 60
Max Retr Estab    : 5                   Max Retr Not Estab: 5
Session Limit     : 32767               AVP Hiding        : never
Transport Type    : udpIp               Challenge         : never
Time Started      : 02/19/2015 13:00:36 Time Idle         : N/A
Time Established  : 02/19/2015 13:00:36 Time Closed       : N/A
```

```
Stop CCN Result   : noError             General Error     : noError
Blacklist-state   : not-blacklisted
Set Dont Fragment : true

Failover
State             : recoverable
Recovery Conn ID  : N/A
Recovery state    : not-applicable
Recovered Conn ID : N/A
Recovery method   : mcs
Track SRRP        : 124
Ctrl msg behavior : handle
-------------------------------------------------------------------------------

No. of tunnels: 1
===============================================================================
```

On LAC (slave node after switchover)

```
show router l2tp tunnel detail
===============================================================================
L2TP Tunnel Status
===============================================================================

Connection ID: 11206656
State        : draining
IP           : 10.124.0.9
UDP          : 1701
Peer IP      : 10.124.0.3
Peer UDP     : 1701
Tx dst-IP    : 10.124.0.3
Tx dst-UDP   : 1701
Rx src-IP    : 10.124.0.3
Rx src-UDP   : 1701
Name         : mc-lac
Remote Name  : mc-lns
Assignment ID: t1
Group Name   : mc-lac
Acct. Policy : l2tp-base
Error Message: N/A

                                         Remote Conn ID    : 429260800
Tunnel ID         : 171                 Remote Tunnel ID  : 6550
Preference        : 50                  Receive Window    : 64
Hello Interval (s): infinite
Idle TO (s)       : infinite            Destruct TO (s)   : 60
Max Retr Estab    : 5                   Max Retr Not Estab: 5
Session Limit     : 32767               AVP Hiding        : never
Transport Type    : udpIp               Challenge         : never
Time Started      : 02/19/2015 13:00:36 Time Idle         : N/A
Time Established  : 02/19/2015 13:00:36 Time Closed       : N/A
Stop CCN Result   : noError             General Error     : noError
Blacklist-state   : not-blacklisted
Set Dont Fragment : true

Failover
State             : recoverable
```

```
Recovery Conn ID  : N/A
Recovery state    : not-applicable
Recovered Conn ID : N/A
Recovery method   : mcs
Track SRRP        : 124
Ctrl msg behavior : forward-to-mcs-peer
-------------------------------------------------------------------------------

No. of tunnels: 1
===============================================================================
```

On LNS after switchover

```
show router l2tp tunnel detail
===============================================================================
L2TP Tunnel Status
===============================================================================

Connection ID: 429260800
State        : established
IP           : 10.124.0.3
UDP          : 1701
Peer IP      : 10.124.0.9
Peer UDP     : 1701
Tx dst-IP    : 10.124.0.9
Tx dst-UDP   : 1701
Rx src-IP    : 10.124.0.9
Rx src-UDP   : 1701
Name         : mc-lns
Remote Name  : mc-lac
Assignment ID: t1
Group Name   : mc-lns
Acct. Policy : N/A
Error Message: N/A

                                         Remote Conn ID    : 11206656
Tunnel ID         : 6550                Remote Tunnel ID  : 171
Preference        : 50                  Receive Window    : 64
Hello Interval (s): 300
Idle TO (s)       : infinite            Destruct TO (s)   : 60
Max Retr Estab    : 5                   Max Retr Not Estab: 5
Session Limit     : 32767               AVP Hiding        : never
Transport Type    : udpIp               Challenge         : never
Time Started      : 02/19/2015 13:00:36 Time Idle         : N/A
Time Established  : 02/19/2015 13:00:36 Time Closed       : N/A
Stop CCN Result   : noError             General Error     : noError
Blacklist-state   : not-blacklisted
Set Dont Fragment : true

Failover
State             : not-recoverable
Recovery Conn ID  : N/A
Recovery state    : not-applicable
Recovered Conn ID : N/A
Recovery method   : mcs
Track SRRP        : (Not specified)
Ctrl msg behavior : handle
```

```
-------------------------------------------------------------------------------

No. of tunnels: 1
===============================================================================
```

On LAC (master node after switchover; 7536640 is the recovered tunnel, 1865089024 is the recovery tunnel)

```
===============================================================================
L2TP Tunnel Status
===============================================================================

Connection ID: 7536640
State        : established
IP           : 10.124.0.9
UDP          : 1701
Peer IP      : 10.124.0.3
Peer UDP     : 1701
Tx dst-IP    : 10.124.0.3
Tx dst-UDP   : 1701
Rx src-IP    : 10.124.0.3
Rx src-UDP   : 1701
Name         : mc-lac
Remote Name  : mc-lns
Assignment ID: t1
Group Name   : mc-lac
Acct. Policy : l2tp-base
Error Message: N/A

                                         Remote Conn ID    : 433324032
Tunnel ID         : 115                 Remote Tunnel ID  : 6612
Preference        : 50                  Receive Window    : 64
Hello Interval (s): infinite
Idle TO (s)       : infinite            Destruct TO (s)   : 60
Max Retr Estab    : 5                   Max Retr Not Estab: 5
Session Limit     : 32767               AVP Hiding        : never
Transport Type    : udpIp               Challenge         : never
Time Started      : 02/19/2015 13:07:53 Time Idle         : N/A
Time Established  : 02/19/2015 13:07:53 Time Closed       : N/A
Stop CCN Result   : noError             General Error     : noError
Blacklist-state   : not-blacklisted
Set Dont Fragment : true

Failover
State             : recoverable
Recovery Conn ID  : 1865089024
Recovery state    : not-applicable
Recovered Conn ID : N/A
Recovery method   : recovery-tunnel
Track SRRP        : 124
Ctrl msg behavior : handle
-------------------------------------------------------------------------------

Connection ID: 1865089024
State        : closed
IP           : 10.124.0.9
UDP          : 1701
```

```
Peer IP      : 10.124.0.3
Peer UDP     : 1701
Tx dst-IP    : 10.124.0.3
Tx dst-UDP   : 1701
Rx src-IP    : 10.124.0.3
Rx src-UDP   : 1701
Name         : mc-lac
Remote Name  : mc-lns
Assignment ID: t1
Group Name   : mc-lac
Acct. Policy : l2tp-base
Error Message: N/A

                                         Remote Conn ID    : 1169424384
Tunnel ID         : 28459               Remote Tunnel ID  : 17844
Preference        : 50                  Receive Window    : 64
Hello Interval (s): infinite
Idle TO (s)       : 60                  Destruct TO (s)   : 60
Max Retr Estab    : 5                   Max Retr Not Estab: 5
Session Limit     : 32767               AVP Hiding        : never
Transport Type    : udpIp               Challenge         : never
Time Started      : 02/19/2015 13:12:05 Time Idle         : N/A
Time Established  : 02/19/2015 13:12:05 Time Closed       : 02/19/2015
13:12:05
Stop CCN Result   : generalReq          General Error     : noError
Blacklist-state   : not-blacklisted
Set Dont Fragment : true

Failover
State             : not-applicable
Recovery Conn ID  : N/A
Recovery state    : recovery-tunnel
Recovered Conn ID : 7536640
Recovery method   : default
Track SRRP        : 124
Ctrl msg behavior : handle
-------------------------------------------------------------------------------

No. of tunnels: 2
===============================================================================
```

On LAC (slave node after switchover)

```
===============================================================================
L2TP Tunnel Status
===============================================================================

Connection ID: 7536640
State        : draining
IP           : 10.124.0.9
UDP          : 1701
Peer IP      : 10.124.0.3
Peer UDP     : 1701
Tx dst-IP    : 10.124.0.3
Tx dst-UDP   : 1701
Rx src-IP    : 10.124.0.3
Rx src-UDP   : 1701
```

```
Name         : mc-lac
Remote Name  : mc-lns
Assignment ID: t1
Group Name   : mc-lac
Acct. Policy : l2tp-base
Error Message: N/A

                                         Remote Conn ID    : 433324032
Tunnel ID         : 115                 Remote Tunnel ID  : 6612
Preference        : 50                  Receive Window    : 64
Hello Interval (s): infinite
Idle TO (s)       : infinite            Destruct TO (s)   : 60
Max Retr Estab    : 5                   Max Retr Not Estab: 5
Session Limit     : 32767               AVP Hiding        : never
Transport Type    : udpIp               Challenge         : never
Time Started      : 02/19/2015 13:07:53 Time Idle         : N/A
Time Established  : 02/19/2015 13:07:53 Time Closed       : N/A
Stop CCN Result   : noError             General Error     : noError
Blacklist-state   : not-blacklisted
Set Dont Fragment : true

Failover
State             : recoverable
Recovery Conn ID  : N/A
Recovery state    : not-applicable
Recovered Conn ID : N/A
Recovery method   : recovery-tunnel
Track SRRP        : 124
Ctrl msg behavior : forward-to-mcs-peer
-------------------------------------------------------------------------------

No. of tunnels: 1
===============================================================================
```

On LNS after switchover (433324032 is the recovered tunnel, 1169424384 is the recovery tunnel)

```
===============================================================================
L2TP Tunnel Status
===============================================================================

Connection ID: 433324032
State        : established
IP           : 10.124.0.3
UDP          : 1701
Peer IP      : 10.124.0.9
Peer UDP     : 1701
Tx dst-IP    : 10.124.0.9
Tx dst-UDP   : 1701
Rx src-IP    : 10.124.0.9
Rx src-UDP   : 1701
Name         : mc-lns
Remote Name  : mc-lac
Assignment ID: t1
Group Name   : mc-lns
Acct. Policy : N/A
Error Message: N/A
```

```
                                        Remote Conn ID    : 7536640
Tunnel ID         : 6612               Remote Tunnel ID  : 115
Preference        : 50                 Receive Window    : 64
Hello Interval (s): 300
Idle TO (s)       : infinite           Destruct TO (s)   : 60
Max Retr Estab    : 5                  Max Retr Not Estab: 5
Session Limit     : 32767              AVP Hiding        : never
Transport Type    : udpIp              Challenge         : never
Time Started      : 02/19/2015 13:07:53 Time Idle         : N/A
Time Established  : 02/19/2015 13:07:53 Time Closed       : N/A
Stop CCN Result   : noError            General Error     : noError
Blacklist-state   : not-blacklisted
Set Dont Fragment : true

Failover
State             : not-recoverable
Recovery Conn ID  : 1169424384
Recovery state    : not-applicable
Recovered Conn ID : N/A
Recovery method   : recovery-tunnel
Track SRRP        : (Not specified)
Ctrl msg behavior : handle
-------------------------------------------------------------------------------

Connection ID: 1169424384
State        : closed
IP           : 10.124.0.3
UDP          : 1701
Peer IP      : 10.124.0.9
Peer UDP     : 1701
Tx dst-IP    : 10.124.0.9
Tx dst-UDP   : 1701
Rx src-IP    : 10.124.0.9
Rx src-UDP   : 1701
Name         : mc-lns
Remote Name  : mc-lac
Assignment ID: t1
Group Name   : mc-lns
Acct. Policy : N/A
Error Message: N/A

                                        Remote Conn ID    : 1865089024
Tunnel ID         : 17844              Remote Tunnel ID  : 28459
Preference        : 50                 Receive Window    : 64
Hello Interval (s): infinite
Idle TO (s)       : 60                 Destruct TO (s)   : 60
Max Retr Estab    : 5                  Max Retr Not Estab: 5
Session Limit     : 32767              AVP Hiding        : never
Transport Type    : udpIp              Challenge         : never
Time Started      : 02/19/2015 13:12:05 Time Idle         : N/A
Time Established  : 02/19/2015 13:12:05 Time Closed       : 02/19/2015
13:12:05
Stop CCN Result   : generalReq         General Error     : noError
Blacklist-state   : not-blacklisted
Set Dont Fragment : true

Failover
State             : not-applicable
```

```
Recovery Conn ID  : N/A
Recovery state    : recovery-tunnel
Recovered Conn ID : 433324032
Recovery method   : default
Track SRRP        : (Not specified)
Ctrl msg behavior : handle
-------------------------------------------------------------------------------
No. of tunnels: 2
===============================================================================
```

2.14.2.2 Clear Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

router

Syntax **router** *router-instance*

Context clear>router

Description This command enters the context in which to clear various parameters for the specified *router-instance*.

Parameters *router-instance* **—** specifies the router name, CPM router instance, or service ID

Values *router-name* or *service-id*

router-instance : *router-name*

router-name	Base | management | vpls-management | *cpm-vr-name*
cpm-vr-name	[32 characters maximum]

service-id: 1 to 2147483647

Default Base

arp

Syntax **arp** {**all** | *ip-addr* | **interface** {*ip-int-name* | *ip-addr*}}

Context clear>router

Description This command clears all or specific ARP entries.

The scope of ARP cache entries cleared depends on the command line option(s) specified.

Parameters **all —** clears all ARP cache entries

ip-addr — clears the ARP cache entry for the specified IP address

interface *ip-int-name* **—** clears all ARP cache entries for the IP interface with the specified name

interface *ip-addr* **—** clears all ARP cache entries for the specified IP interface with the specified IP address

bfd

Syntax **bfd src-ip** *ip-address* **dst-ip** *ip-address*
bfd all

Context clear>router

Description This command enables the context to clear bi-directional forwarding (BFD) sessions and statistics.

session

Syntax **session src-ip** *ip-address* **dst-ip** *ip-address*

Context clear>router>bfd

Description This command clears BFD sessions.

Parameters **src-ip** *ip-address* **—** specifies the address of the local endpoint of this BFD session

dst-ip *ip-address* **—** specifies the address of the remote endpoint of this BFD session

statistics

Syntax **statistics src-ip** *ip-address* **dst-ip** *ip-address*
statistics all

Context clear>router>bfd

Description This command clears BFD statistics.

Parameters **src-ip** *ip-address* **—** specifies the address of the local endpoint of this BFD session.

dst-ip *ip-address* **—** specifies the address of the remote endpoint of this BFD session.

all — clears statistics for all BFD sessions

dhcp

Syntax **dhcp**

Context clear>router

Description This command enables the context to clear DHCP related information.

dhcp6

Syntax **dhcp6**

Context clear>router

Description This command enables the context to clear DHCP6 related information.

forwarding-table

Syntax **forwarding-table** [*slot-number*]

Context clear>router

Description This command clears entries in the forwarding table (maintained by the IOMs).

If the slot number is not specified, the command forces the route table to be recalculated.

Parameters *slot-number* **—** clears the specified card slot

Default all IOMs or linecards

Values 1 to 10

grt-lookup

Syntax **grt-lookup**

Context clear>router

Description This command re-evaluates route policies for GRT.

icmp

Syntax **icmp all**
icmp global
icmp interface *interface-name*

Context clear>router

Description This command clears ICMP statistics.

Parameters **all —** clears all statistics

global — clears global router statistics

interface-name — clears ICMP statistics for the specified interface

Values 32 characters maximum

icmp-redirect-route

Syntax **icmp-redirect-route** {**all** | *ip-address*}

Context clear>router

Description This command deletes routes created as a result of ICMP redirects received on the management interface.

Parameters **all —** clears all routes

ip-address — clears the routes associated with the specified IP address

icmp6

Syntax **icmp6 all**
icmp6 global
icmp6 interface *interface-name*

Context clear>router

Description This command clears ICMPv6 statistics.

Parameters **all —** clears all statistics

global — clears global router statistics

interface-name — clears ICMPv6 statistics for the specified interface

interface

Syntax **interface** [*ip-int-name* **|** *ip-addr*] [**icmp**] [urpf-stats] [statistics]

Context clear>router

Description This command clears IP interface statistics.

If no IP interface is specified either by IP interface name or IP address, the command will perform the clear operation on all IP interfaces.

Parameters *ip-int-name* **|** *ip-addr* — the IP interface name or IP interface address

Default all IP interfaces

icmp — specifies to reset the ICMP statistics for the IP interface(s)

urpf-stats — resets the statistics associated with uRPF failures

statistics — resets the IP interface traffic statistics

l2tp

Syntax **l2pt**

Context clear>router

Description This command enables the context to clear L2PT data.

group

Syntax **group** *tunnel-group-name*

Context clear>router>l2tp

Description This command clears L2PT data.

Parameters *tunnel-group-name* — specifies a Layer Two Tunneling Protocol Tunnel Group name

tunnel

Syntax **tunnel** *tunnel-id*

Context clear>router>l2tp

Description This command clears L2PT data.

Parameters *tunnel-group-name* — clears L2TP tunnel statistics

statistics

Syntax **statistics**

Context clear>router>l2tp
clear>router>l2tp>group
clear>router>l2tp> tunnel

Description This command clears statistics for the specified context.

statistics

Syntax **statistics** [*ip-address* | *ip-int-name*]

Context clear>router>dhcp
clear>router>dhcp6

Description This command clear statistics for DHCP and DHCP6and DHCP6 relay and snooping statistics.

If no IP address or interface name is specified, then statistics are cleared for all configured interfaces.

If an IP address or interface name is specified, then only data regarding the specified interface is cleared.

Parameters *ip-address* **|** *ip-int-name* — displays statistics for the specified IP interface

neighbor

Syntax **neighbor** {**all |** *ip-address*}
neighbor [**interface** *ip-int-name* **|** *ip-address*]

Context clear>router

Description This command clears IPv6 neighbor information.

Parameters **all —** clears IPv6 neighbors

ip-int-name — clears the specified neighbor interface information

Values 32 characters maximum

ip-address — clears the specified IPv6 neighbors

Values

ipv6-address:	x:x:x:x:x:x:x:x (eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d
	x: [0 to FFFF]H
	d: [0 to 255]D

router-advertisement

Syntax **router-advertisement all**
router-advertisement [**interface** *interface-name*]

Context clear>router

Description This command clears all router advertisement counters.

Parameters *all* — clears all router advertisement counters for all interfaces

interface *interface-name* **—** clear router advertisement counters for the specified interface

2.14.2.3 Debug Commands

destination

Syntax **destination** *trace-destination*

Context debug>trace

Description This command specifies the destination to send trace messages.

Parameters *trace-destination* — The destination to send trace messages.

Values stdout, console, logger, memory

enable

Syntax [**no**] **enable**

Context debug>trace

Description This command enables the trace.

The **no** form of the command disables the trace.

trace-point

Syntax [**no**] **trace-point** [**module** *module-name*] [**type** *event-type*] [**class** *event*-class] [**task** *task-name*] [**function** *function-name*]

Context debug>trace

Description This command adds trace points.

The **no** form of the command removes the trace points.

router

Syntax **router** *router-instance*

Context debug

Description This command enters the context to enable debugging of various protocols and areas of a *router-instance*.

Parameters *router-instance* **—** specify the router name, CPM router instance, or service ID

Values *router-name* or *service-id*

router-instance : *router-name*

router-name	Base | management | *cpm-vr-name*
cpm-vr-name	[32 characters maximum]

service-id: 1 to 2147483647

Default Base

ip

Syntax **ip**

Context debug>router

Description This command configures debugging for IP.

arp

Syntax **arp**

Context debug>router>ip

Description This command configures route table debugging.

icmp

Syntax [**no**] **icmp**

Context debug>router>ip

Description This command enables ICMP debugging.

icmp6

Syntax **icmp6** [*ip-int-name*]
no icmp6

Context debug>router>ip

Description This command enables ICMPv6 debugging.

interface

Syntax [**no**] **interface** [*ip-int-name* **|** *ip-address* **|** ipv6-address **|** ipv6-address]

Context debug>router>ip

Description This command displays the router IP interface table sorted by interface index.

Parameters *ip-address* — only displays the interface information associated with the specified IP address

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-address	a.b.c.d (host bits must be 0)
ipv6-address	x:x:x:x:x:x:x:x (eight 16-bit pieces)
	x:x:x:x:x:x:d.d.d.d
	x: [0 to FFFF]H
	d: [0 to 255]D

Values The following values apply to the 7450 ESS:
ipv4-address: a.b.c.d (host bits must be 0)

ip-int-name — only displays the interface information associated with the specified IP interface name

Values 32 characters maximum

packet

Syntax **packet** [*ip-int-name* **|** *ip-address*] [**headers**] [*protocol-id*]
no packet [*ip-int-name* **|** *ip-address*]

Context debug>router>ip

Description This command enables debugging for IP packets.

Parameters *ip-int-name* — only displays the interface information associated with the specified IP interface name

Values 32 characters maximum

ip-address — only displays the interface information associated with the specified IP address

headers — only displays information associated with the packet header *protocol-id* — specifies the decimal value representing the IP protocol to debug. Well known protocol numbers include ICMP(1), TCP(6), UDP(17). The **no** form the command removes the protocol from the criteria.

Values 0 to 255 (values can be expressed in decimal, hexadecimal, or binary)

route-table

Syntax **route-table** [*ip-prefix*/*prefix-length*]
route-table *ip-prefix*/*prefix-length* **longer**
no route-table

Context debug>router>ip

Description This command configures route table debugging.

Parameters *ip-prefix* — The IP prefix for prefix list entry in dotted decimal notation.

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-prefix	a.b.c.d (host bits must be 0)	
ipv4-prefix-length	0 to 32	
ipv6-prefix	x:x:x:x:x:x:x:x (eight 16-bit pieces)	
	x:x:x:x:x:x:d.d.d.d	
	x:	[0 to FFFF]H
	d:	[0 to 255]D
ipv6-prefix-length	0 to 128	

Values The following values apply to the 7450 ESS:

ipv4-prefix	a.b.c.d (host bits must be 0)
ipv4-prefix-length	0 to 32

longer — specifies the prefix list entry matches any route that matches the specified *ip-prefix* and prefix *mask* length values greater than the specified *mask*

tunnel-table

Syntax **tunnel-table** [*ip-address*] [**ldp** | **rsvp** [**tunnel-id** *tunnel-id*] | **sdp** [**sdp-id** *sdp-id*]]

Context debug>router>ip

Description This command enables debugging for tunnel tables.

l2tp

Syntax **l2tp**

Context debug>router

Description This command enables the context to configure debugging for L2TP.

peer

Syntax **peer** *ip-address* [{**udp-port** *port* | **ip**}]

Context debug>router>l2tp

Description This command enables and configures debugging for an L2TP peer.

Parameters *ip-address* — Specifies the IP address of the L2TP peer

port — Specifies the UDP port for the L2TP peer. This parameter is only supported with L2TPv2 peers.

ip — Displays debugging information for peers using IP transport

mtrace

Syntax [**no**] **mtrace**

Context debug>router

Description This command configures debugging for mtrace.

tms

Syntax [**no**] **tms** [**interface** *tms-interface*] **api** [**detail**] *tms-interface*

Context debug>router

Description This command configures debugging for Threat Management Services.

misc

Syntax [**no**] **misc**

Context debug>router>mtrace

Description This command enables debugging for mtrace miscellaneous.

packet

Syntax [**no**] **packet** [**query** | **request** | **response**]

Context debug>router>mtrace

Description This command enables debugging for mtrace packets.

2.14.2.4 Tools Commands

tunnel

Syntax **tunnel**

Context tools>dump>router>segment-routing> tunnel

Description This command displays Segment Routing tunnels information.

Output

Sample Output

```
*A:Dut-F#  tools dump router segment-routing tunnel
=====================================================================================
===============
Legend: (B) - Backup Next-hop for Fast Re-Route
        (D) - Duplicate
=====================================================================================
------------------------------------------------------------------------------------+
Prefix
             |
Sid-Type        Fwd-Type       In-Label  Prot-
Inst                                                   |
                 Next Hop(s)                                    Out-
Label(s) Interface/Tunnel-ID |
-------------------------------------------------------------------------------------
--------------+
1.0.33.3
 Node            Orig/Transit   70000     OSPF-0
                 1.0.36.3                                        40000       DUTF_TO
_DUTC.1.0
              (B)1.0.26.2                                        30998       DUTF_TO
_DUTB.1.0
1.0.44.4
 Node            Orig/Transit   70001     OSPF-0
                 1.0.26.2                                        30001       DUTF_TO
_DUTB.1.0
              (B)1.0.56.5                                        60001       DUTF_TO
_DUTE.1.0
1.0.55.5
 Node            Orig/Transit   70002     OSPF-0
```

```
                 1.0.56.5                                          60002       DUTF_TO
_DUTE.1.0
              (B)1.0.26.2                                          30995       DUTF_TO
_DUTB.1.0

 Node            Terminating    70003     OSPF-0
 1.0.11.1
 Node            Orig/Transit   70004     OSPF-0
                 1.0.26.2                                          30004       DUTF_TO
_DUTB.1.0
              (B)1.0.36.3                                          40004       DUTF_TO
_DUTC.1.0
1.0.22.2
 Node            Orig/Transit   70005     OSPF-0
                 1.0.26.2                                          30005       DUTF_TO
_DUTB.1.0
              (B)1.0.36.3                                          40004       DUTF_TO
_DUTC.1.0
                                                                   20005
 10.20.1.3
 Node            Orig/Transit   70006     OSPF-0
                 1.0.36.3                                          40006       DUTF_TO
_DUTC.1.0
              (B)1.0.26.2                                          30004       DUTF_TO
_DUTB.1.0
                                                                   20006
 10.20.1.4
 Node            Orig/Transit   70007     OSPF-0
                 1.0.26.2                                          30007       DUTF_TO
_DUTB.1.0
              (B)1.0.56.5                                          60007       DUTF_TO
_DUTE.1.0
10.20.1.5
 Node            Orig/Transit   70008     OSPF-0
                 1.0.56.5                                          60008       DUTF_TO
_DUTE.1.0
              (B)1.0.26.2                                          30001       DUTF_TO
_DUTB.1.0
                                                                   50008

 Node            Terminating    70009     OSPF-0
 10.20.1.1
 Node            Orig/Transit   70010     OSPF-0
                 1.0.26.2                                          30010       DUTF_TO
_DUTB.1.0
              (B)1.0.36.3                                          40010       DUTF_TO
_DUTC.1.0
10.20.1.2
 Node            Orig/Transit   70011     OSPF-0
                 1.0.26.2                                          30011       DUTF_TO
_DUTB.1.0
              (B)1.0.56.5                                          60001       DUTF_TO
_DUTE.1.0
                                                                   50011

 Backup Node     Transit        70994     OSPF-0
                 1.0.56.5                                          60994       DUTF_TO
_DUTE.1.0
```

```
 Backup Node      Transit        70995     OSPF-0
                  1.0.26.2                                          30995       DUTF_TO
_DUTB.1.0

 Backup Node      Transit        70996     OSPF-0
                  1.0.26.2                                          30005       DUTF_TO
_DUTB.1.0

 Backup Node      Transit        70998     OSPF-0
                  1.0.26.2                                          30998       DUTF_TO
_DUTB.1.0

 Backup Node      Transit        70999     OSPF-0
                  1.0.36.3                                          40999       DUTF_TO
_DUTC.1.0

 Adjacency        Transit        262140    OSPF-0
                  1.0.26.2                                          3           DUTF_TO
_DUTB.1.0
               (B)1.0.36.3                                          40004       DUTF_TO
_DUTC.1.0
                                                                    20005

 Adjacency        Transit        262141    OSPF-0
                  1.0.56.5                                          3           DUTF_TO
_DUTE.1.0

 Adjacency        Transit        262142    OSPF-0
                  1.0.36.3                                          3           DUTF_TO
_DUTC.1.0

 Adjacency        Transit        262143    OSPF-0
                  1.0.26.2                                          3           DUTF_TO
_DUTB.1.0
               (B)1.0.56.5                                          60001       DUTF_TO
_DUTE.1.0
                                                                    50011
*A:Dut-F#


*A:Dut-A# tools dump router segment-routing tunnel
=====================================================================================
Legend: (B) - Backup Next-hop for Fast Re-
Route
(D)  Duplicate
=====================================================================================
-------------------------------------------------------------------------------------
 Prefix
              |
 Sid-Type         Fwd-Type       In-Label  Prot-
Inst                                                 |
                  Next Hop(s)                                       Out-
Label(s) Interface/Tunnel-ID |
-------------------------------------------------------------------------------------

 Adjacency        Transit        262136    ISIS-0
                  10.10.2.3                                         3           ip-
10.10.2.1
```

```
 Adjacency       Transit        262137    ISIS-0
                 10.10.2.3                                            3           ip-
10.10.2.1

 Adjacency       Transit        262138    ISIS-0
                 10.10.1.2                                            3           ip-
10.10.1.1

 Adjacency       Transit        262139    ISIS-0
                 10.10.1.2                                            3           ip-
10.10.1.1

 Node            Terminating    474387    ISIS-0
 10.20.1.2
 Node            Orig/Transit   474388    ISIS-0
                 10.10.1.2                                            474388      ip-
10.10.1.1
 10.20.1.3
 Node            Orig/Transit   474389    ISIS-0
                 10.10.2.3                                            474389      ip-
10.10.2.1
 10.20.1.4
 Node            Orig/Transit   475287    ISIS-0
                 10.10.1.2                                            475287      ip-
10.10.1.1
 10.20.1.5
 Node            Orig/Transit   475288    ISIS-0
                 10.10.2.3                                            475288      ip-
10.10.2.1
 10.20.1.6
 Node            Orig/Transit   475289    ISIS-0
                 10.10.1.2                                            475289      ip-
10.10.1.1
*A:Dut-A#

*A:Dut-C# tools dump router segment-routing tunnel
==================================================================================
===============
Legend: (B) - Backup Next-hop for Fast Re-
Route
        (D) -
 Duplicate
==================================================================================
===============
----------------------------------------------------------------------------------
--------------+
 Prefix
              |
 Sid-Type        Fwd-Type       In-Label  Prot-
Inst                                                 |
                 Next Hop(s)                                          Out-
Label(s) Interface/Tunnel-ID |
----------------------------------------------------------------------------------
--------------+

 Adjacency       Transit        262129    ISIS-0
                 10.10.12.2                                           3           ip-
10.10.12.3
              (B)10.10.3.2                                            3           ip-
```

```
10.10.3.3

 Adjacency        Transit        262130    ISIS-0
                  10.10.12.2                                      3           ip-
10.10.12.3
               (B)10.10.3.2                                       3           ip-
10.10.3.3

 Adjacency        Transit        262133    ISIS-0
                  10.10.5.5                                       3           ip-
10.10.5.3
               (B)10.10.12.2                                      474389      ip-
10.10.12.3
                                                                  474390

 Adjacency        Transit        262134    ISIS-0
                  10.10.5.5                                       3           ip-
10.10.5.3
               (B)10.10.12.2                                      474389      ip-
10.10.12.3
                                                                  474390

 Adjacency        Transit        262135    ISIS-0
                  10.10.3.2                                       3           ip-
10.10.3.3
               (B)10.10.12.2                                      3           ip-
10.10.12.3

 Adjacency        Transit        262136    ISIS-0
                  10.10.3.2                                       3           ip-
10.10.3.3
               (B)10.10.12.2                                      3           ip-
10.10.12.3

 Adjacency        Transit        262137    ISIS-0
                  10.10.2.1                                       3           ip-
10.10.2.3

 Adjacency        Transit        262138    ISIS-0
                  10.10.2.1                                       3           ip-
10.10.2.3
 10.20.1.4
 Node             Orig/Transit   474389    ISIS-0
                  10.10.12.2                                      474389      ip-
10.10.12.3
               (B)10.10.5.5                                       474389      ip-
10.10.5.3
 10.20.1.5
 Node             Orig/Transit   474390    ISIS-0
                  10.10.5.5                                       474390      ip-
10.10.5.3
               (B)10.10.12.2                                      474389      ip-
10.10.12.3
                                                                  474390
 10.20.1.6
 Node             Orig/Transit   474391    ISIS-0
                  10.10.5.5                                       474391      ip-
10.10.5.3
               (B)10.10.12.2                                      474391      ip-
```

```
10.10.12.3
 10.20.1.2
 Node             Orig/Transit   474392    ISIS-0
                  10.10.12.2                                      474392      ip-
10.10.12.3
               (B)10.10.3.2                                       474392      ip-
10.10.3.3

 Node             Terminating    474393    ISIS-0
*A:Dut-C#

*A:Dut-C# tools dump router segment-routing tunnel
===================================================================================
Legend: (B) - Backup Next-hop for Fast Re-
Route
        (D)  Duplicate

===================================================================================
-----------------------------------------------------------------------------------
 Prefix
              |
 Sid-Type         Fwd-Type       In-Label  Prot-
Inst                                                |
                  Next Hop(s)                                     Out-
Label(s) Interface/Tunnel-ID |
-----------------------------------------------------------------------------------


 Adjacency        Transit        262129    ISIS-0
                  10.10.12.2                                      3           ip-
10.10.12.3
               (B)10.10.3.2                                       3           ip-
10.10.3.3

 Adjacency        Transit        262130    ISIS-0
                  10.10.12.2                                      3           ip-
10.10.12.3
               (B)10.10.3.2                                       3           ip-
10.10.3.3

 Adjacency        Transit        262133    ISIS-0
                  10.10.5.5                                       3           ip-
10.10.5.3
               (B)10.10.12.2                                      474389      ip-
10.10.12.3
                                                                  474390
 Adjacency        Transit        262134    ISIS-0
                  10.10.5.5                                       3           ip-
10.10.5.3
               (B)10.10.12.2                                      474389      ip-
10.10.12.3
                                                                  474390
 Adjacency        Transit        262135    ISIS-0
                  10.10.3.2                                       3           ip-
10.10.3.3
               (B)10.10.12.2                                      3           ip-
10.10.12.3

 Adjacency        Transit        262136    ISIS-0
```

```
                10.10.3.2                                           3           ip-
10.10.3.3
             (B)10.10.12.2                                          3           ip-
10.10.12.3

 Adjacency      Transit        262137    ISIS-0
                10.10.2.1                                           3           ip-
10.10.2.3

 Adjacency      Transit        262138    ISIS-0
                10.10.2.1                                           3           ip-
10.10.2.3
 10.20.1.4
 Node           Orig/Transit   474389    ISIS-0
                10.10.12.2                                          474389      ip-
10.10.12.3
             (B)10.10.5.5                                           474389      ip-
10.10.5.3
 10.20.1.5
 Node           Orig/Transit   474390    ISIS-0
                10.10.5.5                                           474390      ip-
10.10.5.3
             (B)10.10.12.2                                          474389      ip-
10.10.12.3
                                                                    474390
 10.20.1.6
 Node           Orig/Transit   474391    ISIS-0
                10.10.5.5                                           474391      ip-
10.10.5.3
             (B)10.10.12.2                                          474391      ip-
10.10.12.3
 10.20.1.2
 Node           Orig/Transit   474392    ISIS-0
                10.10.12.2                                          474392      ip-
10.10.12.3
             (B)10.10.3.2                                           474392      ip-
10.10.3.3

 Node           Terminating    474393    ISIS-0
*A:Dut-C#
```

l2tp

Syntax **l2tp**

Context tools>perform>router

Description This command enables the context to configure performance tools for L2TP.

peer

Syntax **peer** *ip-address* [{**udp-port** *port* | **ip**}]

Context tools>perform>router>l2tp

Description This command configures performance tools for an L2TP peer.

Parameters *ip-address* — Specifies the IP address of the L2TP peer

port — Specifies the UDP port for the L2TP peer. This parameter is only supported with L2TPv2 peers.

ip — Enables performance tools for peers using IP transport

3 VRRP

3.1 In This Chapter

This chapter provides information about configuring Virtual Router Redundancy Protocol (VRRP) parameters. Topics in this chapter include:

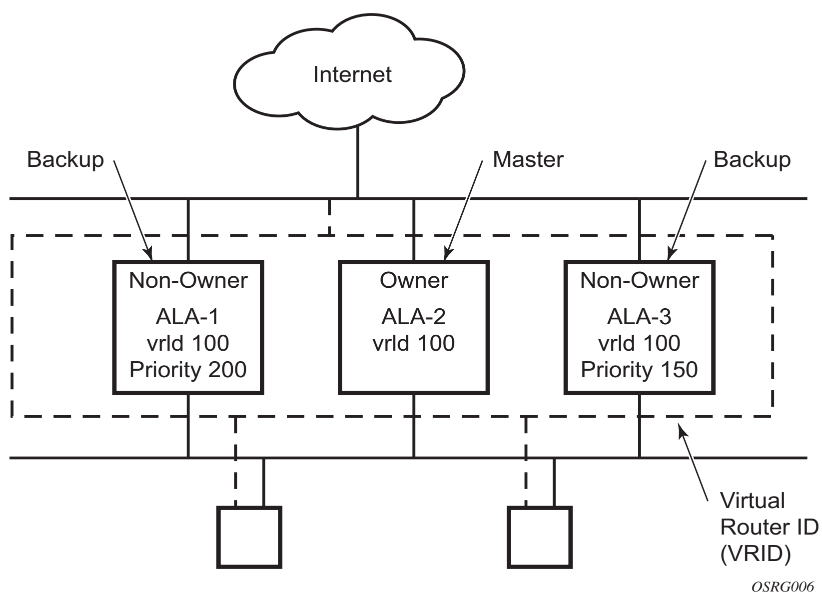
3.2 VRRP Overview

The Virtual Router Redundancy Protocol (VRRP) for IPv4 is defined in the IETF RFC 3768, *Virtual Router Redundancy Protocol*. VRRP for IPv6 is specified in *draft-ietf-vrrp-unified-spec-02.txt* and only applies to the 7750 SR and 7950 XRS. VRRP describes a method of implementing a redundant IP interface shared between two or more routers on a common LAN segment, allowing a group of routers to function as one virtual router. When this IP interface is specified as a default gateway on hosts directly attached to this LAN, the routers sharing the IP interface prevent a single point of failure by limiting access to this gateway address. VRRP can be implemented on IES service interfaces and on core network IP interfaces.

If the master virtual router fails, the backup router configured with the highest acceptable priority becomes the master virtual router. The new master router assumes the normal packet forwarding for the local hosts.

Figure 14 displays an example of a VRRP configuration.

Figure 14 **VRRP Configuration**



3.3 VRRP Components

VRRP consists of the following components:

- Virtual Router
- IP Address Owner
- Primary and Secondary IP Addresses
- Virtual Router Master
- Virtual Router Backup
- Owner and Non-Owner VRRP

3.3.1 Virtual Router

A virtual router is a logical entity managed by VRRP that acts as a default router for hosts on a shared LAN. It consists of a Virtual Router Identifier (VRID) and a set of associated IP addresses (or address) across a common LAN. A VRRP router can backup one or more virtual routers.

The purpose of supporting multiple IP addresses within a single virtual router is for multi-netting. This is a common mechanism that allows multiple local subnet attachment on a single routing interface. Up to four virtual routers are possible on a single Nokia IP interface. The virtual routers must be in the same subnet. Each virtual router has its own VRID, state machine and messaging instance.

3.3.2 IP Address Owner

VRRP can be configured in either an owner or non-owner mode. The owner is the VRRP router whose virtual router IP address is the same as the real interface IP address. This is the router that responds to packets addressed to one of the IP addresses for ICMP pings, TCP connections, etc. All other virtual router instances participating in this message domain must have the same VRID configured and cannot be configured as owner.

Nokia routers allow the virtual routers to be configured as non-owners of the IP address. VRRP on a router can be configured to allow non-owners to respond to ICMP echo requests when they become the virtual router master for the virtual router. Telnet and other connection-oriented protocols can also be configured for non-owner master response. However, the individual application conversations (connections) will not survive a VRRP failover. A non-owner VRRP router operating as a backup will not respond to any packets addressed to any of the virtual router IP addresses.

3.3.3 Primary and Secondary IP Addresses

A primary address is an IP address selected from the set of real interface address. VRRP advertisements are always sent using the primary IP address as the source of the IP packet.

An IP interface must always have a primary IP address assigned for VRRP to be active on the interface. Nokia routers supports both primary and secondary IP addresses (multi-netting) on the IP interface. The virtual router's VRID primary IP address is always the primary address on the IP interface. VRRP uses the primary IP address as the IP address placed in the source IP address field of the IP header for all VRRP messages sent on that interface.

3.3.4 Virtual Router Master

The VRRP router which controls the IP address(es) associated with a virtual router is called the master. The master is responsible for forwarding packets sent to the VRRP IP addresses. An election process provides dynamic failover of the forwarding responsibility if the master becomes unavailable. This allows any of the virtual router IP addresses on the LAN to be used as the default first hop router by end hosts. This enables a higher availability default path without requiring configuration of dynamic routing or router discovery protocols on every end host.

If the master is unavailable, each backup virtual router for the VRID compare the configured priority values to determine the master role. In case of a tie, the virtual router with the highest primary IP address becomes master.

The preempt parameter can be set to false to prevent a backup virtual router with a better priority value from becoming master when an existing non-owner virtual router is the current master. This is determined on a first-come, first-served basis.

While master, a virtual router routes and originates all IP packets into the LAN using the physical MAC address for the IP interface as the Layer 2 source MAC address, not the VRID MAC address. ARP packets also use the parent IP interface MAC address as the Layer 2 source MAC address while inserting the virtual router MAC address in the appropriate hardware address field. VRRP messages are the only packets transmitted using the virtual router MAC address as the Layer 2 source MAC.

3.3.5 Virtual Router Backup

A new virtual router master is selected from the set of VRRP routers available to assume forwarding responsibility for a virtual router should the current master fail.

3.3.6 Owner and Non-Owner VRRP

The owner controls the IP address of the virtual router and is responsible for forwarding packets sent to this IP address. The owner assumes the role of the master virtual router. Only one virtual router in the domain can be configured as owner. All other virtual router instances participating in this message domain must have the same VRID configured.

The most important parameter to be defined on a non-owner virtual router instance is the priority. The priority defines a virtual router's selection order in the master election process. The priority value and the preempt mode determine the virtual router with the highest priority to become the master virtual router.

The base priority is used to derive the in-use priority of the virtual router instance as modified by any optional VRRP priority control policy. VRRP priority control policies can be used to either override or adjust the base priority value depending on events or conditions within the chassis.

For information about non-owner access parameters, refer to VRRP Non-Owner Accessibility.

3.3.7 Configurable Parameters

In addition to backup IP addresses, to facilitate configuration of a virtual router on Nokia routers, the following parameters can be defined in owner configurations:

- Virtual Router ID (VRID)
- Message Interval and Master Inheritance
- VRRP Message Authentication
- Authentication Data
- Virtual MAC Address

The following parameters can be defined in non-owner configurations:

- Virtual Router ID (VRID)

- Priority
- Message Interval and Master Inheritance
- Master Down Interval
- Preempt Mode
- VRRP Message Authentication
- Authentication Data
- Virtual MAC Address
- Inherit Master VRRP Router's Advertisement Interval Timer
- Policies

3.3.7.1 Virtual Router ID (VRID)

The VRID must be configured with the same value on each virtual router associated with the redundant IP address (IP addresses). It is placed in all VRRP advertisement messages sent by each virtual router.

3.3.7.2 Priority

The priority value affects the interaction between this VRID and the same VRID of other virtual routers participating on the same LAN. A higher priority value defines a greater priority in becoming the virtual router master for the VRID. The priority value can only be configured when the defined IP address on the IP interface is different than the virtual router IP address (non-owner mode).

When the IP address on the IP interface matches the virtual router IP address (owner mode), the priority value is fixed at 255, the highest value possible. This virtual router member is considered the owner of the virtual router IP address. There can only be one owner of the virtual router IP address for all virtual router members.

The priority value 0 is reserved for VRRP advertisement message purposes. It is used to tell other virtual routers in the same VRID that this virtual router is no longer acting as master, triggering a new election process. When this happens, each backup virtual router sets its master down timer equal to the skew time value. This shortens the time until one of the backup virtual routers becomes master.

The current master virtual router must transmit a VRRP advertisement message immediately upon receipt of a VRRP message with priority set to 0. This prevents another backup from becoming master for a short period of time.

Non-owner virtual routers may be configured with a priority of 254 through 1. The default value is 100. Multiple non-owners can share the same priority value. When multiple non-owner backup virtual routers are tied (transmit VRRP advertisement messages simultaneously) in the election process, both become master simultaneously, the one with the best priority will win the election. If the priority value in the message is equal to the master's local priority value, then the primary IP address of the local master and the message is evaluated as the tie breaker. The higher IP address becomes master. (The primary IP address is the source IP address of the VRRP advertisement message.)

The priority is also used to determine when to preempt the existing master. If the preempt mode value is true, VRRP advertisement messages from inferior (lower priority) masters are discarded, causing the master down timer to expire and the transition to master state.

The priority value also dictates the skew time added to the master timeout period.

3.3.7.3 IP Addresses

Each virtual router participating in the same VRID should be defined with the same set of IP addresses. These are the IP addresses being used by hosts on the LAN as gateway addresses. Multi-netting supports 16 IP addresses on the IP interface, up to 16 addresses can be assigned to a specific a virtual router instance.

3.3.7.4 Message Interval and Master Inheritance

Each virtual router is configured with a message interval per VRID within which it participates. This parameter must be the same for every virtual router on the VRID.

For IPv4, the default advertisement interval is 1 second and can be configured between 100 milliseconds and 255 seconds 900 milliseconds. For IPv6, the default advertisement interval is 1 second and can be configured between 100 milliseconds and 40 seconds 950 milliseconds.

As specified in the RFC, the advertisement interval field in every received VRRP advertisement message must match the locally configured advertisement interval. If a mismatch occurs, depending on the inherit configuration, the current master's advertisement interval setting can be used to operationally override the locally configured advertisement interval setting. If the current master changes, the new master setting is used. If the local virtual router becomes master, the locally configured advertisement interval is enforced.

If a VRRP advertisement message is received with an advertisement interval set to a value different than the local value and the inherit parameter is disabled, the message is discarded without processing.

The master virtual router on a VRID uses the advertisement interval to load the advertisement timer, specifying when to send the next VRRP advertisement message. Each backup virtual router on a VRID uses the advertisement interval (with the configured local priority) to derive the master down timer value.

VRRP advertisements messages that are fragmented, or contain IP options (IPv4), or contain extension headers (IPv6) require a longer message interval to be configured.

3.3.7.5 Skew Time

The skew time is used to add a time period to the master down interval. This is not a configurable parameter. It is derived from the current local priority of the virtual router's VRID. To calculate the skew time, the virtual router evaluates the following formula:

For IPv4: Skew Time = ((256 - priority) / 256) seconds

For IPv6: Skew Time = (((256 - priority) * Master_Adver_Interval) / 256) centiseconds

The higher priority value, the smaller the skew time will be. This means that virtual routers with a lower priority will transition to master slower than virtual routers with higher priorities.

3.3.7.6 Master Down Interval

The master down interval is a calculated value used to load the master down timer. When the master down timer expires, the virtual router enters the master state. To calculate the master down interval, the virtual router evaluates the following formula:

Master Down Interval = (3 x Operational Advertisement Interval) + Skew Time

The operational advertisement interval is dependent upon the state of the inherit parameter. When the inherit parameter is enabled, the operational advertisement interval is derived from the current master's advertisement interval field in the VRRP advertisement message. When inherit is disabled, the operational advertisement interval must be equal to the locally configured advertisement interval.

The master down timer is only operational when the local virtual router is operating in backup mode.

3.3.7.7 Preempt Mode

Preempt mode is a true or false configured value which controls whether a specific backup virtual router preempts a lower priority master. The IP address owner will always become master when available. Preempt mode cannot be set to false on the owner virtual router. The default value for preempt mode is true.

When preempt mode is true, a master non-owner virtual router will only allow itself to be preempted when the incoming VRRP advertisement message priority field value is one of the following:

- Greater than the virtual router in-use priority value
- Equal to the in-use priority value and the source IP address (primary IP address) is greater than the virtual router instance primary IP address

A backup router will only attempt to become the master router if the preempt mode is true and the received VRRP advertisement priority field is less than the virtual router in-use priority value.

3.3.7.8 VRRP Message Authentication

The authentication type parameter defines the type of authentication used by the virtual router in VRRP advertisement message authentication. VRRP message authentication is applicable to IPv4 only. The current master uses the configured authentication type to indicate any egress message manipulation that must be performed in conjunction with any supporting authentication parameters before transmitting a VRRP advertisement message. The configured authentication type value is transmitted in the message authentication type field with the appropriate authentication data field filled in. Backup routers use the authentication type message field value in interpreting the contained authentication data field within received VRRP advertisement messages.

VRRP supports three message authentication methods which provide varying degrees of security. The supported authentication types are:

- 0 – No Authentication
- 1 – Simple Text Password
- 2 – IP Authentication Header

3.3.7.8.1 Authentication Type 0 – No Authentication

The use of type 0 indicates that VRRP advertisement messages are not authenticated (provides no authentication). The master transmitting VRRP advertisement messages will transmit the value 0 in the egress messages authentication type field and the authentication data field. Backup virtual routers receiving VRRP advertisement messages with the authentication type field equal to 0 will ignore the authentication data field in the message.

All compliant VRRP advertisement messages are accepted. The following fields within the received VRRP advertisement message are checked for compliance (the VRRP specification may require additional checks).

- IP header checks specific to VRRP
  - IP header destination IP address – Must be 224.0.0.18
  - IP header TTL field – Must be equal to 255, the packet must not have traversed any IP routed hops
  - IP header protocol field – must be 112 (decimal)
- VRRP message checks
  - Version field – Must be set to the value 2
  - Type field – Must be set to the value of 1 (advertisement)
  - Virtual router ID field – Must match one of the configured *VRID* on the ingress IP interface (All other fields are dependent on matching the virtual router ID field to one of the interfaces configured *VRID* parameters)
  - Priority field – Must be equal to or greater than the *VRID* in-use priority or be equal to 0 (Equal to the *VRID* in-use priority and 0 requires further processing regarding master/backup and senders IP address to determine validity of the message)
  - Authentication type field – Must be equal to 0
  - Advertisement interval field – Must be equal to the *VRID* configured advertisement interval
  - Checksum field – Must be valid
  - Authentication data fields – Must be ignored.

VRRP messages not meeting the criteria are silently dropped.

3.3.7.8.2 Authentication Type 1 – Simple Text Password

The use of type 1 indicates that VRRP advertisement messages are authenticated with a clear (simple) text password. All virtual routers participating in the virtual router instance must be configured with the same 8 octet password. Transmitting virtual routers place a value of 1 in the VRRP advertisement message authentication type field and put the configured simple text password into the message authentication data field. Receiving virtual routers compare the message authentication data field with the local configured simple text password based on the message authentication type field value of 1.

The same checks are performed for type 0 with the following exceptions (the VRRP specification may require additional checks):

- VRRP message checks
  - Authentication type field – Must be equal to 1
  - Authentication data fields – Must be equal to the *VRID* configured simple text password

Any VRRP message not meeting the type 0 verification checks with the exceptions above are silently discarded.

3.3.7.8.3 Authentication Failure

Any received VRRP advertisement message that fails authentication must be silently discarded with an invalid authentication counter incremented for the ingress virtual router instance.

3.3.7.9 Authentication Data

This feature is different than the VRRP advertisement message field with the same name. This is any required authentication information that is pertinent to the configured authentication type. The type of authentication data used for each authentication type is listed in Table 33.

Table 33 **Authentication Data Type**

Authentication Type	Authentication Data
0	None, authentication is not performed

Table 33 **Authentication Data Type (Continued)**

Authentication Type	Authentication Data
1	Simple text password consisting of 8 octets

3.3.7.10 Virtual MAC Address

The MAC address can be used instead of an IP address in ARP responses when the virtual router instance is master. The MAC address configuration must be the same for all virtual routers participating as a virtual router or indeterminate connectivity by the attached IP hosts will result. All VRRP advertisement messages are transmitted with *ieee-mac-addr* as the source MAC.

3.3.7.11 VRRP Advertisement Message IP Address List Verification

VRRP advertisement messages contain an IP address count field that indicates the number of IP addresses listed in the sequential IP address fields at the end of the message.

The Nokia routers implementation always logs mismatching events. The decision on where and whether to forward the generated messages depends on the configuration of the event manager.

To facilitate the sending of mismatch log messages, each virtual router instance keeps the mismatch state associated with each source IP address in the VRRP master table. Whenever the state changes, a mismatch log message is generated indicating the source IP address within the message, the mismatch or match event and the time of the event.

With secondary IP address support, multiple IP addresses may be found in the list and it should match the IP address on the virtual router instance. Owner and non-owner virtual router instances have the supported IP addresses explicitly defined, making mismatched supported IP address within the interconnected virtual router instances a provisioning issue.

3.3.7.12 Inherit Master VRRP Router's Advertisement Interval Timer

The virtual router instance can inherit the master VRRP router's advertisement interval timer which is used by backup routers to calculate the master down timer.

The inheritance is only configurable in the non-owner nodal context. It is used to allow the current virtual router instance master to dictate the master down timer for all backup virtual routers.

3.3.7.13 IPv6 Virtual Router Instance Operationally Up

Once the 7750 SR or 7950 XRS IPv6 virtual router is properly configured with a minimum of one link-local backup address, the parent interface's router advertisement must be configured to use the virtual MAC address for the virtual router to be considered operationally up.

3.3.7.14 Policies

Policies can be configured to control VRRP priority with the virtual router instance. VRRP priority control policies can be used to override or adjust the base priority value depending on events or conditions within the chassis.

The policy can be associated with more than one virtual router instance. The priority events within the policy override or diminish the base priority dynamically affecting the in-use priority. As priority events clear in the policy, the in-use priority can eventually be restored to the base priority value.

Policies can only be configured in the non-owner VRRP context. For non-owner virtual router instances, if policies are not configured, then the base priority is used as the in-use priority.

3.4 VRRP Priority Control Policies

This implementation of VRRP supports control policies to manipulate virtual router participation in the VRRP master election process and master self-deprecation. The local priority value for the virtual router instance is used to control the election process and master state.

3.4.1 VRRP Virtual Router Policy Constraints

Priority control policies can only be applied to non-owner VRRP virtual router instances. Owner VRRP virtual routers cannot be controlled by a priority control policy because they are required to have a priority value of 255 that cannot be diminished. Only one VRRP priority control policy can be applied to a non-owner virtual router instance.

Multiple VRRP virtual router instances may be associated with the same IP interface, allowing multiple priority control policies to be associated with the IP interface.

An applied VRRP priority control policy only affects the in-use priority on the virtual router instance when the preempt mode has been enabled. A virtual router instance with preempt mode disabled will always use the base priority as the in-use priority, ignoring any configured priority control policy.

3.4.2 VRRP Virtual Router Instance Base Priority

Non-owner virtual router instances must have a base priority value between 1 and 254. The value 0 is reserved for master termination. The value 255 is reserved for owners. The default base priority for non-owner virtual router instances is the value 100.

The base priority is the starting priority for the VRRP instance. The actual in-use priority for the VRRP instance is derived from the base priority and an optional VRRP priority control policy.

3.4.3 VRRP Priority Control Policy Delta In-Use Priority Limit

A VRRP priority control policy enforces an overall minimum value that the policy can inflict on the VRRP virtual router instance base priority. This value provides a lower limit to the delta priority events manipulation of the base priority.

A delta priority event is a conditional event defined in the priority control policy that subtracts a given amount from the current, in-use priority for all VRRP virtual router instances to which the policy is applied. Multiple delta priority events can apply simultaneously, creating a dynamic priority value. The base priority for the instance, less the sum of the delta values derives the actual priority value in-use.

An explicit priority event is a conditional event defined in the priority control policy that explicitly defines the in-use priority for the virtual router instance. The explicitly defined values are not affected by the delta in-use priority limit. When multiple explicit priority events happen simultaneously, the lowest value is used for the in-use priority. The configured base priority is not a factor in explicit priority overrides of the in-use priority.

The allowed range of the Delta In-Use Priority Limit is 1 to 254. The default is 1, which prevents the delta priority events from operationally disabling the virtual router instance.

3.4.4 VRRP Priority Control Policy Priority Events

The main function of a VRRP priority control policy is to define conditions or events that impact the system's ability to communicate with outside hosts or portions of the network. When one or multiple of these events are true, the base priority on the virtual router instance is either overwritten with an explicit value, or a sum of delta priorities is subtracted from the base priority. The result is the in-use priority for the virtual router instance. Any priority event may be configured as an explicit event or a delta event.

Explicit events override all delta events. When multiple explicit events occur, the event with the lowest priority value is assigned to the in-use priority. As events clear, the in-use priority is reevaluated accordingly and adjusted dynamically.

Delta priority events also have priority values. When no explicit events have occurred within the policy, the sum of the occurring delta events priorities is subtracted from the base priority of each virtual router instance. If the result is lower than the delta in-use priority limit, the delta in-use priority limit is used as the in-use priority for the virtual router instance. Otherwise, the in-use priority is set to the base priority less the sum of the delta events.

Each event generates a VRRP priority event message indicating the policy-id, the event type, the priority type (delta or explicit) and the event priority value. Another log message is generated when the event is no longer true, indicating that it has been cleared.

3.4.4.1 Priority Event Hold-Set Timers

Hold-set timers are used to dampen the effect of a flapping event. A flapping event is where the event continually transitions between clear and set. The hold-set value is loaded into a hold set timer that prevents a set event from transitioning to the cleared state until it expires.

Each time an event transitions between cleared and set, the timer is loaded and begins to count down to zero. If the timer reaches zero, the event will be allowed to enter the cleared state once more. Entering the cleared state is always dependent on the object controlling the event conforming to the requirements defined in the event itself. It is possible, on some event types, to have a further set action reload the hold set timer. This extends the amount of time that must expire before entering the cleared state.

For an example of a hold-set timer setting, refer to LAG Degrade Priority Event.

3.4.4.2 Port Down Priority Event

The port down priority event is tied to either a physical port or a SONET/SDH channel for the 7750 SR and 7450 ESS. The port or channel operational state is evaluated to determine a port down priority event or event clear.

When the port or channel operational state is up, the port down priority event is considered false or cleared. When the port or channel operational state is down, the port down priority event is considered true or set.

3.4.4.3 LAG Degrade Priority Event

The LAG degrade priority event is tied to an existing Link Aggregation Group (LAG). The LAG degrade priority event is conditional to percentage of available port bandwidth on the LAG. Multiple bandwidth percentage thresholds may be defined, each with its own priority value.

If the LAG transitions from one threshold to the next, the previous threshold priority value is subtracted from the total delta sum while the new threshold priority value is added to the sum. The new sum is then subtracted from the base priority and compared to the delta in-use priority limit to derive the new in-use priority on the virtual router instance.

The following example illustrates a LAG priority event and it’s interaction with the hold set timer in changing the in-use priority.

The following state and timer settings are used for the LAG events displayed in Table 34:

- User-defined thresholds: 2 ports down 4 ports down 6 ports down
- LAG configured ports: 8 ports
- Hold set timer (hold-set): 5 seconds

Table 34 **LAG Events**

Time	LAG Port State	Parameter	State	Comments
0	All ports down	Event State	Set - 8 ports down	
		Event Threshold	6 ports down	
		Hold Set Timer	5 seconds	Set to **hold-set** parameter
1	One port up	Event State	Set - 8 ports down	Cannot change until Hold Set Timer expires
		Event Threshold	6 ports down	
		Hold Set Timer	5 seconds	Event does not affect timer
2	All ports up	Event State	Set - 8 ports down	Still waiting for Hold Set Timer expires
		Event Threshold	6 ports down	
		Hold Set Timer	3 seconds	
5	All ports up	Event State	Cleared - All ports up	
		Event Threshold	None	Event cleared
		Hold Set Timer	Expired	
100	Five ports down	Event State	Set - 5 ports down	
		Event Threshold	4 ports down	
		Hold Set Timer	Expired	Set to **hold-set** parameter
102	Three ports down	Event State	Set - 5 ports down	
		Event Threshold	4 ports down	
		Hold Set Timer	3 seconds	
103	All ports up	Event State	Set - 5 ports down	
		Event Threshold	4 ports down	
		Hold Set Timer	2 second	

Table 34 **LAG Events (Continued)**

Time	LAG Port State	Parameter	State	Comments
104	Two ports down	Event State	Set - 5 ports down	
		Event Threshold	4 ports down	
		Hold Set Timer	1 second	Current threshold is 5, so 2 down has no effect
105	Two ports down	Event State	Set - 2 ports down	
		Event Threshold	2 ports down	
		Hold Set Timer	Expired	
200	Four ports down	Event State	Set - 2 ports down	
		Event Threshold	4 ports down	
		Hold Set Timer	5 seconds	Set to **hold-set** parameter
202	Seven ports down	Event State	Set - 7 ports down	Changed due to increase
		Event Threshold	6 ports down	
		Hold Set Timer	5 seconds	Set to **hold-set** due to threshold increase
206	All ports up	Event State	Set - 7 ports down	
		Event Threshold	6 ports down	
		Hold Set Timer	1 second	
207	All ports up	Event State	Cleared - All ports up	
		Event Threshold	None	Event cleared
		Hold Set Timer	Expired	

3.4.4.4 Host Unreachable Priority Event

The host unreachable priority event creates a continuous ping task that is used to test connectivity to a remote host. The path to the remote host and the remote host itself must be capable and configured to accept ICMP echo request and replies for the ping to be successful.

The ping task is controlled by interval and size parameters that define how often the ICMP request messages are transmitted and the size of each message. A historical missing reply parameter defines when the ping destination is considered unreachable.

When the host is unreachable, the host unreachable priority event is considered true or set. When the host is reachable, the host unreachable priority event is considered false or cleared.

3.4.4.5 Route Unknown Priority Event

The route unknown priority event defines a task that monitors the existence of a given route prefix in the system's routing table.

The route monitoring task can be constrained by a condition that allows a prefix that is less specific than the defined prefix to be considered as a match. The source protocol can be defined to indicate the protocol the installed route must be populated from. To further define match criteria when multiple instances of the route prefix exist, an optional next hop parameter can be defined.

When a route prefix exists within the active route table that matches the defined match criteria, the route unknown priority event is considered false or cleared. When a route prefix does not exist within the active route table matching the defined criteria, the route unknown priority event is considered true or set.

3.5 VRRP Non-Owner Accessibility

Although the RFC states that only VRRP owners can respond to ping and other management-oriented protocols directed to the VRID IP addresses, the routers allow an override of this restraint on a per VRRP virtual router instance basis.

3.5.1 Non-Owner Access Ping Reply

When non-owner access ping reply is enabled on a virtual router instance, ICMP echo request messages destined to the non-owner virtual router instance IP addresses are not discarded at the IP interface when operating in master mode. ICMP echo request messages are always discarded in backup mode.

When non-owner access ping reply is disabled on a virtual router instance, ICMP echo request messages destined to the non-owner virtual router instance IP addresses are silently discarded in both the master and backup modes.

3.5.2 Non-Owner Access Telnet

When non-owner access Telnet is enabled on a virtual router instance, authorized Telnet sessions may be established that are destined to the virtual router instance IP addresses when operating in master mode. Telnet sessions are always discarded at the IP interface when destined to a virtual router IP address operating in backup mode. Enabling non-owner access Telnet does not guarantee Telnet access, proper management and security features must be enabled to allow Telnet on this interface and possibly from the given source IP address.

When non-owner access Telnet is disabled on a virtual router instance, Telnet sessions destined to the non-owner virtual router instance IP addresses are silently discarded in both master and backup modes.

3.5.3 Non-Owner Access SSH

When non-owner access SSH is enabled on a virtual router instance, authorized SSH sessions may be established that are destined to the virtual router instance IP addresses when operating in master mode. SSH sessions are always discarded at the IP interface when destined to a virtual router IP address operating in backup mode. Enabling non-owner access SSH does not guarantee SSH access, proper management and security features must be enabled to allow SSH on this interface and possibly from the given source IP address. SSH is applicable to IPv4 VRRP only.

When non-owner access SSH is disabled on a virtual router instance, SSH sessions destined to the non-owner virtual router instance IP addresses are silently discarded in both master and backup modes.

3.6 VRRP Configuration Process Overview

Figure 15 displays the process to provision VRRP parameters.

Figure 15 **VRRP Configuration and Implementation Flow - Part 1**

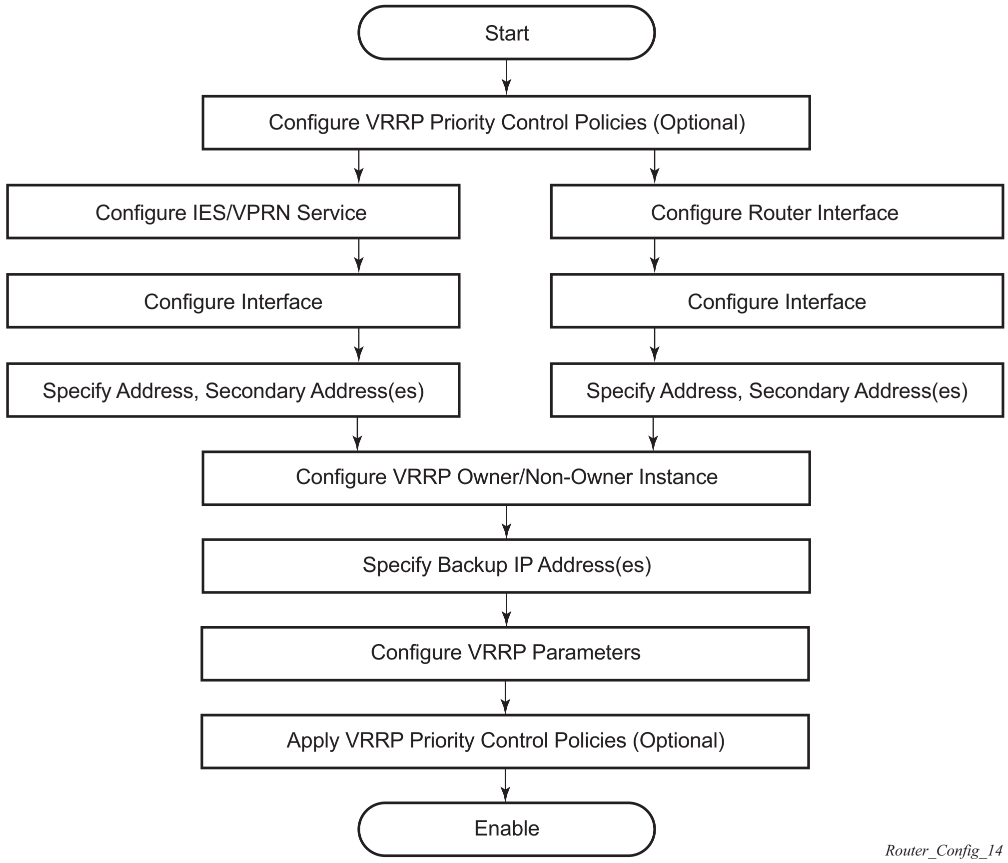
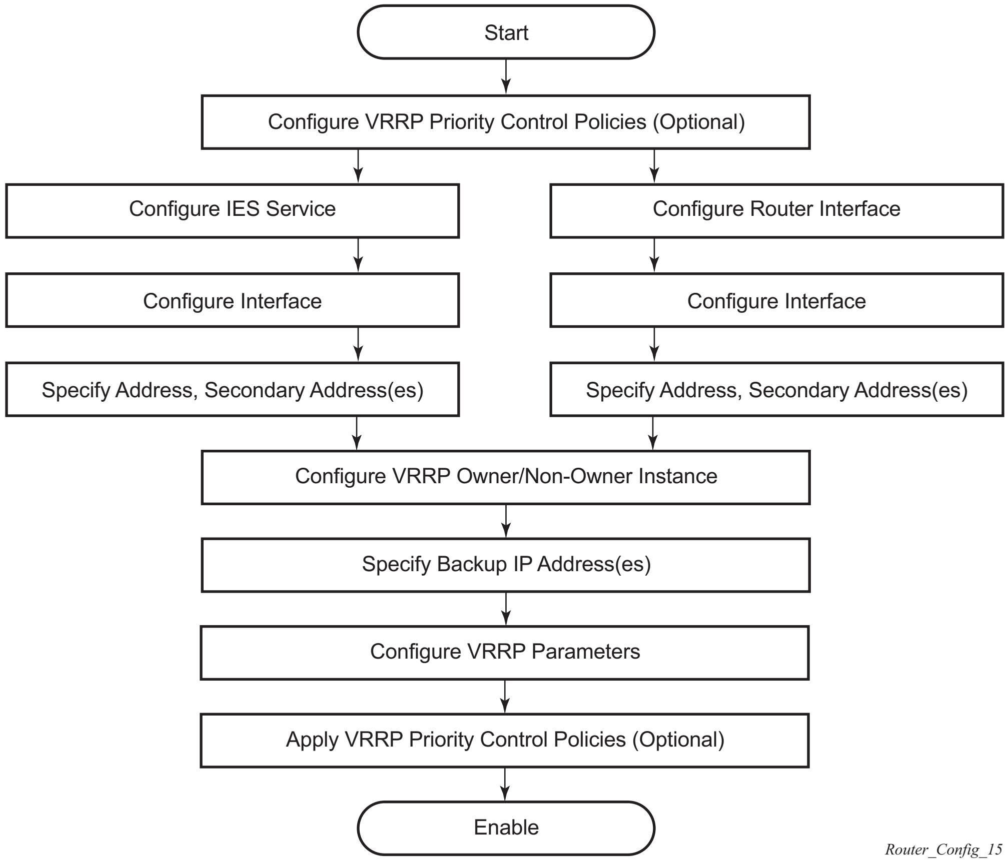


Figure 16 **VRRP Configuration and Implementation Flow**



3.7 Configuration Notes

This section describes VRRP configuration caveats.

3.7.1 General

- Creating and applying VRRP policies are optional.
- Backup command:
  - The backup IP address(es) must be on the same subnet. The backup addresses explicitly define which IP addresses are in the VRRP advertisement message IP address list.

– In the owner mode, the backup IP address must be identical to one of the interface’s IP addresses. The backup address explicitly defines which IP addresses are in the VRRP advertisement message IP address list.
– For IPv6, one of the backup addresses configured must be the link-local address of the owner VRRP instance.

3.8 Configuring VRRP with CLI

This section provides information to configure VRRP using the command line interface.

Topics in this section include:

- VRRP Configuration Overview
  - Preconfiguration Requirements
- Basic VRRP Configurations
  - VRRP Policy
  - VRRP IES Service Parameters
  - VRRP Router Interface Parameters
- Common Configuration Tasks
  - Creating Interface Parameters
- Configuring VRRP Policy Components
  - Configuring Service VRRP Parameters
  - Configuring Router Interface VRRP Parameters
- VRRP Configuration Management Tasks
  - Modifying a VRRP Policy
  - Modifying Service and Interface VRRP Parameters

3.9 VRRP Configuration Overview

Configuring VRRP policies and configuring VRRP instances on interfaces and router interfaces is optional. The basic owner and non-owner VRRP configurations on an IES or router interface must specify the **backup** *ip-address* parameter.

VRRP helps eliminate the single point of failure in a routed environment by using virtual router IP address shared between two or more routers connecting the common domain. VRRP provides dynamic fail over of the forwarding responsibility if the master becomes unavailable.

The VRRP implementation allows one master per IP subnet. All other VRRP instances in the same domain must be in backup mode.

3.9.1 Preconfiguration Requirements

VRRP policies:

- VRRP policies must be configured before they can be applied to an interface or IES/VPRN VRRP instance. VRRP policies are configured in the **config>vrrp** context.

Configuring VRRP on an IES or VPRN service interface:

- The service customer account must be created prior to configuring an IES or VPRN VRRP instance.
- The interface address must be specified in the both the owner and non-owner IES, VPRN, or router interface instances.

3.10 Basic VRRP Configurations

Configure VRRP parameters in the following contexts:

- VRRP Policy
- VRRP IES Service Parameters
- VRRP Router Interface Parameters

3.10.1 VRRP Policy

Configuring and applying VRRP policies are optional. There are no default VRRP policies. Each policy must be explicitly defined. A VRRP configuration must include the following:

- Policy ID
- Define at least one of the following priority events:
  - Port down
  - LAG port down
  - Host unreachable
  - Route unknown

The following example displays a sample configuration of a VRRP policy for the 7450 ESS:

```
A:SR2>config>vrrp>policy# info
----------------------------------------------
            delta-in-use-limit 50
            priority-event
                port-down 4/1/2
                    hold-set 43200
                    priority 100 delta
                exit
                port-down 4/1/3
                    priority 200 explicit
                exit
                lag-port-down 1
                    number-down 3
                        priority 50 explicit
                    exit
                exit
                host-unreachable 10.10.24.4
                    drop-count 25
                exit
                route-unknown 10.10.0.0/32
              priority 50 delta
                exit
            exit
----------------------------------------------
```

The following example displays a sample configuration of a VRRP policy for the 7750 SR and 7950 XRS:

```
A:SR2>config>vrrp>policy# info
----------------------------------------------
            delta-in-use-limit 50
            priority-event
                port-down 4/1/2
                    hold-set 43200
                    priority 100 delta
                exit
                port-down 4/1/3
                    priority 200 explicit
                exit
                lag-port-down 1
                    number-down 3
                        priority 50 explicit
                    exit
                exit
                host-unreachable 10.10.24.4
                    drop-count 25
                exit
                route-unknown 10.10.0.0/32
                    priority 50 delta
                    protocol bgp
                exit
            exit
----------------------------------------------
```

3.10.2 VRRP IES Service Parameters

VRRP parameters are configured within an IES service with two contexts, owner or non-owner. The status is specified when the VRRP configuration is created. When configured as owner, the virtual router instance owns the backup IP addresses. All other virtual router instances participating in this message domain must have the same **vrid** configured and cannot be configured as owner.

For IPv4, up to 4 virtual routers IDs (vrid) can be configured on an IES service interface. Each virtual router instance can manage up to 16 backup IP addresses. For IPv6, only one virtual router instance can be configured on an IES service interface.

VRRP parameters configured within an IES service must include the following:

- VRID
- Backup IP address(es)

The following example displays a sample configuration of a IES service owner and non-owner VRRP configurations.

```
A:SR2>config>service>ies# info
----------------------------------------------
            interface "tuesday" create
                address 10.10.36.2/24
                sap 7/1/1.2.2 create
                vrrp 19 owner
                    backup 10.10.36.2
                    authentication-key "testabc"
                exit
            exit
            interface "testing" create
                address 10.10.10.16/24
                sap 1/1/55:0 create
                vrrp 12
                    backup 10.10.10.15
                    policy 1
                    authentication-key "testabc"
                exit
            exit
            no shutdown
----------------------------------------------
A:SR2>config>service>ies#
```

3.10.2.1 Configure VRRP for IPv6

The following output shows a VRRP for IPV6 configuration example and applies to the 7750 SR and 7950 XRS. The interface must be configured first.

```
*A:nlt7750-3>config>router>router-advert# info
----------------------------------------------
            interface "DSC-101-Application"
                use-virtual-mac
                no shutdown
            exit
...
----------------------------------------------
*A:nlt7750-3>config>router>router-advert#


*A:nlt7750-3>config>service>ies# info
----------------------------------------------
            description "VLAN 921 for DSC-101 Application"
            interface "DSC-101-Application" create
                address 10.152.2.220/28
                vrrp 217
                    backup 10.152.2.222
                    priority 254
                    ping-reply
                exit
                ipv6
                    address FD10:D68F:1:221::FFFD/64
                    link-local-address FE80::D68F:1:221:FFFD preferred
                    vrrp 219
                        backup FE80::D68F:1:221:FFFF
                        priority 254
                        ping-reply
                    exit
                exit
                sap ccag-1.a:921 create
                    description "cross connect to VPLS 921"
                exit
            exit
            no shutdown
----------------------------------------------
*A:nlt7750-3>config>service>ies#
```

3.10.3 VRRP Router Interface Parameters

VRRP parameters are configured on a router interface with two contexts, owner or non-owner. The status is specified when the VRRP configuration is created. When configured as owner, the virtual router instance owns the backed up IP addresses. All other virtual router instances participating in this message domain must have the same vrid configured and cannot be configured as owner.

For IPv4, up to 4 virtual routers IDs (vrid) can be configured on a router interface. Each virtual router instance can manage up to 16 backup IP addresses. For IPv6, only one virtual router instance can be configured on a router interface.

VRRP parameters configured on a router interface must include the following:

- VRID
- Backup IP address(es)

The following example displays a sample configuration of a router interface owner and non-owner VRRP configurations.

```
A:SR4>config>router# info
#------------------------------------------
echo "IP Configuration "
#------------------------------------------
        interface "system"
            address 10.10.0.4/32
        exit
        interface "test1"
            address 10.10.14.1/24
            secondary 10.10.16.1/24
            secondary 10.10.17.1/24
            secondary 10.10.18.1/24
        exit
        interface "test2"
            address 10.10.10.23/24
            vrrp 1 owner
                backup 10.10.10.23
                authentication-key "testabc"
            exit
        exit
#------------------------------------------
A:SR4>config>router#
```

3.11 Common Configuration Tasks

This section provides a brief overview of the tasks that must be performed to configure VRRP and provides the CLI commands.

VRRP parameters are defined under a service interface or a router interface context. An IP address must be assigned to each IP interface. Only one IP address can be associated with an IP interface but several secondary IP addresses also be associated.

Owner and non-owner configurations must include the following parameters:

- All participating routers in a VRRP instance must be configured with the same *vrid.*
- All participating *non-owner* routers can specify up to 16 backup IP addresses (IP addresses the master is representing). The *owner* configuration must include at least one backup IP address.

- For IPv6, all participating routers must be configured with the same link-local backup address (the one configured for the owner instance.)

Other owner and non-owner configurations include the following optional commands:

- authentication-key
- MAC
- message-interval

In addition to the common parameters, the following *non-owner* commands can be configured:

- master-int-inherit
- priority
- policy
- ping-reply
- preempt
- telnet-reply
- ssh-reply (IPv4 only)
- [no] shutdown

3.11.1 Creating Interface Parameters

If you have multiple subnets configured on an Ethernet interface, you can configure VRRP on each subnet.

The following displays an IP interface configuration example:

```
A:SR1>config>router# info
#------------------------------------------
echo "IP Configuration "
#------------------------------------------
        interface "system"
            address 10.10.0.1/32
        exit
        interface "testA"
            address 123.123.123.123/24
        exit
        interface "testB"
            address 10.10.14.1/24
            secondary 10.10.16.1/24
            secondary 10.10.17.1/24
            secondary 10.10.18.1/24
        exit
        router-id 10.10.0.1
```

```
#------------------------------------------
A:SR1>config>router#
```

3.12 Configuring VRRP Policy Components

The following displays a VRRP policy configuration example:

```
A:SR1>config>vrrp# info
----------------------------------------------
        policy 1
            delta-in-use-limit 50
            priority-event
                port-down 1/1/2
                    hold-set 43200
                    priority 100 delta
                exit
                route-unknown 0.0.0.0/0
                    protocol isis
                exit
            exit
        exit
----------------------------------------------
A:SR1>config>vrrp#
```

3.12.1 Configuring Service VRRP Parameters

VRRP parameters can be configured on an interface in a service to provide virtual default router support which allows traffic to be routed without relying on a single router in case of failure. VRRP can be configured the following ways:

- Non-Owner VRRP Example
- Owner Service VRRP

3.12.1.1 Non-Owner VRRP Example

The following displays a basic non-owner VRRP configuration example:

```
A:SR2>config>service>ies# info
----------------------------------------------
...
            interface "testing" create
                address 10.10.10.16/24
                sap 1/1/55:0 create
                vrrp 12
                    backup 10.10.10.15
```

```
                    policy 1
                    authentication-key "testabc"
                exit
            exit
            no shutdown
----------------------------------------------
A:SR2>config>service>ies#
```

3.12.1.2 Owner Service VRRP

The following displays the owner VRRP configuration example:

```
A:SR4>config>router# info
#------------------------------------------
echo "IP Configuration "
#------------------------------------------
...
        interface "test2"
            address 10.10.10.23/24
            vrrp 1 owner
                backup 10.10.10.23
                authentication-key "testabc"
            exit
        exit
#------------------------------------------
A:SR4>config>router#
```

3.12.2 Configuring Router Interface VRRP Parameters

VRRP parameters can be configured on an interface in an interface to provide virtual default router support which allows traffic to be routed without relying on a single router in case of failure.

VRRP can be configured the following ways:

- Router Interface VRRP Non-Owner

3.12.2.1 Router Interface VRRP Non-Owner

The following displays a non-owner interface VRRP configuration example:

```
A:SR2>config># info
#------------------------------------------
     interface "if-test"
            address 10.20.30.40/24
            secondary 10.10.50.1/24
```

```
            secondary 10.10.60.1/24
            secondary 10.10.70.1/24
            vrrp 1
                backup 10.10.50.2
                backup 10.10.60.2
                backup 10.10.70.2
                backup 10.20.30.41
                ping-reply
                telnet-reply
                authentication-key "testabc"
            exit
        exit
#------------------------------------------
A:SR2>config>#
```

3.12.2.2 Router Interface VRRP Owner

The following displays router interface owner VRRP configuration example:

```
A:SR2>config>router# info
#------------------------------------------
     interface "vrrpowner"
            address 10.10.10.23/24
            vrrp 1 owner
                backup 10.10.10.23
                authentication-key "testabc"
            exit
        exit
#------------------------------------------
A:SR2>config>router#
```

3.13 VRRP Configuration Management Tasks

This section discusses the following VRRP configuration management tasks:

- Modifying a VRRP Policy
- Deleting a VRRP Policy
- Modifying Service and Interface VRRP Parameters
  – Modifying Non-Owner Parameters
  – Modifying Owner Parameters
  – Deleting VRRP on an Interface or Service

3.13.1 Modifying a VRRP Policy

To access a specific VRRP policy, you must specify the policy ID. To display a list of VRRP policies, use the show vrrp policy command.

The following example displays the modified VRRP policy configuration:

```
A:SR2>config>vrrp>policy# info
----------------------------------------------
            delta-in-use-limit 50
            priority-event
                port-down 1/1/2
                    hold-set 43200
                    priority 100 delta
                exit
                port-down 1/1/3
                    priority 200 explicit
                exit
                host-unreachable 10.10.24.4
                    drop-count 25
                exit
            exit
----------------------------------------------
A:SR2>config>vrrp>policy#
```

3.13.1.1 Deleting a VRRP Policy

Policies are only applied to non-owner VRRP instances. A VRRP policy cannot be deleted if it is applied to an interface or to an IES service. Each instance in which the policy is applied must be deleted.

The Applied column in the following example displays whether or not the VRRP policies are applied to an entity.

```
A:SR2#
===============================================================================
VRRP Policies
===============================================================================
Policy    Current             Current      Current      Delta       Applied
Id        Priority & Effect   Explicit     Delta Sum    Limit
-------------------------------------------------------------------------------
1         200 Explicit        200          100          50          Yes
15        254                 None         None         1           No
32        100                 None         None         1           No
===============================================================================
A:SR2#
```

3.13.2 Modifying Service and Interface VRRP Parameters

3.13.2.1 Modifying Non-Owner Parameters

Once a VRRP instance is created as non-owner, it cannot be modified to the owner state. The vrid must be deleted and then recreated with the owner keyword to invoke IP address ownership.

3.13.2.2 Modifying Owner Parameters

Once a VRRP instance is created as owner, it cannot be modified to the non-owner state. The vrid must be deleted and then recreated *without* the owner keyword to remove IP address ownership.

Entering the owner keyword is optional when entering the vrid for modification purposes.

3.13.2.3 Deleting VRRP on an Interface or Service

The *vrid* does not need to be shutdown to remove the virtual router instance from an interface or service.

Example:

```
config>router#interface
config>router# interface if-test
config>router>if# shutdown
config>router>if# exit
config>router# no interface if-test
config>router#
```

The following example displays the command usage to delete a VRRP instance from an interface or IES service:

Example:

```
config>service#ies 10
config>service>ies# interface “test”
config>service>ies>if# vrrp 1
config>service>ies>if>vrrp# shutdown
config>service>ies>if>vrrp# exit
config>service>ies>if# no vrrp 1
config>service>ies>if# exit all
```

3.14 VRRP Configuration Command Reference

3.14.1 Command Hierarchies

- IPv4 Interface VRRP Commands
- Router Interface Commands
- IPv6 Interface VRRP Commands
- Priority Control Event Policy Commands

3.14.1.1 IPv4 Interface VRRP Commands

config
— **router**
— [**no**] **interface** *interface-name*
— **vrrp** *virtual-router-id* [**owner**] [**passive**]
— **no vrrp** *virtual-router-id*
— **authentication-key** [*authentication-key* | *hash-key*] [**hash** | **hash2**]
— **no authentication-key**
— [**no**] **backup** *ip-address*
— [**no**] **bfd-enable** *service-id* **interface** *interface-name* **dst-ip** *ip-address*
— [**no**] **bfd-enable interface** *interface-name* **dst-ip** *ip-address*
— **init-delay** *seconds*
— **no init-delay**
— **mac** *mac-address*
— **no mac**
— [**no**] **master-int-inherit**
— **message-interval** {[*seconds*] [**milliseconds** *milliseconds*]}
— **no message-interval**
— [**no**] **ping-reply**
— **policy** *policy-id*
— **no policy**
— [**no**] **preempt**
— **priority** *priority*
— **no priority**
— [**no**] **ssh-reply**
— [**no**] **standby-forwarding**
— [**no**] **telnet-reply**
— [**no**] **shutdown**
— [**no**] **traceroute-reply**

VRRP commands are applicable to router interfaces, IES interfaces and VPRN. The **authentication-key**, **bfd-enable**, and **ssh-reply** commands are applicable only to IPv4 contexts, not IPv6.

3.14.1.2 Router Interface Commands

config
— **router** [*router-name*]
— [**no**] **interface** *ip-int-name*
— [**no**] **ipv6**
— **address** *ipv6-address***/***prefix-length* [**eui-64**]
— **no address** *ipv6-address***/***prefix-length*
— **icmp6**
— **packet-too-big** [*number seconds*]
— **no packet-too-big**
— **param-problem** [*number seconds*]
— **no param-problem**
— **redirects** [*number seconds*]
— **no redirects**
— **time-exceeded** [*number seconds*]
— **no time-exceeded**
— **unreachables** [*number seconds*]
— **no unreachables**
— **link-local-address** *ipv6-address* [**preferred**]
— **no link-local-address**
— [**no**] **local-proxy-nd**
— **neighbor** *ipv6-address* [*mac-address*]
— **no neighbor** *ipv6-address*
— **proxy-nd-policy** *policy-name* [*policy-name*...(up to 5 max)]
— **no proxy-nd-policy**

3.14.1.3 IPv6 Interface VRRP Commands

The IPv6 interface commands only apply to the 7750 SR and 7950 XRS.

config
— **router** [*router-name*]
— [**no**] **interface** *ip-int-name*
— [**no**] **ipv6**
— **vrrp** *virtual-router-id* [**owner**][**passive**]
— **no vrrp** *virtual-router-id*
— [**no**] **backup** *ipv6-address*
— [**no**] **bfd-enable** *service-id* **interface** *interface-name* **dst-ip** *ip-address*
— [**no**] **bfd-enable** **interface** *interface-name* **dst-ip** *ip-address*
— **init-delay** *seconds*
— **no init-delay**
— **mac** *mac-address*
— **no mac**
— [**no**] **master-int-inherit**
— **message-interval** {[*seconds*] [**milliseconds** *milliseconds*]}
— **no message-interval**
— [**no**] **ping-reply**
— **policy** *vrrp-policy-id*

— **no policy**
— [**no**] **preempt**
— **priority** *priority*
— **no priority**
— [**no**] **shutdown**
— [**no**] **standby-forwarding**
— [**no**] **telnet-reply**
— [**no**] **traceroute-reply**

3.14.1.4 Priority Control Event Policy Commands

config
— **vrrp**
— [**no**] **policy** *policy-id* [**context** *service-id*]
— **delta-in-use-limit** *limit*
— **no delta-in-use-limit**
— **description** *description string*
— **no description**
— [**no**] **priority-event**
— [**no**] **host-unreachable** *ip-address*
— [**no**] **host-unreachable** *ipv6-address*
— **drop-count** *consecutive-failures*
— **no drop-count**
— **hold-clear** *seconds*
— **no hold-clear**
— **hold-set** *seconds*
— **no hold-set**
— **interval** *seconds*
— **no interval**
— **padding-size** *size*
— **no padding-size**
— **priority** *priority-level* [{**delta** | **explicit**}]
— **no priority**
— **timeout** *seconds*
— **no timeout**
— [**no**] **lag-port-down** *lag-id*
— **hold-clear** *seconds*
— **no hold-clear**
— **hold-set** *seconds*
— **no hold-set**
— [**no**] **number-down** *number-of-lag-ports-down*
— **priority** *priority-level* [{**delta** | **explicit**}]
— **no priority**
— **weight-down** *lag-ports-down-weight*
— **no weight-down**
— **mc-ipsec-non-forwarding** *tunnel-grp-id*
— **hold-clear** *seconds*
— **no hold-clear**
— **hold-set** *seconds*
— **no hold-set**
— **priority** *priority-level* [{**delta** | **explicit**}]

— **no priority**
— [**no**] **port-down** *port-id*
— **hold-clear** *seconds*
— **no hold-clear**
— **hold-set** *seconds*
— **no hold-set**
— **priority** *priority-level* [{**delta** | **explicit**}]
— **no priority**
— [**no**] **route-unknown** *ip-prefix***/***mask*
— **hold-clear** *seconds*
— **no hold-clear**
— **hold-set** *seconds*
— **no hold-set**
— **less-specific** [**allow-default**]
— **no less-specific**
— [**no**] **next-hop** *ip-address*
— **priority** *priority-level* [**delta** | **explicit**]
— **no priority**
— **protocol** *protocol*
— **no protocol**[*protocol*]
— [**no**] **protocol** {**bgp** | **bgp -vpn** | **ospf** | **isis** | **rip** | **static**}
— [**no**] **shutdown**

3.14.2 Command Descriptions

3.14.2.1 Interface Configuration Commands

authentication-key

Syntax **authentication-key** [*authentication-key* | *hash-key*] [**hash** | **hash2**]
no authentication-key

Context config>router>if>vrrp

Description This command sets the simple text authentication key used to generate master VRRP advertisement messages and validates VRRP advertisements.

If simple text password authentication is not required, the **authentication-key** command is not required.

The command is configurable in both non-owner and owner **vrrp** nodal contexts.

The *key* parameter identifies the simple text password to be used when VRRP Authentication Type 1 is enabled on the virtual router instance. Type 1 uses an eight octet long string that is inserted into all transmitted VRRP advertisement messages and is compared against all received VRRP advertisement messages. The authentication data fields are used to transmit the *key*.

The *key* string is case sensitive and is left justified in the VRRP advertisement message authentication data fields. The first field contains the first four characters with the first octet (starting with IETF RFC bit position 0) containing the first character. The second field similarly holds the fifth through eighth characters. Any unspecified portion of the authentication data field is padded with a 0 value in the corresponding octet.

If the command is re-executed with a different password key defined, the new key is used immediately.

The **authentication-key** command can be executed at anytime.

To change the current in-use password key on multiple virtual router instances:

Identify the current master.

1. Shutdown the virtual router instance on all backups.
2. Execute the **authentication-key** command on the master to change the password key.
3. Execute the **authentication-key** command and **no shutdown** command on each backup.

The **no** form of the command reverts to the default value.

Default no authentication-key — The authentication key value is the null string.

Parameters *authentication-key* — The authentication key. Allowed values are any string up to 8 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

hash-key — The hash key. The key can be any combination of ASCII characters up to 22 (hash-key1) or 121 (hash-key2) characters in length (encrypted). If spaces are used in the string, enclose the entire string in quotation marks (“ ”).

This is useful when a user must configure the parameter, but for security purposes, the actual unencrypted key value is not provided.

hash — Specifies the key is entered in an encrypted form. If the **hash** or **hash2** parameter is not used, the key is assumed to be in an unencrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** or **hash2** parameter specified

hash2 — Specifies the key is entered in a more complex encrypted form that involves more variables than the key value alone, meaning that the **hash2** encrypted variable cannot be copied and pasted. If the **hash** or **hash2** parameter is not used, the key is assumed to be in an unencrypted, clear text form. For security, all keys are stored in encrypted form in the configuration file with the **hash** or **hash2** parameter specified.

backup

Syntax [**no**] **backup** *ip-address*

Context config>router>if>vrrp

Description This command associates router IP addresses with the parental IP interface IP addresses.

The **backup** command has two distinct functions when used in an **owner** or a **non-owner** context of the virtual router instance.

Non-owner virtual router instances actually create a routable IP interface address that is operationally dependent on the virtual router instance mode (master or backup). The **backup** command in **owner** virtual router instances does not create a routable IP interface address; it simply defines the existing parental IP interface IP addresses that are advertised by the virtual router instance.

For **owner** virtual router instances, the **backup** command defines the IP addresses that are advertised within VRRP advertisement messages. This communicates the IP addresses that the master is representing to backup virtual routers receiving the messages. Advertising a correct list is important. The specified *ip-addr* must be equal to one of the existing parental IP interface IP addresses (primary or secondary) or the **backup** command will fail.

For non-owner virtual router instances, the **backup** command actually creates an IP interface IP address used for routing IP packets and communicating with the system when the access commands are defined (**ping-reply**, **telnet-reply**, and **ssh-reply**). The specified *ip-addr* must be an IP address that is within one of the parental IP interface local subnets created with the **address** or **secondary** commands. If a local subnet does not exist that includes the specified *ip-addr* or if *ip-addr* is the same IP address as the parental IP interface IP address, the **backup** command will fail.

The new interface IP address created with the **backup** command assumes the mask and parameters of the corresponding parent IP interface IP address. The *ip-addr* is only active when the virtual router instance is operating in the master state. When not operating as master, the virtual router instance acts as if it is operationally down. It will not respond to ARP requests to *ip-addr*, nor will it route packets received with its *vrid* derived source MAC address. A non-master virtual router instance always silently discards packets destined to *ip-addr*. A single virtual router instance may only have a single virtual router IP address from a given parental local subnet. Multiple virtual router instances can define a virtual router IP address from the same local subnet as long as each is a different IP address.

In IPv4, up to sixteen **backup** *ip-addr* commands can be executed within the same virtual router instance. Executing **backup** multiple times with the same *ip-addr* results in no operation performed and no error generated. At least one successful **backup** *ip-addr* command must be executed before the virtual router instance can enter the operational state.

When operating as (non-owner) master, the default functionality associated with *ip-addr* is ARP response to ARP requests to *ip-addr*, routing of packets destined to the virtual router instance source MAC address and silently discarding packets destined to *ip-addr*. Enabling the non-owner-access parameters selectively allows ping, Telnet and SSH connectivity to *ip-addr* when the virtual router instance is operating as master.

The **no** form of the command removes the specified virtual router IP address from the virtual router instance. For non-owner virtual router instances, this causes all routing and local access associated with the *ip-addr* to cease. For **owner** virtual router instances, the **no backup** command only removes *ip-addr* from the list of advertised IP addresses. If the last *ip-addr* is removed from the virtual router instance, the virtual router instance will enter the operationally down state

Default no backup — No virtual router IP address is assigned.

Special Cases

Assigning the Virtual Router ID IP Address — Once the *vrid* is created on the parent IP interface, IP addresses need to be assigned to the virtual router instance. If the *vrid* was created with the keyword **owner**, the virtual router instance IP addresses must have one or more of the parent IP interface defined IP addresses (primary and secondary). For non-owner virtual router instances, the virtual router IP addresses each must be within one of the parental IP interface IP address defined local subnets. For both **owner** and non-owner virtual router instances, the virtual router IP addresses must be explicitly defined using the **backup** *ip-addr* command.

Virtual Router Instance IP Address Assignment Conditions — The RFC does not specify that the assigned IP addresses to the virtual router instance must be in the same subnet as the parent IP interface primary IP address or secondary IP addresses. The only requirement is that all virtual routers participating in the same virtual router instance have the same virtual router IP addresses assigned. To avoid confusion, the assigned virtual router IP addresses must be in a local subnet of one of the parent IP interfaces IP addresses. For **owner** virtual router instances the assigned virtual router IP address must be the same as one of the parental IP interface primary or secondary IP addresses.

The following rules apply when adding, changing, or removing parental and virtual router IP addresses:

Owner Virtual Router IP Address Parental Association — When an IP address is assigned to an **owner** virtual router instance, it must be associated with one of the parental IP interface-assigned IP addresses. The virtual router IP address must be equal to the primary or one of the secondary IP addresses within the parental IP interface.

Table 35 **Example - Owner Virtual Router Instance**

Parent IP addresses:	10.10.10.10/24 11.11.11.11/24	
Virtual router IP addresses:	10.10.10.11	Invalid (not equal to parent IP address)
	10.10.10.10	Associated (same as parent IP address 10.10.10.10)
	10.10.11.11	Invalid (not equal to parent IP address)
	11.11.11.254	Invalid (not equal to parent IP address)
	11.11.11.255	Invalid (not equal to parent IP address)

Non-Owner Virtual Router IP Address Parental Association — When an IP address is assigned to a non-owner virtual router instance, it must be associated with one of the parental IP interface assigned IP addresses. The virtual router IP address must be a valid IP address within one of the parental IP interfaces local subnet. Local subnets are created by the primary or secondary IP addresses in conjunction with the IP addresses mask. If the defined virtual router IP address is equal to the associated subnet's broadcast address, it is invalid. Virtual router IP addresses for non-owner virtual router instances that are equal to a parental IP interface IP address are also invalid.

The same virtual router IP address may not be assigned to two separate virtual router instances. If the virtual router IP address already exists on another virtual router instance, the virtual router IP address assignment will fail.

Table 36 **Example - Non-Owner Virtual Router Instance**

Parent IP addresses:	10.10.10.10/24 11.11.11.11/24	
Virtual router IP addresses:	10.10.10.11	Associated with 10.10.10.10 (in subnet)
	10.10.10.10	Invalid (same as parent IP address)
	10.10.11.11	Invalid (outside of all Parent IP subnets)
	11.11.11.254	Associated with 11.11.11.11 (in subnet)
	11.11.11.255	Invalid (broadcast address of 11.11.11.11/24)

Virtual Router IP Address Assignment without Parent IP Address — When assigning an IP address to a virtual router instance, an associated IP address (see **backup** and backup) on the parental IP interface must already exist. If an associated IP address on the parental IP interface is not configured, the virtual router IP address assignment fails.

Parent Primary IP Address Changed — When a virtual router IP address is set and the associated parent IP interface IP address is changed, the new parent IP interface IP address is evaluated to ensure it meets the association rules defined in **backup** or backup. If the association check fails, the parental IP address change is not allowed. If the parental IP address change fails, the previously configured IP address definition remains in effect.

Only the primary parent IP address can be changed. Secondary addresses must be removed before the new IP address can be added. **backup** explains IP address removal conditions.

Parent Primary or Secondary IP Address Removal — When a virtual router IP address is successfully set, but removing the associated parent IP interface IP address is attempted and fails. All virtual router IP addresses associated with the parental IP interface IP address must be deleted prior to removing the parental IP address. This includes virtual router IP address associations from multiple virtual router instances on the IP interface.

Parameters *ip-address* — The virtual router IP address expressed in dotted decimal notation. The IP virtual router IP address must be in the same subnet of the parental IP interface IP address or equal to one of the primary or secondary IP addresses for **owner** virtual router instances.

Values 1.0.0.1 - 223.255.255.254

backup

Syntax **backup** *ipv6-address*
no backup

Context config>router>if>ipv6>vrrp

Description This command associates router IPv6 addresses with the parental IP interface IP addresses.

The **backup** command has two distinct functions when used in an **owner** or a **non-owner** context of the virtual router instance.

Non-owner virtual router instances actually create a routable IP interface address that is operationally dependent on the virtual router instance mode (master or backup). The **backup** command in **owner** virtual router instances does not create a routable IP interface address; it simply defines the existing parental IP interface IP addresses that are advertised by the virtual router instance.

For **owner** virtual router instances, the **backup** command defines the IP addresses that are advertised within VRRP advertisement messages. This communicates the IP addresses that the master is representing to backup virtual routers receiving the messages. Advertising a correct list is important. The specified *ipv6-addr* must be equal to one of the existing parental IP interface IP addresses (link-local or global) or the **backup** command will fail.

For non-owner virtual router instances, the **backup** command actually creates an IP interface IP address used for routing IP packets and communicating with the system when the access commands are defined (**ping-reply**, **telnet-reply**, and **ssh-reply**). The specified *ipv6-addr* must be an IP address that is within one of the parental IP interface local subnets created with the **link-local-address or address** commands. If a local subnet does not exist that includes the specified *ipv6-addr* or if *ipv6-addr* is the same IP address as the parental IP interface IP address, the **backup** command will fail.

The new interface IP address created with the **backup** command assumes the mask and parameters of the corresponding parent IP interface IP address. The *ipv6-addr* is only active when the virtual router instance is operating in the master state. For IPv6 VRRP, the parental interface's IP address that is in the same subnet as the backup address must be manually-configured, non EUI-64 and configured to be in the preferred state.

When not operating as master, the virtual router instance acts as if it is operationally down. It will not respond to ARP requests to *ipv6-addr*, nor will it route packets received with its *vrid* derived source MAC address. A non-master virtual router instance always silently discards packets destined to *ipv6-addr*. A single virtual router instance may only have a single virtual router IP address from a given parental local subnet. Multiple virtual router instances can define a virtual router IP address from the same local subnet as long as each is a different IP address.

Executing **backup** multiple times with the same *ipv6-addr* results in no operation performed and no error generated. At least one successful **backup** *ipv6-addr* command must be executed before the virtual router instance can enter the operational state.

When operating as (non-owner) master, the default functionality associated with *ipv6-addr* is ARP response to ARP requests to *ip-addr*, routing of packets destined to the virtual router instance source MAC address and silently discarding packets destined to *ipv6-addr*. An IPv6 virtual router instance can enter the operational state only if one of the configured backup address is a link-local address and the router advertisement of the interface is configured to use the virtual MAC address. Enabling the non-owner-access parameters selectively allows ping, Telnet and traceroute connectivity to *ipv6-addr* when the virtual router instance is operating as master.

The **no** form of the command removes the specified virtual router IP address from the virtual router instance. For non-owner virtual router instances, this causes all routing and local access associated with the *ipv6-addr* to cease. For **owner** virtual router instances, the **no backup** command only removes *ipv6-addr* from the list of advertised IP addresses. If the last *ipv6-addr or the link-local address* is removed from the virtual router instance, the virtual router instance will enter the operationally down state

Default no backup — No virtual router IP address is assigned.

Special Cases **Assigning the Virtual Router ID Address —** Once the *vrid* is created on the parent IP interface, IP addresses need to be assigned to the virtual router instance. If the *vrid* was created with the keyword **owner**, the virtual router instance IP addresses must have one or more of the parent IP interface defined IP addresses. For non-owner virtual router instances, the virtual router IP addresses each must be within one of the parental IP interface IP address defined local subnets. For both **owner** and non-owner virtual router instances, the virtual router IP addresses must be explicitly defined using the **backup** *ipv6-addr* command.

The following rules apply when adding, changing, or removing parental and virtual router IP addresses:

Owner Virtual Router IP Address Parental Association — When an IP address is assigned to an **owner** virtual router instance, it must be associated with one of the parental IP interface-assigned IP addresses.

Table 37 Example - Owner Virtual Router Instance

Parent IP addresses:	10.10.10.10/24 11.11.11.11/24	
Virtual router IP addresses:	10.10.10.11	Invalid (not equal to parent IP address)
	10.10.10.10	Associated (same as parent IP address 10.10.10.10)
	10.10.11.11	Invalid (not equal to parent IP address)
	11.11.11.254	Invalid (not equal to parent IP address)
	11.11.11.255	Invalid (not equal to parent IP address)

Non-Owner Virtual Router IP Address Parental Association — When an IP address is assigned to a non-owner virtual router instance, it must be associated with one of the parental IP interface assigned IP addresses. The virtual router IP address must be a valid IP address within one of the parental IP interfaces local subnet. Local subnets are created by the link-local or global IP addresses in conjunction with the IP addresses mask. If the defined virtual router IP address is equal to the associated subnet's broadcast address, it is invalid. Virtual router IP addresses for non-owner virtual router instances that are equal to a parental IP interface IP address are also invalid.

The same virtual router IP address may not be assigned to two separate virtual router instances. If the virtual router IP address already exists on another virtual router instance, the virtual router IP address assignment will fail.

One exception to this rule is for the IPv6 link-local address that is configured as a backup address. The same link-local address can be configured in all virtual routers that use the same vrid.

Table 38 Example - Non-Owner Virtual Router Instance

Parent IP addresses:	10.10.10.10/24 11.11.11.11/24	
Virtual router IPv6 addresses:	10.10.10.11	Associated with 10.10.10.10 (in subnet)
	10.10.10.10	Invalid (same as parent IP address)
	10.10.11.11	Invalid (outside of all Parent IP subnets)
	11.11.11.254	Associated with 11.11.11.11 (in subnet)
	11.11.11.255	Invalid (broadcast address of 11.11.11.11/24)

Virtual Router IP Address Assignment without Parent IP Address — When assigning an IP address to a virtual router instance, an associated IP address (see **backup** and backup) on the parental IP interface must already exist. If an associated IP address on the parental IP interface is not configured, the virtual router IP address assignment fails.

Virtual Router IPv6 Address Assignment — An IPv6 backup address requires that the parental IP address that is in the same subnet as the backup address must be manually configured, non-EUI-64 and configured to be in the preferred state.

Parameters

ipv6-address — The virtual router IP address expressed in dotted decimal notation. The IP virtual router IP address must be in the same subnet of the parental IP interface IP address or equal to one of the the parent interface addresses for **owner** virtual router instances.

Values

ipv6-address	x:x:x:x:x:x:x:x (eight 16-bit pieces)
	x:x:x:x:x:x::d.d.d.d
	x: [0..FFFF]H
	d: [0..255]D

bfd-enable

Syntax

[**no**] **bfd-enable** [*service-id*] **interface** *interface-name* **dst-ip** *ip-address*
[**no**] **bfd-enable interface** *interface-name* **dst-ip** *ip-address*

Context

config>router>if>vrrp
config>router>if>ipv6>vrrp

Description

This commands assigns a bi-directional forwarding detect (BFD) session to a given VRRP/SRRP instance. This BFD sessions provided a heartbeat mechanism that can be used to speed up the transition of the standby VRRP router to an active state. If the associated BFD session fails, the VRRP routers will immediately send a VRRP Advertisement message. In addition, the standby VRRP router(s) will transition to a Master state to speed convergence. The normal VRRP election process will then take place based on the Advertisement messages sent by all VRRP routers.

There can be only one BFD session assigned to any given VRRP/SRRP instance, but there can be multiple SRRP/VRRP sessions using the same BFD session.

The parameters used for the BFD sessions are set by the BFD command under the IP interface.

The **no** form of this command removes BFD from the configuration.

Parameters

service-id — Specifies the service ID of the interface running BFD.

Values *service-id*:1 to 2147483647

svc-name: 64 characters maximum

interface *interface-name* **—** Specifies the name of the interface running BFD. The specified interface may not yet be configured with BFD. However, when it is, this virtual router will then initiate the BFD session.

dst-ip *ip-address* **—** Specifies the destination address to be used for the BFD session.

init-delay

Syntax **init-delay** *seconds*
no init-delay

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command configures a VRRP initialization delay timer.

Default no init-delay

Parameters *seconds* — Specifies the initialization delay timer for VRRP, in seconds.

Values 1 to 65535

mac

Syntax **mac** *mac-address*
no mac

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command sets an explicit MAC address used by the virtual router instance overriding the VRRP default derived from the VRID.

Changing the default MAC address is useful when an existing HSRP or other non-VRRP default MAC is in use by the IP hosts using the virtual router IP address. Many hosts do not monitor unessential ARPs and continue to use the cached non-VRRP MAC address after the virtual router becomes master of the host's gateway address.

The **mac** command sets the MAC address used in ARP responses when the virtual router instance is master. Routing of IP packets with *mac-address* as the destination MAC is also enabled. The **mac** setting must be the same for all virtual routers participating as a virtual router or indeterminate connectivity by the attached IP hosts will result. All VRRP advertisement messages are transmitted with *mac-address* as the source MAC.

The command can be configured in both non-owner and owner **vrrp** nodal contexts.

The **mac** command can be executed at any time and takes effect immediately. When the virtual router MAC on a master virtual router instance changes, a gratuitous ARP is immediately sent with a VRRP advertisement message. If the virtual router instance is disabled or operating as backup, the gratuitous ARP and VRRP advertisement message is not sent.

The **no** form of the command restores the default VRRP MAC address to the virtual router instance.

Default no mac — The virtual router instance uses the default VRRP MAC address derived from the VRID.

Parameters *mac-address* — The 48-bit MAC address for the virtual router instance in the form *aa*:*bb*:*cc*:*dd*:*ee*:*ff* or *aa-bb-cc-dd-ee-ff* where *aa*, *bb*, *cc*, *dd*, *ee* and *ff* are hexadecimal numbers. Allowed values are any non-broadcast, non-multicast MAC, and non-IEEE reserved MAC addresses.

master-int-inherit

Syntax [**no**] **master-int-inherit**

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command enables the virtual router instance to inherit the master VRRP router’s advertisement interval timer which is used by backup routers to calculate the master down timer.

The **master-int-inherit** command is only available in the non-owner nodal context and is used to allow the current virtual router instance master to dictate the master down timer for all backup virtual routers. The **master-int-inherit** command has no effect when the virtual router instance is operating as master.

If **master-int-inherit** is not enabled, the locally configured **message-interval** must match the master’s VRRP advertisement message advertisement interval field value or the message is discarded.

The **no** form of the command restores the default operating condition which requires the locally configured **message-interval** to match the received VRRP advertisement message advertisement interval field value.

Default **no master-int-inherit** — The virtual router instance does not inherit the master VRRP router’s advertisement interval timer and uses the locally configured message interval.

message-interval

Syntax **message-interval** {[*seconds*] [**milliseconds** *milliseconds*]}

no message-interval

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command configures the administrative advertisement message timer used by the master virtual router instance to send VRRP advertisement messages and to derive the master down timer as backup.

For an owner virtual router instance, the administrative advertisement timer directly sets the operational advertisement timer and indirectly sets the master down timer for the virtual router instance.

Non-owner virtual router instances usage of the **message-interval** setting is dependent on the state of the virtual router (master or backup) and the state of the **master-int-inherit** parameter.

- When a non-owner is operating as master for the virtual router, the configured **message-interval** is used as the operational advertisement timer similar to an owner virtual router instance. The **master-int-inherit** command has no effect when operating as master.
- When a non-owner is in the backup state with **master-int-inherit** disabled, the configured **message-interval** value is used to match the incoming VRRP advertisement message advertisement interval field. If the locally configured message interval does not match the advertisement interval field, the VRRP advertisement is discarded.
- When a non-owner is in the backup state with **master-int-inherit** enabled, the configured **message-interval** is ignored. The master down timer is indirectly derived from the incoming VRRP advertisement message advertisement interval field value.

VRRP advertisements messages that are fragmented, or contain IP options (IPv4), or contain extension headers (IPv6) require a longer message interval to be configured.

The in-use value of the message interval is used to derive the master down timer to be used when the virtual router is operating in backup mode based on the following formula:

(3x (in-use message interval) + skew time)

The skew time portion is used to slow down virtual routers with relatively low priority values when competing in the master election process.

The command is available in both non-owner and owner **vrrp** nodal contexts.

By default, a **message-interval** of 1 second is used.

The **no** form of the command reverts to the default value.

Default **message-interval 1** — Advertisement timer set to 1 second

Parameters *seconds* — The number of seconds that will transpire before the advertisement timer expires expressed as a decimal integer.

Values IPv4: 1 to 255
IPv6: 1 to 40

milliseconds *milliseconds* **—** Specifies the time interval, in milliseconds, between sending advertisement messages. This parameter is not supported on the 7450 ESS-1 chassis.

Values 100 to 900
IPv6: 10 to 990

policy

Syntax **policy** *policy-id*
no policy

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command adds a VRRP priority control policy association with the virtual router instance.

To further augment the virtual router instance base priority, VRRP priority control policies can be used to override or adjust the base priority value depending on events or conditions within the chassis.

The policy can be associated with more than one virtual router instance. The priority events within the policy either override or diminish the base priority set with the **priority** command dynamically affecting the in-use priority. As priority events clear in the policy, the in-use priority can eventually be restored to the base **priority** value.

The **policy** command is only available in the non-owner **vrrp** nodal context. The priority of **owner** virtual router instances is permanently set to 255 and cannot be changed by VRRP priority control policies. For non-owner virtual router instances, if the **policy** command is not executed, the base **priority** is used as the in-use priority.

The **no** form of the command removes existing VRRP priority control policy associations from the virtual router instance. All associations must be removed prior to deleting the policy from the system.

Default **no policy** — No VRRP priority control policy is associated with the virtual router instance.

Parameters *policy-id* — The policy ID of the VRRP priority control expressed as a decimal integer. The *vrrp-policy-id* must already exist for the command to function.

Values 1 to 9999

preempt

Syntax [**no**] **preempt**

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description The preempt mode value controls whether a specific backup virtual router preempts a lower priority master.

When preempt is enabled, the virtual router instance overrides any non-owner master with an "in use" message priority value less than the virtual router instance in-use priority value. If preempt is disabled, the virtual router only becomes master if the master down timer expires before a VRRP advertisement message is received from another virtual router.

The IP address owner will always become master when available. Preempt mode cannot be disabled on the owner virtual router.

The default value for preempt mode is enabled.

Default **preempt**

priority

Syntax **priority** *base-priority*
no priority

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command configures the base router priority for the virtual router instance used in the master election process.

The priority is the most important parameter set on a non-owner virtual router instance. The priority defines a virtual router’s selection order in the master election process. Together, the priority value and the **preempt** mode allow the virtual router with the best priority to become the master virtual router.

The *base-priority* is used to derive the in-use priority of the virtual router instance as modified by any optional VRRP priority control policy. VRRP priority control policies can be used to either override or adjust the base priority value depending on events or conditions within the chassis.

The **priority** command is only available in the non-owner **vrrp** nodal context. The priority of **owner** virtual router instances is permanently set to 255 and cannot be changed.

For non-owner virtual router instances, the default base priority value is 100.

The **no** form of the command reverts to the default value.

Default **priority 100**

Parameters *base-priority* — The base priority used by the virtual router instance expressed as a decimal integer. If no VRRP priority control policy is defined, the *base-priority* is the in-use priority for the virtual router instance.

Values 1 to 254

ping-reply

Syntax [**no**] **ping-reply**

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command enables the non-owner master to reply to ICMP echo requests directed at the virtual router instances IP addresses.

Non-owner virtual router instances are limited by the VRRP specifications to responding to ARP requests destined to the virtual router IP addresses and routing IP packets not addressed to the virtual router IP addresses. Many network administrators find this limitation frustrating when troubleshooting VRRP connectivity issues.

The SR OS allows this access limitation to be selectively lifted for certain applications. Ping, Telnet and SSH can be individually enabled or disabled on a per-virtual-router-instance basis.

The **ping-reply** command enables the non-owner master to reply to ICMP echo requests directed at the virtual router instances IP addresses. The Ping request can be received on any routed interface. Ping must not have been disabled at the management security level (either on the parental IP interface or based on the Ping source host address).

When **ping-reply** is not enabled, ICMP echo requests to non-owner master virtual IP addresses are silently discarded.

Non-owner backup virtual routers never respond to ICMP echo requests regardless of the **ping-reply** setting.

The **ping-reply** command is only available in non-owner **vrrp** nodal context.

By default, ICMP echo requests to the virtual router instance IP addresses are silently discarded.

The **no** form of the command configures discarding all ICMP echo request messages destined to the non-owner virtual router instance IP addresses.

Default **no ping-reply** — ICMP echo requests to the virtual router instance IP addresses are discarded.

shutdown

Syntax [**no**] **shutdown**

Context config>router>if>vrrp
config>router>if>ipv6>vrrp
config>vrrp>policy

Description This command administratively disables an entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics.

The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they may be deleted.

The **no** form of this command administratively enables an entity.

Default no shutdown

Special Cases **Non-Owner Virtual Router —** Non-owner virtual router instances can be administratively shutdown. This allows the termination of VRRP participation in the virtual router and stops all routing and other access capabilities with regards to the virtual router IP addresses. Shutting down the virtual router instance provides a mechanism to maintain the virtual routers without causing false backup/master state changes.

If the **shutdown** command is executed, no VRRP advertisement messages are generated and all received VRRP advertisement messages are silently discarded with no processing.

By default, virtual router instances are created in the **no shutdown** state.

Whenever the administrative state of a virtual router instance transitions, a log message is generated.

Whenever the operational state of a virtual router instance transitions, a log message is generated.

Owner Virtual Router — An owner virtual router context does not have a **shutdown** command. To administratively disable an owner virtual router instance, use the **shutdown** command within the parent IP interface node which administratively downs the IP interface.

ssh-reply

Syntax [**no**] **ssh-reply**

Context config>router>if>vrrp

Description This command enables the non-owner master to reply to SSH requests directed at the virtual router instance IP addresses. This command is only applicable to IPv4.

Non-owner virtual router instances are limited by the VRRP specifications to responding to ARP requests destined to the virtual router IP addresses and routing IP packets not addressed to the virtual router IP addresses.

This limitation can be disregarded for certain applications. Ping, Telnet and SSH can be individually enabled or disabled on a per-virtual-router-instance basis.

The **ssh-reply** command enables the non-owner master to reply to SSH requests directed at the virtual router instances IP addresses. The SSH request can be received on any routed interface. SSH must not have been disabled at the management security level (either on the parental IP interface or based on the SSH source host address). Proper login and CLI command authentication is still enforced.

When **ssh-reply** is not enabled, SSH requests to non-owner master virtual IP addresses are silently discarded.

Non-owner backup virtual routers never respond to SSH requests regardless of the **ssh-reply** setting.

The **ssh-reply** command is only available in non-owner **vrrp** nodal context.

By default, SSH requests to the virtual router instance IP addresses are silently discarded.

The **no** form of the command discards all SSH request messages destined to the non-owner virtual router instance IP addresses.

Default **no ssh-reply** — SSH requests to the virtual router instance IP addresses are discarded.

standby-forwarding

Syntax [**no**] **standby-forwarding**

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command specifies whether this VRRP instance allows forwarding packets to a standby router. When disabled, a standby router should not forward traffic sent to virtual router's MAC address. However, the standby router should forward traffic sent to the standby router’s real MAC address. When enabled, a standby router should forward all traffic.

Default no standby-forwarding

telnet-reply

Syntax [**no**] **telnet-reply**

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command enables the non-owner master to reply to TCP port 23 Telnet requests directed at the virtual router instances' IP addresses.

Non-owner virtual router instances are limited by the VRRP specifications to responding to ARP requests destined to the virtual router IP addresses and routing IP packets not addressed to the virtual router IP addresses. Many network administrators find this limitation frustrating when troubleshooting VRRP connectivity issues.

This limitation can be disregarded for certain applications. Ping, SSH and Telnet can each be individually enabled or disabled on a per-virtual-router-instance basis.

The **telnet-reply** command enables the non-owner master to reply to Telnet requests directed at the virtual router instances' IP addresses. The Telnet request can be received on any routed interface. Telnet must not have been disabled at the management security level (either on the parental IP interface or based on the Telnet source host address). Proper login and CLI command authentication is still enforced.

When **telnet-reply** is not enabled, Telnet requests to non-owner master virtual IP addresses are silently discarded.

Non-owner backup virtual routers never respond to Telnet requests regardless of the **telnet-reply** setting.

The **telnet-reply** command is only available in non-owner **vrrp** nodal context.

By default, Telnet requests to the virtual router instance IP addresses will be silently discarded.

The **no** form of the command configures discarding all Telnet request messages destined to the non-owner virtual router instance IP addresses.

Default **no telnet-reply** — Telnet requests to the virtual router instance IP addresses are discarded.

traceroute-reply

Syntax [**no**] **traceroute-reply**

Context config>router>if>vrrp
config>router>if>ipv6>vrrp

Description This command is valid only if the VRRP virtual router instance associated with this entry is a non-owner.

When this command is enabled, a non-owner master can reply to traceroute requests directed to the virtual router instance IP addresses.

A non-owner backup virtual router never responds to such traceroute requests regardless of the **trace-route-reply** status.

Default no traceroute-reply

vrrp

Syntax **vrrp** *vrid* [**owner**] [**passive**]
no vrrp *vrid*

Context config>router>interface
config>router>if>ipv6

Description This command creates the context to configure a VRRP virtual router instance. A virtual router is defined by its virtual router identifier (VRID) and a set of IP addresses.

The optional **owner** keyword indicates that the **owner** controls the IP address of the virtual router and is responsible for forwarding packets sent to this IP address. The **owner** assumes the role of the master virtual router.

All other virtual router instances participating in this message domain must have the same *vrid* configured and cannot be configured as **owner**. Once created, the **owner** keyword is optional when entering the *vrid* for configuration purposes.

A *vrid* is internally associated with the IP interface. This allows the *vrid* to be used on multiple IP interfaces while representing different virtual router instances.

For IPv4, up to four VRRP VRID nodes can be configured on a router interface. Each virtual router instance can manage up to 16 backup IP addresses. For IPv6, only one VRID can be configured on a router interface.

The optional **passive** keyword indicates that a *vrid* can be configured as **passive**, in which case, the VRRP advertisement messages are suppressed on transmission and reception, and all routers configured with the same *vrid* become master. Passive *VRIDs* can exceed the limit of four VRRP VRID nodes on a router interface.

The **no** form of the command removes the specified *vrid* from the IP interface. This terminates VRRP participation and deletes all references to the *vrid* in conjunction with the IP interface. The *vrid* does not need to be shut down to remove the virtual router instance.

Default **no vrrp** — No VRRP virtual router instance is associated with the IP interface.

Special Cases **Virtual Router Instance Owner IP Address Conditions —** The virtual router instance **owner** can be created prior to assigning the parent IP interface primary or secondary IP addresses. In this case, the virtual router instance is not associated with an IP address. The operational state of the virtual router instance is down.

VRRP Owner Command Exclusions — By specifying the VRRP *vrid* as **owner**, the following commands are no longer available:

- **vrrp priority —** The virtual router instance **owner** is hard-coded with a **priority** value of 255 and cannot be changed.
- **vrrp master-int-inherit** — Owner virtual router instances do not accept VRRP advertisement messages; the advertisement interval field is not evaluated and cannot be inherited.

- **ping-reply**, **telnet-reply** and **ssh-reply —** The **owner** virtual router instance always allows Ping, Telnet and SSH if the management and security parameters are configured to accept them on the parent IP interface.
- **vrrp shutdown —** The **owner** virtual router instance cannot be shut down on the **vrrp** node. If this was allowed, VRRP messages would not be sent, but the parent IP interface address would continue to respond to ARPs and forward IP packets. Another virtual router instance may detect the missing master due to the termination of VRRP advertisement messages and become master. This would result in two routers responding to ARP requests for the same IP addresses. To shut down the **owner** virtual router instance, use the **shutdown** command in the parent IP interface context. This will prevent VRRP participation, IP ARP reply and IP forwarding. To continue parent IP interface ARP reply and forwarding without VRRP participation, remove the **vrrp** *vrid* instance.
- **traceroute-reply**

VRRP Passive Command Exclusions — By specifying the VRRP *vrid* as **passive**, the following commands related to the master election and processing of VRRP advertisement messages are no longer available:

- **vrrp priority**
- **policy**
- **preempt**
- **master-int-inherit**
- **standby-forwarding**
- **int-delay**
- **message-interval**
- **authentication-key**
- **bfd-enable**

Parameters *vrid* — the virtual router ID for the IP interface expressed as a decimal integer

Values 1 to 255

owner — identifies this virtual router instance as owning the virtual router IP addresses. If the **owner** keyword is not specified at the time of *vrid* creation, the **vrrp backup** commands must be specified to define the virtual router IP addresses. The **owner** keyword is not required when entering the *vrid* for editing purposes. When created as **owner**, a *vrid* on an IP interface cannot have the **owner** parameter removed. The *vrid* must be deleted, and then recreated without the **owner** keyword, to remove ownership.

passive — identifies this virtual router instance as **passive**, therefore owning the virtual router IP addresses. A **passive** *vrid* does not send or receive VRRP advertisement messages and is always in either the **master** state (if the interface is operationally up), or the **init** state (if the interface is operationally down). The **passive** keyword is not required when entering the *vrid* for editing purposes. When a *vrid* on an IP interface is created as **passive**, the parameter cannot be removed from the *vrid*. The *vrid* must be deleted, and then recreated without the **passive** keyword, to remove the parameter.

3.14.2.2 Priority Policy Commands

delta-in-use-limit

Syntax **delta-in-use-limit** *in-use-priority-limit*
no delta-in-use-limit

Context config>vrrp>policy

Description This command sets a lower limit on the virtual router in-use priority that can be derived from the delta priority control events.

Each *vrrp-priority-id* places limits on the delta priority control events to define the in-use priority of the virtual router instance. Setting this limit prevents the sum of the delta priority events from lowering the in-use priority value of the associated virtual router instances below the configured value.

The limit has no effect on explicit priority control events. Explicit priority control events are controlled by setting the in-use priority to any value between 1 and 254.

Only non-owner virtual router instances can be associated with VRRP priority control policies and their priority control events.

Once the total sum of all delta events is calculated and subtracted from the base **priority** of the virtual router instance, the result is compared to the **delta-in-use-limit** value. If the result is less than the limit, the **delta-in-use-limit** value is used as the virtual router in-use priority value. If an explicit priority control event overrides the delta priority control events, the **delta-in-use-limit** has no effect.

Setting the limit to a higher value than the default of 1 limits the effect of the delta priority control events on the virtual router instance base **priority** value. This allows for multiple priority control events while minimizing the overall effect on the in-use priority.

Changing the *in-use-priority-limit* causes an immediate re-evaluation of the in-use priority values for all virtual router instances associated with this *vrrp-policy-id* based on the current sum of all active delta control policy events.

The **no** form of the command reverts to the default value.

Default **delta-in-use-limit 1** — The lower limit of 1 for the in-use priority, as modified, by delta priority control events.

Parameters *in-use-priority-limit* — The lower limit of the in-use priority base, as modified by priority control policies. The *in-use-priority-limit* has the same range as the non-owner virtual router instance base-priority parameter. If the result of the total delta priority control events minus the virtual router instances base-priority, is less than the *in-use-priority-limit*, the *in-use-priority-limit* value is used as the virtual router instances in-use priority value.

Setting the *in-use-priority-limit* to a value equal to or larger than the virtual router instance *base-priority* prevents the delta priority control events from having any effect on the virtual router instance in-use priority value.

Values 1 to 254

description

Syntax **description** *string*
no description

Context config>vrrp>policy

Description This command creates a text description stored in the configuration file for a configuration context.

The **description** command associates a text string with a configuration context to help identify the content in the configuration file.

The **no** form of the command removes the string from the configuration.

Default n/a

Parameters *string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

policy

Syntax **policy** *policy-id* [**context** *service-id*]
no policy *policy-id*

Context config>vrrp

Description This command creates the context to configure a VRRP priority control policy which is used to control the VRRP in-use priority based on priority control events. It is a parental node for the various VRRP priority control policy commands that define the policy parameters and priority event conditions.

The virtual router instance **priority** command defines the initial or base value to be used by non-owner virtual routers. This value can be modified by assigning a VRRP priority control policy to the virtual router instance. The VRRP priority control policy can override or diminish the base priority setting to establish the actual in-use priority of the virtual router instance.

The **policy** *policy-id* command must be created first, before it can be associated with a virtual router instance.

Because VRRP priority control policies define conditions and events that must be maintained, they can be resource intensive. The number of policies is limited to 1000.

The *policy-id* do not have to be consecutive integers. The range of available policy identifiers is from 1 to 9999.

The **no** form of the command deletes the specific *policy-id* from the system.
The *policy-id* must be removed first from all virtual router instances before the **no policy** command can be issued. If the *policy-id* is associated with a virtual router instance, the command will fail.

Parameters *vrrp-policy-id* — The VRRP priority control ID expressed as a decimal integer that uniquely identifies this policy from any other VRRP priority control policy defined on the system. Up to 1000 policies can be defined.

Values 1 to 9999

context *service-id* **—** Specifies the service ID to which this policy applies. A value of zero (0) means that this policy does not apply to a service but applies to the base router instance.

Values 1 to 2147483647

priority-event

Syntax [**no**] **priority-event**

Context config>vrrp>policy>priority-event

Description This command creates the context to configure VRRP priority control events used to define criteria to modify the VRRP in-use priority.

A priority control event specifies an object to monitor and the effect on the in-use priority level for an associated virtual router instance.

Up to 32 priority control events can be configured within the **priority-event** node.

The **no** form of the command clears any configured priority events.

Default n/a

3.14.2.3 Priority Policy Event Commands

hold-clear

Syntax **hold-clear** *seconds*
no hold-clear

Context config>vrrp>policy>priority-event>host-unreachable
config>vrrp>policy>priority-event>lag-port-down
config>vrrp>policy>priority-event>mc-ipsec-non-forwarding
config>vrrp>policy>priority-event>port-down
config>vrrp>policy>priority-event>route-unknown

Description This command configures the hold clear time for the event. The *seconds* parameter specifies the hold-clear time, the amount of time in seconds by which the effect of a cleared event on the associated virtual router instance is delayed.

The hold-clear time is used to prevent black hole conditions when a virtual router instance advertises itself as a master before other conditions associated with the cleared event have had a chance to enter a forwarding state.

Default no hold-clear

Parameters *seconds* — Specifies the amount of time in seconds by which the effect of a cleared event on the associated virtual router instance is delayed.

Values 0 to 86400

hold-set

Syntax **hold-set** *seconds*
no hold-set

Context config>vrrp>policy>priority-event>host-unreachable
config>vrrp>policy>priority-event>lag-port-down
config>vrrp>policy>priority-event>mc-ipsec-non-forwarding
config>vrrp>policy>priority-event>port-down
config>vrrp>policy>priority-event>route-unknown

Description This command specifies the amount of time that must pass before the set state for a VRRP priority control event event can transition to the cleared state to dampen flapping events. A flapping event continually transitions between clear and set.

The **hold-set** command is used to dampen the effect of a flapping event. The **hold-set** value is loaded into a hold set timer that prevents a set event from transitioning to the cleared state until it expires.

Each time an event transitions between cleared and set, the timer is loaded and begins a countdown to zero. When the timer reaches zero, the event is allowed to enter the cleared state. Entering the cleared state is dependent on the object controlling the event, conforming to the requirements defined in the event itself. It is possible, on some event types, to have another set action reload the hold-set timer. This extends the amount of time that must expire before entering the cleared state.

Once the hold set timer expires and the event meets the cleared state requirements or is set to a lower threshold, the current set effect on the virtual router instances in-use priority can be removed. As with **lag-port-down** events, this may be a decrease in the set effect if the *clearing* amounts to a lower set threshold.

The **hold-set** command can be executed at anytime. If the hold-set timer value is configured larger than the new *seconds* setting, the timer is loaded with the new **hold-set** value.

The **no** form of the command reverts the default value.

Default **0** — The hold-set timer is disabled so event transitions are processed immediately.

Parameters *seconds* — The number of seconds that the hold set timer waits after an event enters a set state or enters a higher threshold set state, depending on the event type.

The value of 0 disables the hold set timer, preventing any delay in processing lower set thresholds or cleared events.

Values 0 to 86400

priority

Syntax **priority** *priority-level* [{**delta | explicit**}]
no priority

Context config>vrrp>policy>priority-event>host-unreachable
config>vrrp>policy>priority-event>lag-port-down
config>vrrp>policy>priority-event>mc-ipsec-non-forwarding
config>vrrp>policy>priority-event>port-down
config>vrrp>policy>priority-event>route-unknown

Description This command controls the effect the set event has on the virtual router instance in-use priority.

When the event is set, the *priority-level* is either subtracted from the base priority of each virtual router instance or it defines the explicit in-use priority value of the virtual router instance depending on whether the **delta** or **explicit** keywords are specified.

Multiple set events in the same policy have interaction constraints:

- If any set events have an explicit **priority** value, all the delta **priority** values are ignored.
- The set event with the lowest explicit **priority** value defines the in-use priority that are used by all virtual router instances associated with the policy.
- If no set events have an explicit **priority** value, all the set events delta **priority** values are added and subtracted from the base priority value defined on each virtual router instance associated with the policy.
- If the delta priorities sum exceeds the **delta-in-use-limit** parameter, then the **delta-in-use-limit** parameter is used as the value subtracted from the base priority value defined on each virtual router instance associated with the policy.

If the **priority** command is not configured on the priority event, the *priority-value* defaults to 0 and the qualifier keyword defaults to **delta**, thus, there is no impact on the in-use priority.

The **no** form of the command reverts to the default values.

Default **0 delta** — The set event will subtract 0 from the base priority (no effect).

Parameters *priority-level* — The priority level adjustment value expressed as a decimal integer.

Values 0 to 254

delta | explicit — Configures what effect the *priority-level* will have on the base priority value.

When **delta** is specified, the *priority-level* value is subtracted from the associated virtual router instance's base priority when the event is set and no explicit events are set. The sum of the priority event *priority-level* values on all set delta priority events are subtracted from the virtual router base priority to derive the virtual router instance in-use priority value. If the **delta** priority event is cleared, the *priority-level* is no longer used in the in-use priority calculation.

When **explicit** is specified, the *priority-level* value is used to override the base priority of the virtual router instance if the priority event is set and no other **explicit** priority event is set with a lower *priority-level*. The set **explicit** priority value with the lowest *priority-level* determines the actual in-use protocol value for all virtual router instances associated with the policy.

Default delta

Values delta, explicit

weight-down

Syntax **weight-down** *lag-ports-down-weight*
no weight-down

Context config>vrrp>policy>priority-event>lag-port-down

Description This command creates a context to configure an event set threshold within a lag-port-down priority control event. The weight-down command defines a sub-node within the lag-port-down event and is uniquely identified with the lag-ports-down-weight parameter. Each weight-down node within the same lag-port-down event node must have a unique lag-ports-down-weight value. Each weight-down node has its own priority command that takes effect whenever that node represents the current threshold. A single LAG can use either weight-threshold or port threshold. The command is required for proper operation on mixed port-speed LAGs and can be used for non-mixed port-speed LAGs as well.

The total number of sub-nodes (uniquely identified by the lag-ports-down-weight parameter) allowed in the system is 2048.

A **weight-down** node is not required for each possible number of ports that could be down. The active threshold is always the closest lower threshold.

The **no** form of the command deletes the event set threshold. The threshold may be removed at any time. If the removed threshold is the current active threshold, the event set thresholds must be re-evaluated after removal.

Default no weight-down

Parameters *lag-ports-down-weight* — The total weight of LAG ports down to create a set event threshold. This is the active threshold when the weight of down ports in the LAG equals or exceeds *lag-ports-down-weight*, but does not equal or exceed the next highest configured *lag-ports-down-weight*.

Values 1 to 64

mc-ipsec-non-forwarding

Syntax [**no**] **mc-ipsec-non-forwarding** *tunnel-grp-id*

Context config>vrrp>policy>priority-event

Description This command configures an instance of a multi-chassis IPsec tunnel-group Priority Event used to override the base priority value of a VRRP virtual router instance depending on the operational state of the event.

Default n/a

Parameters *tunnel-grp-id* — Identifies the multi-chassis IPsec tunnel group whose non-forwarding state is monitored by this priority control event.

3.14.2.4 Priority Policy Port Down Event Commands

port-down

Syntax [**no**] **port-down** *port-id*

Context config>vrrp>policy>priority-event

Description This command configures a port down priority control event that monitors the operational state of a port or SONET/SDH channel. When the port or channel enters the operational down state, the event is considered set. When the port or channel enters the operational up state, the event is considered cleared.

Multiple unique **port-down** event nodes can be configured within the **priority-event** context up to the overall limit of 32 events. Up to 32 events can be defined in any combination of types.

The **port-down** command can reference an arbitrary port or channel. The port or channel does not need to be preprovisioned or populated within the system. The operational state of the **port-down** event is set as follows:

- Set – non-provisioned
- Set – not populated
- Set – down
- Cleared – up

When the port or channel is provisioned, populated, or enters the operationally up or down state, the event operational state is updated appropriately.

When the event enters the operationally down, non-provisioned, or non-populated state, the event is considered to be set. When an event transitions from clear to set, the set is processed immediately and must be reflected in the associated virtual router instances in-use priority value. As the event transitions from cleared to set, a hold set timer is loaded with the value configured by the events **hold-set** command. This timer prevents the event from clearing until it expires, damping the effect of event flapping. If the event clears and becomes set again before the hold set timer expires, the timer is reset to the **hold-set** value, extending the time before another clear can take effect.

When the event enters the operationally up state, the event is considered to be cleared. Once the events **hold-set** expires, the effects of the events **priority** value are immediately removed from the in-use priority of all associated virtual router instances.

The actual effect on the virtual router instance in-use priority value depends on the defined event priority and its delta or explicit nature.

The **no** form of the command deletes the specific port or channel monitoring event. The event may be removed at anytime. When the event is removed, the in-use priority of all associated virtual router instances will be re-evaluated. The events **hold-set** timer has no effect on the removal procedure.

Default **no port-down** — No port down priority control events are defined.

Parameters *port-id* — The port ID of the port monitored by the VRRP priority control event.

The *port-id* can only be monitored by a single event in this policy. The port can be monitored by multiple VRRP priority control policies. A port and a specific channel on the port are considered to be separate entities. A port and a channel on the port can be monitored by separate events in the same policy.

Values The following values apply to the 7750 SR:

port-id	*slot*/*mda*/*port*[.*channel*]		
	eth-sat-id	esat-*id*/*slot*/*port*	
		esat	keyword
		id	1 to 20
	pxc-id	pxc-*id*.*sub-port*	
		pxc	keyword
		id	1 to 64
		sub-port	a, b
	aps-id	aps-*group-id*[.*channel*]	
		aps	keyword
		group-id	1 to 64
	bundle-type-slot/mda.<bundle-num>		
		bundle	keyword
		type	ima, ppp
		bundle-num	1 to 256
	ccag-id	ccag-*id*. *path-id*[*cc-type*]	
		ccag	keyword
		id	1 to 8
		path-id	a, b
		cc-type	.sap-net, .net-sap

Values The following values apply to the 7450 ESS:

port-id	*slot*/*mda*/*port*[.*channel*]		
	eth-sat-id	esat-*id*/*slot*/*port*	
		esat	keyword
		id	1 to 20
	pxc-id	pxc-*id*.*sub-port*	
		pxc	keyword
		id	1 to 64
		sub-port	a, b
	ccag-id	ccag-*id*. *path-id*[*cc-type*]	
		ccag	keyword
		id	1 to 8
		path-id	a, b
		cc-type	.sap-net, .net-sap

The POS channel on the port monitored by the VRRP priority control event. The *port-id***.***channel-id* can only be monitored by a single event in this policy. The channel can be monitored by multiple VRRP priority control policies. A port and a specific channel on the port are considered to be separate entities. A port and a channel on the port can be monitored by separate events in the same policy.

If the port is provisioned, but the *channel* does not exist or the port has not been populated, the appropriate event operational state is Set – non-populated.

If the port is not provisioned, the event operational state is Set – non-provisioned.

If the POS interface is configured as a clear-channel, the *channel-id* is 1 and the channel bandwidth is the full bandwidth of the port.

3.14.2.5 Priority Policy LAG Events Commands

lag-port-down

Syntax [**no**] **lag-port-down** *lag-id*

Context config>vrrp>policy>priority-event

Description This command creates the context to configure Link Aggregation Group (LAG) priority control events that monitor the operational state of the links in the LAG.

The **lag-port-down** command configures a priority control event. The event monitors the operational state of each port in the specified LAG. When one or more of the ports enter the operational down state, the event is considered to be set. When all the ports enter the operational up state, the event is considered to be clear. As ports enter the operational up state, any previous set threshold that represents more down ports is considered cleared, while the event is considered to be set.

Multiple unique **lag-port-down** event nodes can be configured within the **priority-event** node up to the maximum of 32 events.

The **lag-port-down** command can reference an arbitrary LAG. The *lag-id* does have to already exist within the system. The operational state of the **lag-port-down** event will indicate:

- Set – non-existent
- Set – one port down
- Set – two ports down
- Set – three ports down

- Set – four ports down
- Set – five ports down
- Set – six ports down
- Set – seven ports down
- Set – eight ports down
- Cleared – all ports up

When the *lag-id* is created, or a port in *lag-id* becomes operationally up or down, the event operational state must be updated appropriately.

When one or more of the LAG composite ports enters the operationally down state or the *lag-id* is deleted or does not exist, the event is considered to be set. When an event transitions from clear to set, the set is processed immediately and must be reflected in the associated virtual router instances in-use priority value. As the event transitions from clear to set, a hold set timer is loaded with the value configured by the events **hold-set** command. This timer prevents the event from clearing until it expires, damping the effect of event flapping. If the event clears and becomes set again before the hold set timer expires, the timer is reset to the **hold-set** value, extending the time before another clear can take effect.

The **lag-port-down** event is considered to have a tiered event set state. While the priority impact per number of ports down is totally configurable, as more ports go down, the effect on the associated virtual router instances in-use priority is expected to increase (lowering the priority). When each configured threshold is crossed, any higher thresholds are considered further event sets and are processed immediately with the hold set timer reset to the configured value of the **hold-set** command. As the thresholds are crossed in the opposite direction (fewer ports down then previously), the priority effect of the event is not processed until the hold set timer expires. If the number of ports down threshold again increases before the hold set timer expires, the timer is only reset to the **hold-set** value if the number of ports down is equal to or greater than the threshold that set the timer.

The event contains **number-down** nodes that define the priority delta or explicit value to be used based on the number of LAG composite ports that are in the operationally down state. These nodes represent the event set thresholds. Not all port down thresholds must be configured. As the number of down ports increase, the **number-down** *ports-down* node that expresses a value equal to or less than the number of down ports describes the delta or explicit priority value to be applied.

The **no** form of the command deletes the specific LAG monitoring event. The event can be removed at anytime. When the event is removed, the in-use priority of all associated virtual router instances must be reevaluated. The events **hold-set** timer has no effect on the removal procedure.

Default **no lag-port-down** — No LAG priority control events are created.

Parameters *lag-id* — The LAG ID that the specific event is to monitor expressed as a decimal integer. The *lag-id* can only be monitored by a single event in this policy. The LAG may be monitored by multiple VRRP priority control policies. A port within the LAG and the LAG ID itself are considered to be separate entities. A composite port may be monitored with the **port-down** event while the *lag-id* the port is in is monitored by a **lag-port-down** event in the same policy.

Values 1 to 800 (apply to the 7750 SR and 7950 XRS)
1 to 200 (apply to the 7450 ESS)

number-down

Syntax [**no**] **number-down** *number-of-lag-ports-down*

Context config>vrrp>policy>priority-event>lag-port-down

Description This command creates a context to configure an event set threshold within a lag-port-down priority control event.

The **number-down** command defines a sub-node within the **lag-port-down** event and is uniquely identified with the *number-of-lag-ports-down* parameter. Each **number-down** node within the same **lag-port-down** event node must have a unique *number-of-lag-ports-down* value. Each **number-down** node has its own **priority** command that takes effect whenever that node represents the current threshold.

The total number of sub-nodes (uniquely identified by the *number-of-lag-ports-down* parameter) allowed in a single **lag-port-down** event is equal to the total number of possible physical ports allowed in a LAG.

A **number-down** node is not required for each possible number of ports that could be down. The active threshold is always the closest lower threshold. When the number of ports down equals a given threshold, that is the active threshold.

The **no** form of the command deletes the event set threshold. The threshold may be removed at any time. If the removed threshold is the current active threshold, the event set thresholds must be re-evaluated after removal.

Default **no number-down** — No threshold for the LAG priority event is created.

Parameters *number-of-lag-ports-down* — The number of LAG ports down to create a set event threshold. This is the active threshold when the number of down ports in the LAG equals or exceeds *number-of-lag-ports-down*, but does not equal or exceed the next highest configured *number-of-lag-ports-down*.

Values 1 to 64 (applies to 64-link LAG)
1 to 32 (applies to other LAGs)

3.14.2.6 Priority Policy Host Unreachable Event Commands

drop-count

Syntax **drop-count** *consecutive-failures*
no drop-count

Context config>vrrp vrrp-policy-id>priority-event>host-unreachable

Description This command configures the number of consecutively sent ICMP echo request messages that must fail before the host unreachable priority control event is set.

The **drop-count** command is used to define the number of consecutive message send attempts that must fail for the **host-unreachable** priority event to enter the set state. Each unsuccessful attempt increments the event's consecutive message drop counter. With each successful attempt, the event's consecutive message drop counter resets to zero.

If the event's consecutive message drop counter reaches the **drop-count** value, the **host-unreachable** priority event enters the set state.

The event's **hold-set** value defines how long the event must stay in the set state even when a successful message attempt clears the consecutive drop counter. The event is not cleared until the consecutive drop counter is less than the **drop-count** value and the **hold-set** timer has a value of zero (expired).

The **no** form of the command reverts to the default value.

Default **drop-count 3** — 3 consecutive ICMP echo request failures are required before the host unreachable priority control event is set.

Parameters *consecutive-failures* — The number of ICMP echo request message attempts that must fail for the event to enter the set state. It also defines the threshold so a lower consecutive number of failures can clear the event state.

Values 1 to 60

host-unreachable

Syntax [**no**] **host-unreachable** *ip-address*
[**no**] **host-unreachable** *ipv6-address*

Context config>vrrp>policy>priority-event

Description This command creates the context to configure a host unreachable priority control event to monitor the ability to receive ICMP echo reply packets from an IP host address.

A host unreachable priority event creates a continuous ICMP echo request (ping) probe to the specified *ip-address*. If a ping fails, the event is considered to be set. If a ping is successful, the event is considered to be cleared.

Multiple unique (different *ip-address*) **host-unreachable** event nodes can be configured within the **priority-event** node to a maximum of 32 events.

The **host-unreachable** command can reference any valid local or remote IP address. The ability to ARP a local IP address or find a remote IP address within a route prefix in the route table is considered part of the monitoring procedure. The **host-unreachable** priority event operational state tracks ARP or route table entries dynamically appearing and disappearing from the system. The operational state of the **host-unreachable** event are listed in Table 39.

Table 39 **Host Unreachable Operational States**

Host Unreachable Operational State	Description
Set – no ARP	No ARP address found for *ip-addr* for **drop-count** consecutive attempts. Only applies when IP address is considered local.
Set – no route	No route exists for *ip-addr* for **drop-count** consecutive attempts. Only when IP address is considered remote.
Set – host unreachable	ICMP host unreachable message received for **drop-count** consecutive attempts.
Set – no reply	ICMP echo request timed out for **drop-count** consecutive attempts.
Set – reply received	Last ICMP echo request attempt received an echo reply but historically not able to clear the event.
Cleared – no ARP	No ARP address found for *ip-addr* - not enough failed attempts to set the event.
Cleared – no route	No route exists for *ip-addr* - not enough failed attempts to set the event.
Cleared – host unreachable	ICMP host unreachable message received - not enough failed attempts to set the event.
Cleared – no reply	ICMP echo request timed out - not enough failed attempts to set the event.
Cleared – reply received	Event is cleared - last ICMP echo request received an echo reply.

Unlike other priority event types, the **host-unreachable** priority event monitors a repetitive task. A historical evaluation is performed on the success rate of receiving ICMP echo reply messages. The operational state takes its cleared and set orientation from the historical success rate. The informational portion of the operational state is derived from the last attempt's result. It is possible for the previous attempt to fail while the operational state is still cleared due to an insufficient number of failures to cause it to become set. It is also possible for the state to be set while the previous attempt was successful.

When an event transitions from clear to set, the set is processed immediately and must be reflected in the associated virtual router instances in-use priority value. As the event transitions from clear to set, a hold set timer is loaded with the value configured by the events **hold-set** command. This timer prevents the event from clearing until it expires, damping the effect of event flapping. If the event clears and becomes set again before the hold set timer expires, the timer is reset to the **hold-set** value, extending the time before another clear can take effect.

The hold-set timer be expired and the historical success rate must be met prior to the event operational state becoming cleared.

The **no** form of the command deletes the specific IP host monitoring event. The event may be deleted at anytime. When the event is deleted, the in-use priority of all associated virtual router instances must be reevaluated. The event's **hold-set** timer has no effect on the removal procedure.

Default **no host-unreachable** — No host unreachable priority events are created.

Parameters *ip-addr* — The IP address of the host for which the specific event will monitor connectivity. The *ip-addr* can only be monitored by a single event in this policy. The IP address can be monitored by multiple VRRP priority control policies. The IP address can be used in one or multiple **ping** requests. Each VRRP priority control **host-unreachable** and **ping** destined to the same *ip-addr* is uniquely identified on a per message basis. Each session originates a unique identifier value for the ICMP echo request messages it generates. This allows received ICMP echo reply messages to be directed to the appropriate sending application.

Values The following values apply to the 7450 ESS:

ipv4-address: a.b.c.d

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-address:	a.b.c.d	
ipv6-address:	x:x:x:x:x:x:x:x[-interface]	
	x:	[0..FFFF]H
	interface:	32 chars maximum, mandatory for link local addresses

The link-local IPv6 address must have an interface name specified. The global IPv6 address must not have an interface name specified.

interval

Syntax **interval** *seconds*
no interval

Context config>vrrp>priority-event>host-unreachable

Description This command configures the number of seconds between host unreachable priority event ICMP echo request messages directed to the host IP address.

The **no** form of the command reverts to the default value.

Default **interval 1**

Parameters *seconds* — The number of seconds between the ICMP echo request messages sent to the host IP address for the host unreachable priority event.

Values 1 to 60

padding-size

Syntax **padding-size** *size*
no padding-size

Context config>vrrp>priority-event>host-unreachable

Description This command allows the operator to increase the size of IP packet by padding the PDU.

The **no** form of the command reverts to the default.

Default padding-size 0

Parameters *size* — Specifies amount of increase to to ICMP PDU.

Values 0 to 16384

timeout

Syntax **timeout** *seconds*
no timeout

Context config>vrrp vrrp-policy-id>priority-event>host-unreachable

Description This command defines the time, in seconds, that must pass before considering the far-end IP host unresponsive to an outstanding ICMP echo request message.

The **timeout** value is not directly related to the configured **interval** parameter. The **timeout** value may be larger, equal, or smaller, relative to the **interval** value.

If the **timeout** value is larger than the **interval** value, multiple ICMP echo request messages may be outstanding. Every ICMP echo request message transmitted to the far end host is tracked individually according to the message identifier and sequence number.

With each consecutive attempt to send an ICMP echo request message, the timeout timer is loaded with the **timeout** value. The timer decrements until:

- An internal error occurs preventing message sending (request unsuccessful).
- An internal error occurs preventing message reply receiving (request unsuccessful).
- A required route table entry does not exist to reach the IP address (request unsuccessful).
- A required ARP entry does not exist and ARP request timed out (request unsuccessful).
- A valid reply is received (request successful).

It is possible for a required ARP request to succeed or timeout after the message timeout timer expires. In this case, the message request is unsuccessful.

If an ICMP echo reply message is not received prior to the **timeout** period for a given ICMP echo request, that request is considered to be dropped and increments the consecutive message drop counter for the priority event.

If an ICMP echo reply message with the same sequence number as an outstanding ICMP echo request message is received prior to that message timing out, the request is considered successful. The consecutive message drop counter is cleared and the request message no longer is outstanding.

If an ICMP Echo Reply message with a sequence number equal to an ICMP echo request sequence number that had previously timed out is received, that reply is silently discarded while incrementing the priority event reply discard counter.

The **no** form of the command reverts to the default value.

Default **timeout 1**

Parameters *seconds* — The number of seconds before an ICMP echo request message is timed out. Once a message is timed out, a reply with the same identifier and sequence number is discarded.

Values 1 to 60

3.14.2.7 Priority Policy Route Unknown Event Commands

less-specific

Syntax [**no**] **less-specific** [**allow-default**]

Context config>vrrp>policy>priority-event>route-unknown

Description This command allows a CIDR shortest match hit on a route prefix that contains the IP route prefix associated with the route unknown priority event.

The **less-specific** command modifies the search parameters for the IP route prefix specified in the **route-unknown** priority event. Specifying **less-specific** allows a CIDR shortest match hit on a route prefix that contains the IP route prefix.

The **less-specific** command eases the RTM lookup criteria when searching for the *prefix/mask-length*. When the **route-unknown** priority event sends the prefix to the RTM (as if it was a destination lookup), the result route table prefix (if a result is found) is checked to see if it is an exact match or a less specific match. The **less-specific** command enables a less specific route table prefix to match the configured prefix. When **less-specific** is not specified, a less specific route table prefix fails to match the configured prefix. The **allow-default** optional parameter extends the **less-specific** match to include the default route (0.0.0.0).

The **no** form of the command prevents RTM lookup results that are less specific than the route prefix from matching.

Default **no less-specific** — The route unknown priority events requires an exact prefix/mask match.

Parameters **allow-default —** When the **allow-default** parameter is specified with the **less-specific** command, an RTM return of 0.0.0.0 matches the IP prefix. If **less-specific** is entered without the **allow-default** parameter, a return of 0.0.0.0 will not match the IP prefix. To disable **allow-default**, but continue to allow **less-specific** match operation, only enter the **less-specific** command (without the **allow-default** parameter).

next-hop

Syntax [**no**] **next-hop** *ip-address*

Context config>vrrp>policy>priority-event>route-unknown

Description This command adds an allowed next hop IP address to match the IP route prefix for a route-unknown priority control event.

If the next-hop IP address does not match one of the defined *ip-address*, the match is considered unsuccessful and the **route-unknown** event transitions to the set state.

The **next-hop** command is optional. If no **next-hop** *ip-address* commands are configured, the comparison between the RTM prefix return and the **route-unknown** IP route prefix are not included in the next hop information.

When more than one next hop IP addresses are eligible for matching, a **next-hop** command must be executed for each IP address. Defining the same IP address multiple times has no effect after the first instance.

The **no** form of the command removes the *ip-address* from the list of acceptable next hops when looking up the **route-unknown** prefix. If this *ip-address* is the last next hop defined on the **route-unknown** event, the returned next hop information is ignored when testing the match criteria. If the *ip-address* does not exist, the **no next-hop** command returns a warning error, but continues to execute if part of an **exec** script.

Default **no next-hop** — No next hop IP address for the route unknown priority control event is defined.

Parameters *ip-address* — The IP address for an acceptable next hop IP address for a returned route prefix from the RTM when looking up the **route-unknown** route prefix.

Values The following values apply to the 7450 ESS:

ipv4-address: a.b.c.d

Values The following values apply to the 7750 SR and 7950 XRS:

ipv4-address:	a.b.c.d	
ipv6-address:	x:x:x:x:x:x:x:x[-interface]	
	x:	[0..FFFF]H
	interface:	32 chars maximum, mandatory for link local addresses

The link-local IPv6 address must have an interface name specified. The global IPv6 address must not have an interface name specified.

protocol

Syntax **protocol** {**bgp** | **bgp-vpn** | **ospf** | **is-is** | **rip** | **static**}
no protocol

Context config>vrrp>policy>priority-event>route-unknown

Description This command adds one or more route sources to match the route unknown IP route prefix for a route unknown priority control event.

If the route source does not match one of the defined protocols, the match is considered unsuccessful and the **route-unknown** event transitions to the set state.

The **protocol** command is optional. If the **protocol** command is not executed, the comparison between the RTM prefix return and the **route-unknown** IP route prefix will not include the source of the prefix. The **protocol** command cannot be executed without at least one associated route source parameter. All parameters are reset each time the **protocol** command is executed and only the explicitly defined protocols are allowed to match.

The **no** form of the command removes protocol route source as a match criteria for returned RTM route prefixes.

To remove specific existing route source match criteria, execute the **protocol** command and include only the specific route source criteria. Any unspecified route source criteria is removed.

Default **no protocol** — No route source for the route unknown priority event is defined.

Parameters **bgp —** This parameter defines BGP as an eligible route source for a returned route prefix from the RTM when looking up the **route-unknown** route prefix. The **bgp** parameter is not exclusive from the other available **protocol** parameters. If **protocol** is executed without the **bgp** parameter, a returned route prefix with a source of BGP will not be considered a match and will cause the event to enter the set state. This parameter only applies to the 7750 SR and 7950 XRS.

bgp-vpn — This parameter defines **bgp-vpn** as an eligible route source for a returned route prefix from the RTM when looking up the **route-unknown** route prefix. The **bgp-vpn** parameter is not exclusive from the other available **protocol** parameters. If **protocol** is executed without the **bgp-vpn** parameter, a returned route prefix with a source of **bgp-vpn** will not be considered a match and will cause the event to enter the set state. This parameter only applies to the 7750 SR and 7950 XRS.

ospf — This parameter defines OSPF as an eligible route source for a returned route prefix from the RTM when looking up the **route-unknown** route prefix. The **ospf** parameter is not exclusive from the other available **protocol** parameters. If **protocol** is executed without the **ospf** parameter, a returned route prefix with a source of OSPF will not be considered a match and will cause the event to enter the set state.

is-is — This parameter defines IS-IS as an eligible route source for a returned route prefix from the RTM when looking up the **route-unknown** route prefix. The **is-is** parameter is not exclusive from the other available **protocol** parameters. If **protocol** is executed without the **is-is** parameter, a returned route prefix with a source of IS-IS will not be considered a match and will cause the event to enter the set state.

rip — This parameter defines RIP as an eligible route source for a returned route prefix from the RTM when looking up the **route-unknown** route prefix. The **rip** parameter is not exclusive from the other available **protocol** parameters. If **protocol** is executed without the **rip** parameter, a returned route prefix with a source of RIP will not be considered a match and will cause the event to enter the set state.

static — This parameter defines a static route as an eligible route source for a returned route prefix from the RTM when looking up the **route-unknown** route prefix. The **static** parameter is not exclusive from the other available **protocol** parameters. If **protocol** is executed without the **static** parameter, a returned route prefix with a source of static route will not be considered a match and will cause the event to enter the set state.

route-unknown

Syntax [**no**] **route-unknown** [*ip-prefix***/***mask* **|** *ipv6-address / prefix-length*)

Context config>vrrp>policy>priority-event

Description This command creates a context to configure a route unknown priority control event that monitors the existence of a specific active IP route prefix within the routing table.

The **route-unknown** command configures a priority control event that defines a link between the VRRP priority control policy and the Route Table Manager (RTM). The RTM registers the specified route prefix as monitored by the policy. If any change (add, delete, new next hop) occurs relative to the prefix, the policy is notified and takes proper action according to the priority event definition. If the route prefix exists and is active in the routing table according to the conditions defined, the event is in the cleared state. If the route prefix is removed, becomes inactive or fails to meet the event criteria, the event is in the set state.

The command creates a **route-unknown** node identified by *prefix/mask-length* and containing event control commands.

Multiple unique (different *prefix/mask-length*) **route-unknown** event nodes can be configured within the **priority-event** node up to the maximum limit of 32 events.

The **route-unknown** command can reference any valid IP address mask-length pair. The IP address and associated mask length define a unique IP router prefix. The dynamic monitoring of the route prefix results in one of the event operational states listed in Table 40.

Table 40 **Route-unknown Operational States**

route-unknown Operational State	Description
Set – non-existent	The route does not exist in the route table.
Set – inactive	The route exists in the route table but is not being used.
Set – wrong next hop	The route exists in the route table but does not meet the **next-hop** requirements.
Set – wrong protocol	The route exists in the route table but does not meet the **protocol** requirements.
Set – less specific found	The route exists in the route table but does is not an exact match and does not meet any **less-specific** requirements.
Set – default best match	The route exists in the route table as the default route but the default route is not allowed for route matching.
Cleared – less specific found	A less specific route exists in the route table and meets all criteria including the **less-specific** requirements.
Cleared – found	The route exists in the route table manager and meets all criteria.

An existing route prefix in the RTM must be active (used by the IP forwarding engine) to clear the event operational state. It may be less specific (the defined prefix may be contained in a larger prefix according to Classless Inter-Domain Routing (CIDR) techniques) if the event has the **less-specific** statement defined. The less specific route that incorporates the router prefix may be the default route (0.0.0.0) if the **less-specific allow-default** statement is defined. The matching prefix may be required to have a specific next hop IP address if defined by the event **next-hop** command. Finally, the source of the RTM prefix may be required to be one of the dynamic routing protocols or be statically defined if defined by the event **protocol** command. If an RTM prefix is not found that matches all the above criteria (if defined in the event control commands), the event is considered to be set. If a matching prefix is found in the RTM, the event is considered to be cleared.

When an event transitions from clear to set, the set is processed immediately and must be reflected in the associated virtual router instances in-use priority value. As the event transitions from clear to set, a hold set timer is loaded with the value configured by the events **hold-set** command. This timer prevents the event from clearing until it expires, damping the effect of event flapping. If the event clears and becomes set again before the hold set timer expires, the timer is reset to the **hold-set** value, extending the time before another clear can take effect.

The **no** form of the command is used to remove the specific *prefix/mask-length* monitoring event. The event can be removed at anytime. When the event is removed, the in-use priority of all associated virtual router instances must be reevaluated. The events **hold-set** timer has no effect on the removal procedure.

Default **no route-unknown** — No route unknown priority control events are defined for the priority control event policy.

Parameters *prefix* — The IP prefix address to be monitored by the route unknown priority control event in dotted decimal notation.

Values 0.0.0.0 to 255.255.255.255

mask-length — The subnet mask length expressed as a decimal integer associated with the IP *prefix* defining the route prefix to be monitored by the route unknown priority control event.

Values 0 to 32

ip-address — The IP address of the host for which the specific event will monitor connectivity. The *ip-addr* can only be monitored by a single event in this policy. The IP address can be monitored by multiple VRRP priority control policies. The IP address can be used in one or multiple **ping** requests. Each VRRP priority control **host-unreachable** and **ping** destined to the same *ip-addr* is uniquely identified on a per message basis. Each session originates a unique identifier value for the ICMP echo request messages it generates. This allows received ICMP echo reply messages to be directed to the appropriate sending application.

Values The following values apply to the 7450 ESS:

ip-prefix/ mask:	ip-prefix	a.b.c.d (host bits must be 0)
	mask	0 to 32

Values The following values apply to the 7750 SR and 7950 XRS:

ip-prefix/mask:	ip-prefix	a.b.c.d (host bits must be 0)	
	mask	0 to 32	
ipv6-address/*prefix*:	ipv6-address	x:x:x:x:x:x:x:x (eight 16-bit pieces)	
		x:x:x:x:x:x:d.d.d.d	
		x:	[0..FFFF]H
	prefix-length	1 to 128	

3.15 Show, Monitor, Clear, and Debug Command Reference

- Command Hierarchies
- Command Descriptions

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

3.15.1 Command Hierarchies

- Show Commands
- Monitor Commands
- Clear Commands
- Debug Commands

3.15.1.1 Show Commands

show
— **vrrp**
— **policy** [*policy-id* [**event** *event-type specific-qualifier*]]
— **router**
— **vrrp**
— **instance**
— **instance** [**interface** *interface-name* [**vrid** *virtual-router-id*]]
— **instance** **interface** *interface-name* **vrid** *virtual-router-id* **ipv6**
— **statistics**

3.15.1.2 Monitor Commands

monitor
— **router**
— **vrrp**
— **instance** **interface** *interface-name* **vr-id** *virtual-router-id* [**ipv6**] [**interval** *seconds*] [**repeat** *repeat*] [**absolute** | **rate**]

3.15.1.3 Clear Commands

clear
— **vrrp**
— **statistics**
— **router**
— **vrrp**
— **interface** *ip-int-name* [**vrid** *virtual-router-id*]
— **interface** *ip-int-name* **vrid** *virtual-router-id* **ipv6**
— **statistics** **interface** *interface-name* [**vrid** *virtual-router-id*]
— **statistics**
— **statistics** **interface** *interface-name* **vrid** *virtual-router-id* **ipv6**

3.15.1.4 Debug Commands

debug
- **router**
  - **vrrp**
    - **events**
    - **events interface** *ip-int-name* [**vrid** *virtual-router-id*]
    - **events interface** *ip-int-name* **vrid** *virtual-router-id* **ipv6**
    - **no events**
    - **no events interface** *ip-int-name* [**vrid** *virtual-router-id*]
    - **no events interface** *ip-int-name* **vrid** *virtual-router-id* **ipv6**
    - **packets**
    - **packets interface** *ip-int-name* [**vrid** *virtual-router-id*]
    - **packets interface** *ip-int-name* **vrid** *virtual-router-id* **ipv6**
    - **no packets**
    - **no packets interface** *ip-int-name* [**vrid** *virtual-router-id*]
    - **no packets interface** *ip-int-name* **vrid** *virtual-router-id* **ipv6**

3.15.2 Command Descriptions

3.15.2.1 Show Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

instance

Syntax **instance**
instance [**interface** *interface-name* [**vrid virtual-router-id**]]
instance interface *interface-name* **vrid virtual-router-id ipv6**

Context show>vrrp

Description This command displays information for VRRP instances.

If no command line options are specified, summary information for all VRRP instances displays.

Parameters **interface** *ip-int-name* **—** Displays detailed information for the VRRP instances on the specified IP interface including status and statistics.

Default Summary information for all VRRP instances.

vrid *virtual-router-id* **—** Displays detailed information for the specified VRRP instance on the IP interface.

Default All VRIDs for the IP interface.

Values 1 to 255

ipv6 — Specifies the IPv6 instance.

Output The following output is an example of VRRP instance information for the 7450 ESS, and Table 41 describes the fields.

Sample Output

```
*A:ALA-A# show router vrrp instance
===============================================================================
VRRP Instances
===============================================================================
Interface Name                   VR Id Own Adm  State       Base Pri   Msg Int
                                 IP        Opr  Pol Id      InUse Pri  Inh Int
-------------------------------------------------------------------------------
n2                               1     No  Up   Master       100       1
                                 IPv4      Up   n/a         100        No
  Backup Addr: 5.1.1.10
```

```
-------------------------------------------------------------------------------
Instances : 2
===============================================================================
*A:ALA-A#


*A:ALA-A# show router vrrp instance interface n2 vrid 1
===============================================================================
VRRP Instance 1 for interface "n2"
===============================================================================
Owner               : No                  VRRP State        : Master
Primary IP of Master: 5.1.1.2 (Self)
Primary IP          : 5.1.1.2             Standby-Forwarding: Disabled
VRRP Backup Addr    : 5.1.1.10
Admin State         : Up                  Oper State        : Up
Up Time             : 09/23/2004 06:53:45 Virt MAC Addr     : 00:00:5e:00:01:01
Auth Type           : None
Config Mesg Intvl   : 1                   In-Use Mesg Intvl : 1
Master Inherit Intvl: No
Base Priority       : 100                 In-Use Priority   : 100
Policy ID           : n/a                 Preempt Mode      : Yes
Ping Reply          : No                  Telnet Reply      : No
SSH Reply           : No                  Traceroute Reply  : No
Init Delay          : 0                   Init Timer Expires: 0.000 sec
Creation State      : Active
-------------------------------------------------------------------------------
Master Information
-------------------------------------------------------------------------------
Primary IP of Master: 5.1.1.2 (Self)
Addr List Mismatch  : No                  Master Priority   : 100
Master Since        : 09/23/2004 06:53:49
-------------------------------------------------------------------------------
Masters Seen (Last 32)
-------------------------------------------------------------------------------
Primary IP of Master   Last Seen             Addr List Mismatch     Msg Count
-------------------------------------------------------------------------------
5.1.1.2                09/23/2004 06:53:49   No                             0
-------------------------------------------------------------------------------
Statistics
-------------------------------------------------------------------------------
Become Master       : 1                   Master Changes    : 1
Adv Sent            : 103                 Adv Received      : 0
Pri Zero Pkts Sent  : 0                   Pri Zero Pkts Rcvd: 0
Preempt Events      : 0                   Preempted Events  : 0
Mesg Intvl Discards : 0                   Mesg Intvl Errors : 0
Addr List Discards  : 0                   Addr List Errors  : 0
Auth Type Mismatch  : 0                   Auth Failures     : 0
Invalid Auth Type   : 0                   Invalid Pkt Type  : 0
IP TTL Errors       : 0                   Pkt Length Errors : 0
Total Discards      : 0
===============================================================================
```

The following output is an example of VRRP instance information for the 7750 SR and 7950 XRS, and Table 41 describes the fields

Output Sample

```
*A:ALA-A# show router vrrp instance interface n2 vrid 1 ipv6
===============================================================================
VRRP Instance 1 for interface "n2"
===============================================================================
No Matching Entries
===============================================================================
*A:ALA-A#


*A:ALA-A# show router vrrp instance interface n2 vrid 10 ipv6
===============================================================================
VRRP Instance 10 for interface "n2"
===============================================================================
Owner               : No                    VRRP State        : Master
Primary IP of Master: FE80::1 (Self)
Primary IP          : FE80::1
                                            Standby-Forwarding: Disabled
VRRP Backup Addr    : 5::10
                    : FE80::10
Admin State         : Up                    Oper State        : Up
Up Time             : 09/23/2004 06:55:12 Virt MAC Addr     : 00:00:5e:00:02:0a
Config Mesg Intvl   : 1.0                   In-Use Mesg Intvl : 1.0
Master Inherit Intvl: Yes
Base Priority       : 100                   In-Use Priority   : 100
Policy ID           : n/a                   Preempt Mode      : Yes
Ping Reply          : No                    Telnet Reply      : No
                                            Traceroute Reply  : No
Init Delay          : 0                     Init Timer Expires: 0.000 sec
Creation State      : Active
-------------------------------------------------------------------------------
Master Information
-------------------------------------------------------------------------------
Primary IP of Master: FE80::1 (Self)
Addr List Mismatch  : No                    Master Priority   : 100
Master Since        : 09/23/2004 06:55:16
=============================================================================
Masters Seen (Last 32)
===============================================================================
Primary IP of Master
                       Last Seen             Addr List Mismatch     Msg Count
-------------------------------------------------------------------------------
FE80::1
                       09/23/2004 06:55:16   No                             0
-------------------------------------------------------------------------------
Statistics
-------------------------------------------------------------------------------
Master Transitions  : 1                     Discontinuity Time: 09/09/2004 01:57*
Adv Sent            : 23                    Adv Received      : 0
Pri Zero Pkts Sent  : 0                     Pri Zero Pkts Rcvd: 0
Preempt Events      : 0                     Preempted Events  : 0
Mesg Intvl Discards : 0                     Mesg Intvl Errors : 0
Total Discards      : 0                     Addr List Errors  : 0
Auth Failures       : 0                     Invalid Pkt Type  : 0
IP TTL Errors       : 0                     Pkt Length Errors : 0
===============================================================================
* indicates that the corresponding row element may have been truncated.
```

Table 41 **Show VRRP Instance Output Fields**

Label	**Description**
Interface name	The name of the IP interface.
VR ID	The virtual router ID for the IP interface
Own Owner	Yes Specifies that the virtual router instance as owning the virtual router IP addresses.
	No Indicates that the virtual router instance is operating as a non-owner.
Adm	Up Indicates that the administrative state of the VRRP instance is up.
	Down Indicates that the administrative state of the VRRP instance is down.
Opr	Up Indicates that the operational state of the VRRP instance is up.
	Down Indicates that the operational state of the VRRP instance is down.
State	When owner, **backup** defines the IP addresses that are advertised within VRRP advertisement messages. When non-owner, **backup** actually creates an IP interface IP address used for routing IP packets and communicating with the system when the access commands are defined (ping-reply, telnet-reply, and ssh-reply).
Pol Id	The value that uniquely identifies a Priority Control Policy.
Base Priority	The *base-priority* value used to derive the in-use priority of the virtual router instance as modified by any optional VRRP priority control policy.
InUse Priority	The current in-use priority associated with the VRRP virtual router instance.
Msg Int	The administrative advertisement message timer used by the master virtual router instance to send VRRP advertisement messages and to derive the master down timer as backup.

Table 41 **Show VRRP Instance Output Fields (Continued)**

Label	**Description**
Inh Int	Yes When the VRRP instance is a non-owner and is operating as a backup and the **master-int-inherit** command is enabled, the master down timer is indirectly derived from the value in the advertisement interval field of the VRRP message received from the current master.
	No When the VRRP instance is operating as a backup and the **master-int-inherit** command is *not* enabled, the configured advertisement interval is matched against the value in the advertisement interval field of the VRRP message received from the current master. If the two values do not match then the VRRP advertisement is discarded. If the VRRP instance is operating as a master, this value has no effect.
Backup Addr	The backup virtual router IP address.
BFD	Indicates BFD is enabled.
VRRP State	Specifies whether the VRRP instance is operating in a master or backup state.
Policy ID	The VRRP priority control policy associated with the VRRP virtual router instance. A value of 0 indicates that no control policy policy is associated with the virtual router instance.
Preempt Mode	Yes The preempt mode is enabled on the virtual router instance where it will preempt a VRRP master with a lower priority.
	No The preempt mode is disabled and prevents the non-owner virtual router instance from preempting another, less desirable virtual router.

Table 41 **Show VRRP Instance Output Fields (Continued)**

Label	Description
Ping Reply	Yes A non-owner master is enabled to reply to ICMP Echo requests directed to the virtual router instance IP addresses. Ping Reply is valid only if the VRRP virtual router instance associated with this entry is a non-owner. A non-owner backup virtual router never responds to such ICMP echo requests irrespective if Ping Reply is enabled.
	No ICMP echo requests to the virtual router instance IP addresses are discarded.
Telnet Reply	Yes Non-owner masters can to reply to TCP port 23 Telnet requests directed at the virtual router instances IP addresses.
	No Telnet requests to the virtual router instance IP addresses are discarded.
SSH Reply	Yes Non-owner masters can to reply to SSH requests directed at the virtual router instances IP addresses.
	No All SSH request messages destined to the non-owner virtual router instance IP addresses are discarded.
Primary IP of Master	The IP address of the VRRP master.
Primary IP	The IP address of the VRRP owner.
Up Time	The date and time when the operational state of the event last changed.
Virt MAC Addr	The virtual MAC address used in ARP responses when the VRRP virtual router instance is operating as a master.
Auth Type	Specifies the VRRP authentication Type 0 (no authentication), Type 1 (simple password), or Type 2 (MD5) for the virtual router.
Addr List Mismatch	Specifies whether a trap was generated when the IP address list received in the advertisement messages received from the current master did not match the configured IP address list. This is an edge triggered notification. A second trap will not be generated for a packet from the same master until this event has been cleared.

Table 41 **Show VRRP Instance Output Fields (Continued)**

Label	Description
Master Priority	The priority of the virtual router instance which is the current master.
Master Since	The date and time when operational state of the virtual router changed to master. For a backup virtual router, this value specifies the date and time when it received the first VRRP advertisement message from the virtual router which is the current master.

policy

Syntax **policy** [*vrrp-policy-id* [**event** *event-type specific-qualifier*]]

Context show>vrrp

Description This command displays VRRP priority control policy information.

If no command line options are specified, a summary of the VRRP priority control event policies displays.

Parameters *vrrp-policy-id* — Displays information on the specified priority control policy ID.

Default All VRRP policies IDs

Values 1 to 9999

event *event-type* **—** Displays information on the specified VRRP priority control event within the policy ID.

Default All event types and qualifiers

Values
port-down *port-id*
lag-port-down *lag-id*
host-unreachable *host-ip-addr*
route-unknown *route-prefix***/***mask*
mc-ipsec-non-forwarding

specific-qualifier — Display information about the specified qualifier.

Values port-id, lag-id, host-ip-addr, route-prefix/mask, tunnel-group-id

Output **VRRP Policy Output —** The following output is an example of VRRP policy information, and Table 42 describes the fields.

Table 42 Show VRRP Policy Output Fields

Label	Description
Policy Id	The VRRP priority control policy associated with the VRRP virtual router instance. A value of 0 indicates that no control policy is associated with the virtual router instance.
Current Priority & Effects	
Current Explicit	When multiple explicitly defined events associated with the priority control policy happen simultaneously, the lowest value of all the current explicit priorities will be used as the in-use priority for the virtual router.
Current Delta Sum	The sum of the priorities of all the delta events when multiple delta events associated with the priority control policy happen simultaneously. This sum is subtracted from the base priority of the virtual router to give the in-use priority.
Delta Limit	The delta-in-use-limit for a VRRP policy. Once the total sum of all delta events has been calculated and subtracted from the base-priority of the virtual router, the result is compared to the delta-in-use-limit value. If the result is less than this value, the delta-in-use-limit value is used as the virtual router in-use priority value. If an explicit priority control event overrides the delta priority control events, the delta-in-use-limit has no effect. If the delta-in-use-limit is 0, the sum of the delta priority control events to reduce the virtual router's in-use-priority to 0 can prevent it from becoming or staying master.
Current Priority	The configured delta-in-use-limit priority for a VRRP priority control policy or the configured delta or explicit priority for a priority control event.
Applied	The number of virtual router instances to which the policy has been applied. The policy cannot be deleted unless this value is 0.
Description	A text string which describes the VRRP policy.

Table 42 **Show VRRP Policy Output Fields (Continued)**

Label	Description
Event Type & ID	A delta priority event is a conditional event defined in a priority control policy that subtracts a given amount from the base priority to give the current in-use priority for the VRRP virtual router instances to which the policy is applied. An explicit priority event is a conditional event defined in a priority control policy that explicitly defines the in-use priority for the VRRP virtual router instances to which the policy is applied. Explicit events override all delta Events. When multiple explicit events occur simultaneously, the event with the lowest priority value defines the in-use priority.
Event Oper State	The operational state of the event.
Hold Set Remaining	The amount of time that must pass before the set state for a VRRP priority control event can transition to the cleared state to dampen flapping events.
Priority & Effect	Delta The *priority-level* value is subtracted from the associated virtual router instance’s base priority when the event is set and no explicit events are set. The sum of the priority event *priority-level* values on all set delta priority events are subtracted from the virtual router base priority to derive the virtual router instance in-use priority value. If the **delta** priority event is cleared, the *priority-level* is no longer used in the in-use priority calculation.
	Explicit The *priority-level* value is used to override the base priority of the virtual router instance if the priority event is set and no other **explicit** priority event is set with a lower *priority-level*. The set **explicit** priority value with the lowest *priority-level* determines the actual in-use protocol value for all virtual router instances associated with the policy.
In Use	Specifies whether or not the event is currently affecting the in-use priority of some virtual router.

Sample Output

```
A:ALA-A# show vrrp policy
===============================================================================
VRRP Policies
===============================================================================
Policy    Current             Current      Current      Delta       Applied
Id        Priority & Effect   Explicit     Delta Sum    Limit
```

```
-------------------------------------------------------------------------------
1         None                None         None         1            Yes
2         None                None         None         1            No
===============================================================================
A:ALA-A#


A:ALA-A# show vrrp policy 1
===============================================================================
VRRP Policy 1
===============================================================================
Description      : 10.10.200.253 reachability
Current Priority: None                Applied            : No
Current Explicit: None                Current Delta Sum : None
Delta Limit      : 1

-------------------------------------------------------------------------------
Applied To                       VR     Opr     Base    In-use  Master  Is
Interface Name                   Id             Pri     Pri     Pri     Master
-------------------------------------------------------------------------------
None

-------------------------------------------------------------------------------
Priority Control Events
-------------------------------------------------------------------------------
Event Type & ID                  Event Oper State        Hold Set  Priority In
                                                         Remaining &Effect  Use
-------------------------------------------------------------------------------
Host Unreach 10.10.200.252       n/a                     Expired    20 Del  No
Host Unreach 10.10.200.253       n/a                     Expired    10 Del  No
Route Unknown 10.10.100.0/24     n/a                     Expired     1 Exp  No
===============================================================================
```

VRRP Policy Event Output — The following output is an example of VRRP policy event information, and Table 43 describes the fields.

Sample Output

```
A:ALA-A#show vrrp policy 1 event port-down
===============================================================================
VRRP Policy 1, Event Port Down 1/1/1
===============================================================================
Description      :
Current Priority: None                Applied            : Yes
Current Explicit: None                Current Delta Sum : None
Delta Limit      : 1

-------------------------------------------------------------------------------
Applied To                       VR     Opr     Base    In-use  Master  Is
Interface Name                   Id             Pri     Pri     Pri     Master
-------------------------------------------------------------------------------
ies301backup                     1      Down    100     100     0       No

-------------------------------------------------------------------------------
Priority Control Event Port Down 1/1/1
-------------------------------------------------------------------------------
Priority         : 30                 Priority Effect    : Delta
```

```
Hold Set Config : 0 sec                Hold Set Remaining: Expired
Value In Use    : No                   Current State     : Cleared
# trans to Set  : 6                    Previous State    : Set-down
Last Transition : 04/13/2007 04:54:35
===============================================================================
A:ALA-A#

A:ALA-A# show vrrp policy 1 event host-unreachable
===============================================================================
VRRP Policy 1, Event Host Unreachable 10.10.200.252
===============================================================================
Description     : 10.10.200.253 reachability
Current Priority: None                 Applied           : No
Current Explicit: None                 Current Delta Sum : None
Delta Limit     : 1

-------------------------------------------------------------------------------
Applied To                      VR     Opr     Base    In-use  Master  Is
Interface Name                  Id             Pri     Pri     Pri     Master
-------------------------------------------------------------------------------
None

-------------------------------------------------------------------------------
Priority Control Event Host Unreachable 10.10.200.252
-------------------------------------------------------------------------------
Priority        : 20                   Priority Effect   : Delta
Interval        : 1 sec                Timeout           : 1 sec
Drop Count      : 3
Hold Set Config : 0 sec                Hold Set Remaining: Expired
Value In Use    : No                   Current State     : n/a
# trans to Set  : 0                    Previous State    : n/a
Last Transition : 04/13/2007 23:10:24
===============================================================================
A:ALA-A#


A:ALA-A# show vrrp policy 1 event route-unknown
===============================================================================
VRRP Policy 1, Event Route Unknown 10.10.100.0/24
===============================================================================
Description     : 10.10.200.253 reachability
Current Priority: None                 Applied           : No
Current Explicit: None                 Current Delta Sum : None
Delta Limit     : 1

-------------------------------------------------------------------------------
Applied To                      VR     Opr     Base    In-use  Master  Is
Interface Name                  Id             Pri     Pri     Pri     Master
-------------------------------------------------------------------------------
None

-------------------------------------------------------------------------------
Priority Control Event Route Unknown 10.10.100.0/24
-------------------------------------------------------------------------------
Priority        : 1                    Priority Effect   : Explicit
Less Specific   : No                   Default Allowed   : No
Next Hop(s)     : None
Protocol(s)     : None
Hold Set Config : 0 sec                Hold Set Remaining: Expired
```

```
Value In Use    : No                  Current State     : n/a
# trans to Set  : 0                   Previous State    : n/a
Last Transition : 04/13/2007 23:10:24
===============================================================================
```

Table 43 Show VRRP Policy Event Output Fields

Label	Description
Description	A text string which describes the VRRP policy.
Policy Id	The VRRP priority control policy associated with the VRRP virtual router instance. A value of 0 indicates that no control policy is associated with the virtual router instance.
Current Priority	The base router priority for the virtual router instance used in the master election process.
Current Explicit	When multiple explicitly defined events associated with the priority control policy happen simultaneously, the lowest value of all the current explicit priorities will be used as the in-use priority for the virtual router.
Applied	The number of virtual router instances to which the policy has been applied. The policy cannot be deleted unless this value is 0.
Current Delta Sum	The sum of the priorities of all the delta events when multiple delta events associated with the priority control policy happen simultaneously. This sum is subtracted from the base priority of the virtual router to give the in-use priority.
Delta Limit	The delta-in-use-limit for a VRRP policy. Once the total sum of all delta events has been calculated and subtracted from the base-priority of the virtual router, the result is compared to the delta-in-use-limit value. If the result is less than this value, the delta-in-use-limit value is used as the virtual router in-use priority value. If an explicit priority control event overrides the delta priority control events, the delta-in-use-limit has no effect. If the delta-in-use-limit is 0, the sum of the delta priority control events to reduce the virtual router's in-use-priority to 0 can prevent it from becoming or staying master.
Applied to Interface Name	The interface name where the VRRP policy is applied.
VR ID	The virtual router ID for the IP interface.

Table 43 Show VRRP Policy Event Output Fields (Continued)

Label	Description
Opr	Up Indicates that the operational state of the VRRP instance is up.
	Down Indicates that the operational state of the VRRP instance is down.
Base Pri	The base priority used by the virtual router instance.
InUse Priority	The current in-use priority associated with the VRRP virtual router instance.
Master Priority	The priority of the virtual router instance which is the current master.
Priority	The base priority used by the virtual router instance.
Priority Effect	Delta A delta priority event is a conditional event defined in a priority control policy that subtracts a given amount from the base priority to give the current in-use priority for the VRRP virtual router instances to which the policy is applied.
	Explicit A conditional event defined in a priority control policy that explicitly defines the in-use priority for the VRRP virtual router instances to which the policy is applied. Explicit events override all delta events. When multiple explicit events occur simultaneously, the event with the lowest priority value defines the in-use priority.
Current Priority	The configured delta-in-use-limit priority for a VRRP priority control policy or the configured delta or explicit priority for a priority control event.
Event Oper State	The operational state of the event.
Hold Set Remaining	The amount of time that must pass before the set state for a VRRP priority control event can transition to the cleared state to dampen flapping events.
Priority	The base priority used by the virtual router instance.

Table 43 **Show VRRP Policy Event Output Fields (Continued)**

Label	Description
Priority Effect	Delta The *priority-level* value is subtracted from the associated virtual router instance’s base priority when the event is set and no explicit events are set. The sum of the priority event *priority-level* values on all set delta priority events are subtracted from the virtual router base priority to derive the virtual router instance in-use priority value. If the **delta** priority event is cleared, the *priority-level* is no longer used in the in-use priority calculation.
	Explicit The *priority-level* value is used to override the base priority of the virtual router instance if the priority event is set and no other **explicit** priority event is set with a lower *priority-level*. The set **explicit** priority value with the lowest *priority-level* determines the actual in-use protocol value for all virtual router instances associated with the policy.
Hold Set Config	The configured number of seconds that the hold set timer waits after an event enters a set state or enters a higher threshold set state, depending on the event type.
Value In Use	Yes The event is currently affecting the in-use priority of some virtual router.
	No The event is not affecting the in-use priority of some virtual router.
# trans to Set	The number of times the event has transitioned to one of the 'set' states.
Last Transition	The time and date when the operational state of the event last changed.

statistics

Syntax **statistics**

Context show>router>vrrp

Description This command displays statistics for VRRP instance.

Output The following output is an example of VRRP statistics information, and table describes the fields.

Sample Output

```
A:ALA-48# show router vrrp statistics
===============================================================================
VRRP Global Statistics
===============================================================================
VR Id Errors       : 0                  Version Errors     : 0
Checksum Errors    : 0
===============================================================================
```

Table 44 Show VRRP Statistics Output Fields

Label	Description
VR Id Errors	Displays the number of virtual router ID errors.
Version Errors	Displays the number of version errors.
Checksum Errors	Displays the number of checksum errors.

3.15.2.2 Monitor Commands

instance

Syntax **instance interface** *interface-name* **vr-id** *virtual-router-id* [**ipv6**] [**interval** *seconds*] [**repeat** *repeat*] [**absolute | rate**]

Context monitor>router>vrrp

Description Monitor statistics for a VRRP instance.

Parameters *interface-name* — The name of the existing IP interface on which VRRP is configured.

vr-id *virtual-router-id* **—** The virtual router ID for the existing IP interface, expressed as a decimal integer.

interval *seconds* **—** Configures the interval for each display in seconds.

Values 3 to 60

Default 5 seconds

repeat *repeat* — Configures how many times the command is repeated.

Values 1 to 999

Default 10

absolute — When the **absolute** keyword is specified, the raw statistics are displayed, without processing. No calculations are performed on the delta or rate statistics.

rate — When the **rate** keyword is specified, the rate-per-second for each statistic is displayed instead of the delta.

ipv6 — Specifies to monitor IPv6 instances.

Output The following output is an example of VRRP instance information.

Sample Output

```
*A:ALA-A# monitor router vrrp instance interface n2 vr-id 1
===============================================================================
Monitor statistics for VRRP Instance 1 on interface "n2"
===============================================================================
-------------------------------------------------------------------------------
At time t = 0 sec (Base Statistics)
-------------------------------------------------------------------------------
Become Master       : 1                 Master Changes    : 1
Adv Sent            : 1439              Adv Received      : 0
Pri Zero Pkts Sent  : 0                 Pri Zero Pkts Rcvd: 0
Preempt Events      : 0                 Preempted Events  : 0
Mesg Intvl Discards : 0                 Mesg Intvl Errors : 0
Addr List Discards  : 0                 Addr List Errors  : 0
Auth Type Mismatch  : 0                 Auth Failures     : 0
Invalid Auth Type   : 0                 Invalid Pkt Type  : 0
IP TTL Errors       : 0                 Pkt Length Errors : 0
```

```
Total Discards      : 0
===============================================================================
```

The following output is an example of VRRP instance information for the 7750 SR and 7950 XRS.

Sample Output

```
*A:ALA-A# monitor router vrrp instance interface n2 vr-id 10 ipv6
===============================================================================
Monitor statistics for VRRP Instance 10 on interface "n2"
===============================================================================
-------------------------------------------------------------------------------
At time t = 0 sec (Base Statistics)
-------------------------------------------------------------------------------
Master Transitions  : 1                  Discontinuity Time: 09/09/2004 01:57*
Adv Sent            : 1365               Adv Received      : 0
Pri Zero Pkts Sent  : 0                  Pri Zero Pkts Rcvd: 0
Preempt Events      : 0                  Preempted Events  : 0
Mesg Intvl Discards : 0                  Mesg Intvl Errors : 0
Total Discards      : 0                  Addr List Errors  : 0
Auth Failures       : 0                  Invalid Pkt Type  : 0
IP TTL Errors       : 0                  Pkt Length Errors : 0
===============================================================================
```

3.15.2.3 Clear Commands

interface

Syntax **interface** *ip-int-name* [**vrid** *virtual-router-id*]
interface *ip-int-name* **vrid** *virtual-router-id* **ipv6**

Context clear>router>vrrp

Description This command resets VRRP protocol instances on an IP interface.

Parameters *ip-int-name* — The IP interface to reset the VRRP protocol instances.

vrid *vrid* **—** Resets the VRRP protocol instance for the specified VRID on the IP interface.

Default All VRIDs on the IP interface.

Values 1 to 255

ipv6 — Clears IPv6 information for the specified interface.

statistics

Syntax **statistics** [**policy** *policy-id*]

Context clear>router>vrrp

Description This command enables the context to clear and reset VRRP entities.

Parameters **policy** *policy-id* **—** Clears statistics for the specified policy.

Values 1 to 9999

statistics

Syntax **statistics interface** *interface-name* [**vrid** *virtual-router-id*]
statistics
statistics interface *interface-name* **vrid** *virtual-router-id* **ipv6**

Context clear>router>vrrp

Description This command clears statistics for VRRP instances on an IP interface or VRRP priority control policies.

Parameters **interface** *ip-int-name* **—** Clears the VRRP statistics for all VRRP instances on the specified IP interface.

vrid *virtual-router-id* **—** Clears the VRRP statistics for the specified VRRP instance on the IP interface.

Default All VRRP instances on the IP interface.

Values 1 to 255

policy [*vrrp-policy-id***] —** Clears VRRP statistics for all or the specified VRRP priority control policy.

Default All VRRP policies.

Values 1 to 9999

ipv6 — Clears IPv6 statistics for the specified interface.

3.15.2.4 Debug Commands

events

Syntax **events**
events interface *ip-int-name* [**vrid** *virtual-router-id*]
events interface *ip-int-name* **vrid** *virtual-router-id* **ipv6**
no events
no events interface *ip-int-name* **vrid** *virtual-router-id* **ipv6**
no events interface *ip-int-name* [**vrid** *virtual-router-id*]

Context debug>router>vrrp

Description This command enables debugging for VRRP events.

The **no** form of the command disables debugging.

Parameters *ip-int-name* — Displays the specified interface name.

vrid *virtual-router-id* **—** Displays the specified VRID.

ipv6 — Debugs the specified IPv6 VRRP interface.

packets

Syntax **packets interface** *ip-int-name* [**vrid** *virtual-router-id*]
packets
no packets interface *ip-int-name* [**vrid** *virtual-router-id*] [**ipv6**]
no packets

Context debug>router>vrrp

Description This command enables debugging for VRRP packets.

The **no** form of the command disables debugging.

Parameters *ip-int-name* — Displays the specified interface name.

vrid *virtual-router-id* **—** Displays the specified VRID.

4 Filter Policies

4.1 In This Chapter

The SR OS supports filter policies for services and network interfaces (described in this chapter), subscriber management (integrated with subscriber management filter policies defined in the *Triple Play Guide*), and CPM security and Management Interface (described in the *7450 ESS, 7750 SR, and 7950 XRS System Management Guide*).

Topics in this chapter include:

- Filter Policy-based ESM Service Chaining
- Policy-Based Forwarding for Deep Packet Inspection in VPLS

4.2 ACL Filter Policy Overview

ACL filter policies, also referred to as Access Control Lists (ACLs) or filters for short, are sets of ordered rule entries specifying packet match criteria and actions to be performed to a packet upon a match. Filter policies are created with a unique filter ID, but each filter can also have a unique filter name configured once the filter policy has been created. Either filter ID or filter name can be used throughout the system to manage filter policies and assign them to interfaces.

There are three main types of filter policies: IPv4, IPv6, and MAC filter policies. Additionally MAC filter policies support three sub-types: **configure**>**filter>mac-filter>type** {**normal** | **isid** | **vid**}. These sub-types allow operators to configure different Layer 2 match criteria for a MAC filter.

There are different kinds of filter policies as defined by the filter policy **scope**:

- An **exclusive** filter allows defining policy rules explicitly for a single interface. An exclusive filter allows highest-level of customization but uses most resources, since each exclusive filter consumes H/W resources on line cards on which the interface exists.
- A **template** filter allows usage of identical set of policy rules across multiple interfaces. Template filters use a single set of resources per line card, regardless of how many interfaces use a given template filter policy on that line card. Template filter policies used on access interfaces, consume resources on line cards only if at least one access interface for a given template filter policy is configured on a given line card.
- An **embedded** filter allows defining common set of policy rules that can then be used (embedded) by other exclusive or template filters in the system. This allows optimized management of filter policies.
- A **system** filter policy allows defining common set of policy rules that can then be activated within other exclusive/template filters. A system filter policy is intended mainly for system-level blacklisting rules but can be used for other applications as well. This allows optimized management of common rules (similarly to embedded filters); however, active system filter policy entries are not duplicated inside each policy that actives the system policy (as is the case when embedding is used). The active system policy is downloaded once to line cards, and activating filter policies are chained to it.

Once created, filter policies must then be associated with interfaces/services/subscribers or with other filter policies (if the created policy cannot be directly deployed on interface/services/subscriber), so the incoming/outgoing traffic can be subjected to filter rules. Filter policies are associated with interfaces/services/subscribers separately in ingress and in egress direction. A policy deployed on ingress and egress direction can be same or different. In general, it is recommended to use different filter policies per-ingress and per-egress directions and to use different filter policies per service type, since filter policies support different match criteria and different actions for different direction/service contexts. A filter policy is applied to a packet in the ascending rule entry order. When a packet matches all the parameters specified in a filter entry's match criteria, the system takes the action defined for that entry. If a packet does not match the entry parameters, the packet is compared to the next higher numerical filter entry rule and so on. If the packet does not match any of the entries, the system executes the **default-action** specified in the filter policy: **drop** or **forward**.

For Layer 2, either an IPv4/IPv6, and MAC filter policy can be applied. For Layer 3 and network interfaces, an IPv4/IPv6 policy can be applied. For r-VPLS service, a Layer 2 filter policy can be applied to Layer 2 forwarded traffic and Layer 3 filter policy can be applied to Layer 3 routed traffic. For dual stack interfaces, if both IPv4 and IPv6 filter policies are configured, the policy applied will be based on the outer IP header of the packet. Non-IP packets are not hitting an IP filter policy, so the default action in the IP filter policy will not apply to these packets. IPv6 filters do not apply to the 7450 ESS except when it is in mixed mode.

4.2.1 Filter Policy Basics

The following subsections define main functionality supported by filter policies.

4.2.1.1 Filter Policy Packet Match Criteria

This section defines packet match criteria supported on SR OS for IPv4, IPv6 and MAC filters. Types of criteria supported depends on the hardware platform and filter direction, please see your Nokia representative for further details.

General notes:

- If multiple unique match criteria are specified in a single filter policy entry, all criteria must be met in order for the packet to be considered a match against that filter policy entry (logical AND).
- Any match criteria not explicitly defined is ignored during match.

- An ACL filter policy entry with match criteria defined but no action configured, is considered incomplete and inactive (an entry is not downloaded to the line card). A filter policy must have at least single entry active for the policy to be considered active.
- An ACL filter entry with no match conditions defined matches all packets.
- Because an ACL filter policy is an order list, entries should be configured (numbered) from the most explicit to the least explicit.

4.2.1.2 IPv4/IPv6 Filter Policy Entry Match Criteria

The IPv4 and IPv6 match criteria supported by the SR OS are listed below. The criteria are evaluated against outer IPv4/IPv6 header and a L4 header that follows (if applicable). Support for a given match criteria may depend on H/W and/or filter direction as per below description. It is recommended not to configure a filter in a direction or on a H/W where a given match condition is not supported as this may lead to undesired behavior. Some match criteria may be grouped in match lists and may be auto-generated based on router configuration – see Filter Policy Advanced Topics for more details.

Basic Layer 3 match criteria:

- **dscp** — Match for the specified DSCP value against the Differentiated Services Code Point/Traffic Class field in the IPv4 or IPv6 packet header.
- **src-ip/dst-ip** — Match for the specified source/destination IPv4/IPv6 address-prefix against the source/destination IPv4/IPv6 address field in the IPv4/IPv6 packet header. Operator can optionally configure a mask to be used in a match.
- **flow-label** — Match for the specified flow label against the Flow label field in IPv6 packets. Operator can optionally configure a mask to be used in a match. Supported for ingress filters on FP-2-based line cards only. Requires minimum chassis mode C.

Conditional action match criteria:

- **hop-limit** — Match for the specified hop-limit value/range against the Hop Limit field in IPv6 packet header. This match condition is supported for drop action only and is part of action evaluation – i.e. after packet is determined to match the entry based on other match criteria configured. Packets that match all match criteria for a given filter policy entry are dropped if the hop-limit match criterion is met and forwarded if the hop-limit match criterion is not met. When a filter entry with a hop-limit condition is used as a mirror source, only forwarded packets are mirrored. When a filter entry with a hop-limit condition is used in cflowd processing, the hop-limit condition is ignored for cflowd processing. Supported for ingress filters only. Requires minimum FP-2-based line cards. The hop-limit match condition is always true if a filter is configured on egress or on older hardware.

- **packet-length/payload-length** — Match for the specified length value/range against the Total Length field in IPv4 packet header or Payload Length field in IPv6 packet header. (The IPv6 payload-length field does not account for the size of the fixed IP header, which is 40 bytes.) This match condition is supported for drop action only and is part of action evaluation – i.e. after packet is determined to match the entry based on other match criteria configured. Packets that match all match criteria for a given filter policy entry are dropped if the packet-length or payload-length match criterion is met and forwarded if the packet match criterion is not met. When a filter entry with a packet-length or payload-length condition is used as a mirror source, only forwarded packets are mirrored. Supported for ingress filters only. Requires minimum FP-2-based line cards. The packet-length match condition is always true if a filter is configured on egress or on an older hardware.
- **ttl** — Match for the specified TTL value/range against the Time To Live field in IPv4 packet header. This match condition is supported for drop action only and is part of action evaluation – i.e. after packet is determined to match the entry based on other match criteria configured. Packets that match all match criteria for a given filter policy entry are dropped if the TTL match criterion is met and forwarded if the TTL match criterion is not met. When a filter entry with a TTL condition is used as a mirror source, only forwarded packets are mirrored. When a filter entry with a TTL condition is used in cflowd processing, the TTL condition is ignored for cflowd processing. Supported for ingress filters only. Requires minimum FP-2-based line cards. The TTL match condition is always true if a filter is configured on egress or on an older hardware.

Fragmentation match criteria:

- **fragment** — Enable fragmentation support in filter policy match. For IPv4, match against MF bit or Fragment Offset field to determine whether the packet is a fragment or not. For IPv6 for the 7750 SR and 7950 XRS, match against Next Header Field for Fragment Extension Header value to determine whether the packet is a fragment or not. Up to 6 extension headers are matched against to find Fragmentation Extension Header. Supported on FP-2-based line cards.

  Additionally, match against whether the fragment is an initial fragment or non-initial fragment is also supported for IPv6 filters.

  IPv4 match fragment criteria are supported on both ingress and egress. IPv6 match fragment criteria are supported on ingress only and require minimum FP-2-based line cards.

IPv4 options match criteria:

- **ip-option** — Match for the specified option value in the first option of the IPv4 packet. Operator can optionally configure a mask to be used in a match.
- **option-present** — Match for the presence or absence of IP options in the IPv4 packet. Padding and EOOL are also considered as IP options. Up to 6 IP options are matched against.
- **multiple-option** — Match for the presence of multiple IP options in the IPv4 packet.
- **src-route-option** — Match for the presence of IP Option 3 or 9 (Loose or Strict Source Route) in the first 3 IP Options of the IPv4 packet. A packet will also match this rule if the packet has more than 3 IP Options.

IPv6 next-header match criteria (see also Upper-layer protocol match next-header description below):

- **ah-ext-header** — Match for presence/absence of the Authentication Header extension header in the IPv6 packet. This match criterion is supported on ingress only and requires minimum FP-2-based line cards. Up to 6 extension headers are matched against.
- **esp-ext-header** — Match for presence/absence of the Encapsulating Security Payload extension header in the IPv6 packet. This match criterion is supported on ingress only and requires minimum FP-2-based line cards. Up to 6 extension headers are matched against.
- **hop-by-hop-opt** — Match for the presence/absence of Hop-by-hop options extension header in the IPv6 packet. This match criterion is supported on ingress only and requires minimum FP-2-based line cards. Up to 6 extension headers are matched against.
- **routing-type0** — Match for the presence/absence of Routing extension header type 0 in the IPv6 packet. This match criterion is supported on ingress only and requires minimum FP-2-based line cards. Up to 6 extension headers are matched against.

Upper-layer protocol match:

- **next-header** — Match for the specified upper layer protocol (for example, TCP, UDP, IGMPv6) against the Next Header field of the IPv6 packet header. “*” can be used to specify TCP or UDP upper-layer protocol match (Logical OR). Next-header matching allows also matching on presence of a subset of IPv6 extension headers. See CLI section for details on which extension header match is supported.
- **protocol** — Match for the specified protocol against the Protocol field in the IPv4 packet header (for example, TCP, UDP, IGMP) of the outer IPv4. “*” can be used to specify TCP or UDP upper-layer protocol match (Logical OR).

- **icmp-code** — Match for the specified value against the Code field of the ICMP/ICMPv6 header of the packet. This match is supported only for entries that also define protocol/next-header match for “ICMP”/”ICMPv6” protocol.
- **icmp-type** — Match for the specified value against the Type field of the ICMP/ICMPv6 header of the packet. This match is supported only for entries that also define protocol/next-header match for “ICMP”/”ICMPv6” protocol.
- **src-port/dst-port/port** – Match for the specified port value, port list, or port range against the Source Port Number/Destination Port Number of the UDP/TCP/SCTP packet header. An option to match either source or destination (Logical OR) using a single filter policy entry is supported by using a directionless “port” command. Source/destination match is supported only for entries that also define protocol/next-header match for “TCP”, “UDP”, “SCTP”, or “TCP or UDP” protocols. A non-initial fragment will never match an entry with non-zero port criteria specified.
- **tcp-ack/tcp-syn** — Match for the TCP ACK/TCP SYNC flag presence/absence in the TCP header of the packet. This match is supported only for entries that also define protocol/next-header match for “TCP” protocol.

Operational Note – For fragmented traffic, when non-initial fragments do not contain the L4 header, the L4 match criteria in the filter policy look-up key are set to zero (0). If a filter policy contains an entry that specifies L4 zero match criterion (for example, TCP/UDP/SCTP port/src-port/dst-port eq 0), the non-initial fragment will match the entry if other match criteria are also met. IPv6 L4 match criteria are supported with up to 6 extension headers present in the packet.

4.2.1.3 MAC Filter Policy Entry Match Criteria

The following list describes the MAC match criteria supported by the SR OS or switches for all types of MAC filters (normal, isid, and vid). The criteria are evaluated against the Ethernet header of the Ethernet frame. Support for a given match criteria may depend on H/W and/or filter direction as per below description. Match criterion is blocked if it is not supported by a specified frame-type or MAC filter sub-type. It is recommended not to configure a filter in a direction or on a H/W where a given match condition is not supported as this may lead to undesired behavior.

- **frame-type** — Entering the frame type allows the filter to match for a specific type of frame format. For example, configuring frame-type ethernet_II will match only Ethernet-II frames.
- **src-mac**— Entering the source MAC address allows the filter to search for matching a source MAC address frames. Operator can optionally configure a mask to be used in a match.

- **dst-mac**— Entering the destination MAC address allows the filter to search for matching destination MAC address frames. Operator can optionally configure a mask to be used in a match.
- **dot1p** — Entering an IEEE 802.1p value allows the filter to search for matching 802.1p frames. Operator can optionally configure a mask to be used in a match.
- **etype**— Entering an Ethertype value allows the filter to search for matching Ethernet II frames. The Ethernet type field is a two-byte field used to identify the protocol carried by the Ethernet frame.
- **ssap**— Entering an Ethernet 802.2 LLC SSAP value allows the filter to search for matching frames with a source access point on the network node designated in the source field of the packet. Operator can optionally configure a mask to be used in a match.
- **dsap**— Entering an Ethernet 802.2 LLC DSAP value allows the filter to search for matching frames with a destination access point on the network node designated in the destination field of the packet. Operator can optionally configure a mask to be used in a match.
- **snap-oui**— Entering an Ethernet IEEE 802.3 LLC SNAP OUI allows the filter to search for matching frames with the specified the three-byte OUI field.
- **snap-pid**— Entering an Ethernet IEEE 802.3 LLC SNAP PID allows the filter to search for the matching frames with the specified two-byte protocol ID that follows the three-byte OUI field.
- **isid** — Entering an Ethernet IEEE 802.1ag ISID from the I-TAG value allows the filter to search for the matching Ethernet frames with the 24 bits ISID value from the PBB I-TAG. This match criterion is mutually exclusive with all the other match criteria under a particular mac-filter policy and is applicable to MAC filters of type isid only. The resulting mac-filter can only be applied on a BVPLS SAP or PW in the egress direction.
- **inner-tag/outer-tag** — Entering inner-tag/outer-tag VLAN ID values allows the filter to search for the matching Ethernet frames with the non-service delimiting tags as described In “VID MAC filters” subsection later-on this. This match criterion is mutually exclusive with all other match criteria under a particular mac-filter policy and is applicable to MAC filters of type vid only.

4.2.1.4 Filter Policy Actions

The following lists actions supported by ACL filter policies

- **drop** — This action allows operators to deny traffic to ingress/egress the system
- **forward** — This action allows operators to permit traffic to ingress/egress the system and be subject to regular processing

- **rate-limit** — This action allows operators to limit the rate of traffic ingressing the system through IPv4, IPv6, or MAC filter policies. Packets matching the filter condition are dropped when the traffic rate is above the configured rate limiter value, and forwarded if the traffic rate is below the configured rate limiter value.

  If multiple interfaces (including LAG interfaces) use the same rate-limit filter policy on different FPs, the system will allocate a rate limiter resource for each FP; an independent rate limit applies to each FP.

  If multiple interfaces (including LAG interfaces) use the same rate-limit filter policy on the same FP, the system will allocate a single rate limiter resource to the FP; a common aggregate rate limit is applied to those interfaces.

  The rate-limit filter policy requires minimum FP-2 base line cards and chassis mode D. For ingress rate-limit, traffic extracted to the CPM is not rate-limited.

  Rate-limit filter policy entries can coexist with cflowd, log, and mirror irrespective of the outcome of the rate limit.

  Interaction with QoS: Packets matching an ingress rate-limit filter policy entry will bypass ingress QoS queuing or policing, and only the filter rate limit policer will be applied. Packets matching an egress rate-limit filter policy bypass egress QoS policing, normal egress QoS queuing still applies.

- **forward** “Policy-based Routing/Forwarding (PBR/PBF) action”— PBR/PBF actions allows operators to permit ingress traffic but change the regular routing/ forwarding packet would be a subject to. The PBR/PBF is applicable to unicast traffic only. The following PBR/PBF actions are supported (See CLI section for command details):

  – **egress-pbr** — Enabling **egress-pbr** activates a PBR action on egress, while disabling **egress-pbr** activates a PBR action on ingress (default).

    The following subset of the below-defined PBR actions can be activated on egress: **redirect-policy**, **next-hop router**, and **esi**.

    Egress PBR is supported in IPv4 and IPv6 filter policies for ESM only. Unicast traffic that is subject to slow-path processing on ingress (for example IPv4 packets with options or IPv6 packets with hop-by-hop extension header) will not match egress pbr entries. Filter logging, cflowd, and mirror source are mutually exclusive to configuring a filter entry with an egress PBR action. Configuring **pbr-down-action-override**, if supported with a given PBR ingress action type, is also supported when the action is an egress PBR action. Processing defined by **pbr-down-action-override** does not apply if the action is deployed in the wrong direction. If a packet matches a filter PBR entry and the entry is not activated for the direction in which the filter is deployed, **action forward** is executed. Egress PBR cannot be enabled in system filters.

    Egress PBR functionality requires chassis mode D.

- **esi** — Forwards the incoming traffic using VXLAN tunnel resolved using EVPN MP BGP control plane to the first service chain function identified by ESI (Layer 2) or ESI/SF-IP (Layer 3). Supported with VPLS (Layer 2) and IES/VPRN (Layer 3) services. If the service function forwarding cannot be resolved, traffic matches an entry and action forward is executed.

  For VPLS, no cross service PBF is supported, in other words, the filter specifying ESI PBF entry must be deployed in the VPLS service where BGP EVPN control plane resolution takes place as configured for a given ESI PBF action. The functionality is supported in filter policies deployed on ingress VPLS interfaces. BUM traffic that matches a filter entry with ESI PBF will be unicast forwarded to the VTEP:VNI resolved through PBF forwarding.

  For IES/VPRN, the outgoing R-VPLS interface can be in any VPRN service. The outgoing interface and VPRN service for BGP EVPN control plane resolution must again be configured as part of ESI PBR entry configuration. The functionality is supported in filter policies deployed on ingress IES/VPRN interfaces and in filter policies deployed on ingress and egress for ESM subscribers. Only unicast traffic is subject to ESI PBR, any other traffic matching a filter entry with Layer 3 ESI action will be subject to **action forward**.

  The functionality requires chassis mode D. When deployed in unsupported direction, traffic matching a filter policy ESI PBR/PBF entry will be subject to **action forward**.
- **lsp** — Forwards the incoming traffic onto the specified LSP. Supports RSVP-TE LSPs (type static or dynamic only) or MPLS-TP LSPs. Supported for ingress IPv4/IPv6 filter policies only deployed on IES SAPs or network interfaces. If the configured LSP is down, traffic matches the entry and action forward is executed.
- **next-hop** — Changes the IP destination address used in routing from the address in the packet to the address configured in this PBR action. The operator can configure whether the next-hop IP address must be direct (local subnet only) or indirect (any IP). This functionality is supported for ingress IPv4/IPv6 filter policies only, and is deployed on Layer 3 interfaces. If the configured next-hop is not reachable, traffic is dropped and a “ICMP destination unreachable” message is sent. If the indirect keyword is not specified but the IP address is a remote IP address, traffic will be dropped. IPv6 requires minimum chassis mode C.
  - **interface** — Forwards the incoming traffic onto the specified IPv4 interface. Supported for ingress IPv4 filter policies in global routing table instance. If the configured interface is down or not of the supported type, traffic is dropped.

  - **redirect-policy** — Implements PBR **next-hop** or PBR **next-hop router** action with ability to select and prioritize multiple redirect targets and monitor the specified redirect targets so PBR action can be changed if the selected destination goes down. Supported for ingress IPv4 and IPv6 filter policies deployed on Layer 3 interfaces only. See section Redirect Policies for more information.
  - **remark dscp** — Allows an operator to remark the DiffServ Code Points of packets matching filter policy entry criteria. Packets are remarked regardless of QoS-based in-/out-of- profile classification and QoS-based DSCP remarking is overridden. DSCP remarking is supported both as a main action and as an extended action. As a main action, this functionality applies to IPv4 and IPv6 filter policies of any scope and can only be applied at ingress on either access or network interfaces of Layer 3 services only. As an extended action, this functionality applies to IPv4 and IPv6 filter policies of any scope and can be applied at ingress on either access or network interfaces of Layer 3 services, or at egress on Layer 3 subscriber interfaces. The functionality requires IOM3 or above.
  - **router** — Changes the routing instance a packet is routed in from the upcoming interface's instance to the routing instance specified in the PBR action (supports both GRT and VPRN redirect). This action requires incoming interfaces to be on FP2 line cards or newer. It is supported for ingress IPv4/IPv6 filter policies deployed on Layer 3 interfaces. The action can be combined with the **next-hop** action specifying direct/indirect IPv4/ IPv6 next hop. Packets are dropped if they cannot be routed in the configured routing instance. For more information, see section "Traffic Leaking to GRT" in the Layer 3 Services Guide.
  - **sap** — Forwards the incoming traffic onto the specified VPLS SAP. Supported for ingress IPv4/IPv6 and MAC filter policies deployed in VPLS service. The SAP traffic is to egress on must be in the same VPLS service as the incoming interface. If the configured SAP is down, traffic is dropped.
  - **sdp** — Forwards the incoming traffic onto the specified VPLS SDP. Supported for ingress IPv4/IPv6 and MAC filter policies deployed in VPLS service. The SDP traffic is to egress on must be in the same VPLS service as the incoming interface. If the configured SDP is down, traffic is dropped.
- forward "isa action" — ISA processing actions allow operator to permit ingress traffic and send it for ISA processing as per specified isa action. The following isa actions are supported (see CLI section for command details):
  - **gtp-local-breakout** — Forwards matching traffic to NAT instead of being GTP tunneled to the mobile operator's PGW or GGSN. The action applies to GTP-subscriber-hosts. If filter is deployed on other entities, action forward is applied. Supported for IPv4 ingress filter policies only. If ISAs performing NAT are down, traffic is dropped.

  - **nat** — Forwards matching traffic for NAT. Supported for IPv4/IPv6 filter policies for Layer 3 services in GRT or VPRN. If ISAs performing NAT are down, traffic is dropped. (see CLI for options)
  - **reassemble** — Forwards matching packets to the reassembly function. Supported for IPv4 ingress filter policies only. If ISAs performing reassemble are down, traffic is dropped.
  - **tcp-mss-adjust** — Forwards matching packets (TCP Syn) to an ISA BB Group for MSS adjustment. In addition to the IP filter, the operator also needs to configure the **mss-adjust-group** command under the Layer 3 service to specify the *bb-group-id* and the new *segment-size*. Requires FP-2 line cards and chassis mode D.
- **http-redirect** — Implements HTTP redirect captive portal. HTTP GET is forwarded to CPM card for captive portal processing by router. See HTTP-redirect (Captive Portal) section for further details.

In addition to the above actions:

- An operator can select a **default-action** for a filter policy. The default action is executed on packets subjected to an active filter when none of the filter's active entries matches the packet. By default, filter policies have default action set to drop but operator can select a default action to be forward instead.
- An operator can override default action applied to packets matching a PBR/PBF entry when the PBR/PBF target is down using **pbr-down-action-override**. Supported options are to drop the packet, forward the packet, or apply the same action as configured for the filter policy's **default-action**. The override is supported for the following PBR/PBF actions. For the last three actions, the override is supported whether in redundancy mode or not.
  - **forward esi** (Layer 2 or Layer 3)
  - **forward sap**
  - **forward sdp**
  - **forward next-hop [indirect] router**

  The following table defines default behavior for packets matching a PBR/PBF filter entry when a target is down:

Table 45 **Default behavior when a PBR/PBF target is down**

PBR/PBF action	Default behavior when down
forward esi (any type)	Forward
forward lsp	Forward
forward next-hop (any type)	Drop

Table 45 **Default behavior when a PBR/PBF target is down (Continued)**

PBR/PBF action	Default behavior when down
forward redirect-policy	Forward when redirect policy is shutdown
forward redirect-policy	Forward - when destination tests are enabled and the best destination is not reachable
forward redirect-policy	Drop - when destination tests are not enabled and the best destination is not reachable
forward sap	Drop
forward sdp	Drop
forward router	Drop

4.2.1.5 Filter Policy Statistics

Filter policies support per-entry, packet/Byte match statistics. The cumulative matched packet/Byte counters are available per ingress and per egress direction. Every packet arriving on an interface/service/subscriber using a filter policy increments ingress or egress (as applicable) matched packet/Byte count for a filter entry the packet matches (if any) on the line card the packet ingresses/egresses. For each policy, the counters for all entries are collected from all line cards, summed up and made available to an operator.

Starting with SR OS Release 11.0 R4, filter policies applied on access interfaces are downloaded only when active and only to line cards that have interfaces associated with those filter policies. If a filter policy is not downloaded to any line card, the statistics show 0 (zero). If a filter policy is being removed from any of the line cards the policy is currently downloaded to (as result of association change or when a filter becomes inactive), the statistics for the filter are reset to 0 (zero). Downloading a filter policy to a new line card keeps incrementing existing statistics.

Starting with SR OS Release 13.0R4, filter policies support bulk requests CPM cache for policy interfaces created entries. The cache is periodically refreshed through a background collection of counters from hardware. The counters are also refreshed when the ACL entry corresponding to the cache entry has statistics read from hardware through any direct-read from hardware mechanism. If a cache entry represents an entry for an ACL filter policy not downloaded to any line cards, the cache returns values of 0 (zero). If a cache entry represents an ACL filter entry that was removed from a line card since the previous refresh, the current refresh will reload the cache with the most recent values from hardware. The cache has to be rebuilt on a High Availability (HA) switchover, thus initial statistics requests after an HA switchover may require reads from hardware.

Operational notes:

- Two consecutive bulk requests for one entry will return the same values if the cache has not been refreshed between the two requests. The refresh interval is platform/release dependent. Please contact your Nokia representative for further details.
- The cache is currently used only for Open Flow statistics retrieval. Please see the “Hybrid OpenFlow Switch” section for more details.
- Conditional action match criteria filter entries for **ttl**, **hop-limit**, **packet-length**, and **payload-length** support logging and statistics when the condition is met, allowing visibility of filter matched and action executed. If the condition is not met, packets are not logged and statistics against the entry are not incremented.

4.2.1.6 Filter Policy Logging

SR OS supports logging of the information from the packets that match a given filter policy. Logging is configurable per filter policy entry by specifying preconfigured filter log (**config>filter>log**). A filter log can be applied to ACL filters and CPM hardware filters. Operators can configure multiple filter logs and specify: memory allocated to a filter log destination, syslog id for filter log destination, filter logging summarization, and wrap-around behavior.

Notes related to filter log summarization:

- The implementation of the feature applies to filter logs with destination syslog.
- Summarization logging is the collection and summarization of log messages for 1 specific log-id within a period of time.
- The summarization interval is 100 seconds.
- Upon activation of a summary, a mini-table with src/dst-address and count is created for each type (IPv4/IPv6/MAC).
- Every received log packet (due to filter hit) is examined for source or destination address.
- If the log packet (source/destination address) matches a source/destination address entry in the mini-table a packet received previously), the summary counter of the matching address is incremented.
- If source or destination address of the log messages does not match an entry already present in the table, the source/destination address is stored in a free entry in the mini-table.
- In case the mini-table has no more free entries, only total counter is incremented.

- At expiry of the summarization interval, the mini-table for each type is flushed to the syslog destination.

Operational note:

- Conditional action match criteria filter entries for **ttl**, **hop-limit**, **packet-length**, and **payload-length** support logging and statistics when the condition is met, allowing visibility of filter matched and action executed. If the condition is not met, packets are not logged and statistics against the entry are not incremented.

4.2.1.7 Filter Policy cflowd Sampling

Filter policies can be used to control how cflowd sampling is performed on an IP interface. If an IP interface has cflowd sampling enabled, an operator can exclude some flows for interface sampling by configuring filter policy rules that match the flows and by disabling interface sampling as part of the filter policy entry configurations (**interface-disable-sample**). If an IP interface has cflowd sampling disabled, an operator can enable cflowd sampling on a subset of flows by configuring filter policy rules that match the flows and by enabling cflowd sampling as part of the filter policy entry configurations (**filter-sample**).

The above cflowd filter sampling behavior is exclusively driven by match criteria: The sampling logic applies regardless of whether an action was executed or not (including evaluation of conditional action match criteria, for example, **packet-length** or **ttl**).

4.2.1.8 Filter Policy Management

4.2.1.8.1 Modifying Existing Filter Policy

There are several ways to modify an existing filter policy. A filter policy can be modified through configuration change or can have entries populated through dynamic, policy-controlled dynamic interfaces like Radius or OpenFlow or Flowspec or Gx for example. Although in general, the SR OS ensures filter resources exist before a filter can be modified, because of a dynamic nature of the policy-controlled interfaces, a configuration that was accepted may not be applied in H/W due to lack of resources. When that happens, an error is raised.

A filter policy can be modified directly – by changing/adding/deleting the existing entry in that filter policy or indirectly. Examples of indirect change to filter policy include, among others, changing embedded filter entry this policy embeds (see the Embedded Filters section), changing redirect policy this filter policy uses.

Finally, a filter policy deployed on a given interface can be changed by changing the policy the interface is associated with.

All of the above changes can be done in service. A filter policy that is associated with service/interface cannot be deleted unless all associations are removed first.

For a large (complex) filter policy change, it may take a few seconds to load and initiate the filter policy configuration. Filter policy changes are downloaded to line cards immediately, therefore operators should use filter policy copy or transactional CLI to ensure partial policy change is not activated.

4.2.1.8.2 Filter Policy Copy and Renumbering

To assist operators in filter policy management, SR OS supports entry copy and entry renumbering operations.

Filter **copy** allows operators to perform bulk operations on filter policies by copying one filter's entries to another filter. Either all entries or a specified entry of the source filter can be selected for copy. When entries are copied, entry order is preserved unless destination filter's entry ID is selected (applicable to single entry copy). The filter copy allows overwrite of the existing entries in the destination filter by specifying "overwrite" option during the copy command. Filter copy can be used, for example, when creating new policies from existing policies or when modifying an existing filter policy (an existing source policy is copied to a new destination policy, the new destination policy is modified, then the new destinations policy is copied back the source policy with overwrite specified).

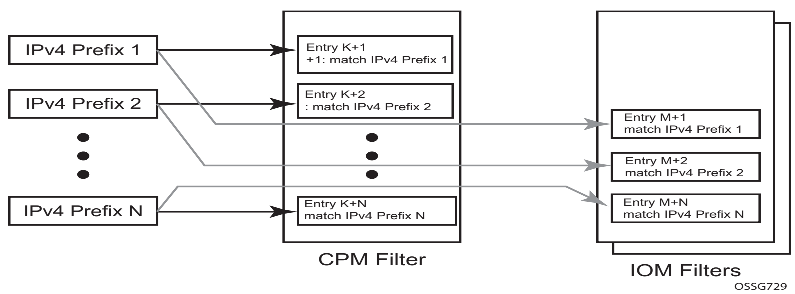
Entry renumbering allows operators to change relative order of a filter policy entry by changing the entry Id. Entry renumbering can also be used to move two entries closer together or further apart, thus creating additional entry space for new entries.

4.2.2 Filter Policy Advanced Topics

4.2.2.1 Match-list for Filter Policies

Figure 17 depicts an approach to implement logical OR on a list of matching criterion (IPv4 address prefixes in this example) in one or more filter policies prior to introduction of match list.

Figure 17 **IOM/CPM Filter Policy using Individual Address Prefixes**



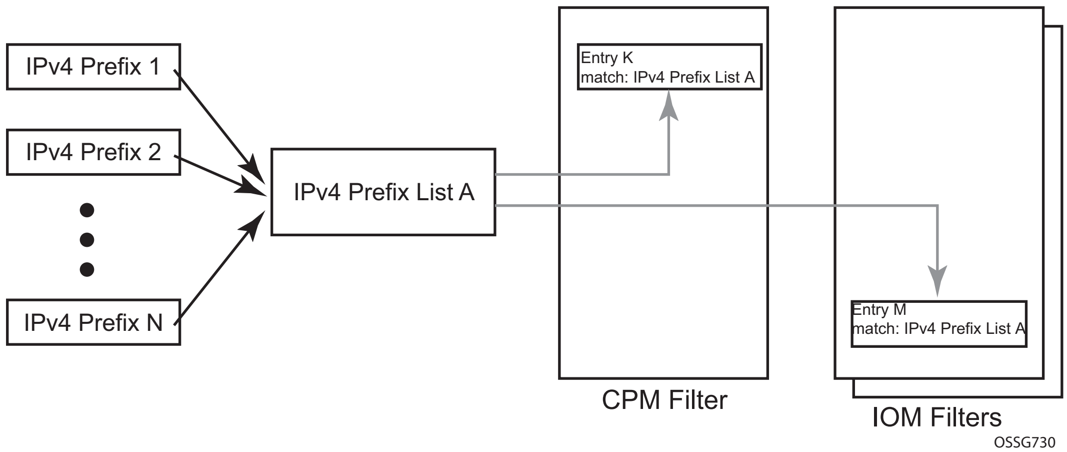
An operator has to create one entry for each address prefix to execute a common action. Each entry defines a match on a unique address prefix from the list plus any other additional match criteria and the common action. If the same set of address prefixes needs to be used in another IOM/linecard, or CPM filter policy, an operator again needs to create one entry for each address prefix of the list in those filter policies. Same procedure applies (not shown above) if another action needs to be performed on the list of the addresses within the same filter policy (when for example specifying different additional match criteria). This process can introduce large operational overhead, especially when a list contains many elements or/and needs to be reused multiple times across one or more filter policies.

Match list for CPM and IOM/FP filter policies are introduced to eliminate above operational complexity by simplifying the IOM/FP and CPM filter policy management on a list of a match criterion. Instead of defining multiple filter entries in any given filter, an operator can now group same type of the matching criteria into a single filter match list, and then use that list as a match criterion value, thus requiring only single filter policy entry per each unique action. The same match list can be used in one or more IOM/linecard filter policies as well as CPM filter policies.

The match lists further simplify management and deployment of the policy changes. A change in a match-list content is automatically propagated across all policies employing that list in their match criteria, thus only a single configuration change is required to trigger policy changes when a list is used by multiple entries in one or more filter policies.

Figure 18 depicts how the IOM/CPM filter policy illustrated at the top of this section changes with a filter match list usage (using IPv4 address prefix list in this example).

Figure 18 **IOM/CPM Filter Policy Using an Address Prefix Match List**



The hardware resource usage does not change whether filter match lists are used or whether operator creates multiple entries (each per one element of the list): however, a careful consideration must be given to how the lists are used to ensure only desired match permutations are created in a filter policy entry (especially when other matching criteria that are also lists or ranges are specified in the same entry). The system verifies that a new list element, for example, an IP address prefix, cannot be added to a given list or a list cannot be used by a new filter policy unless resources exist in hardware to implement the required filter policy (ies) that reference that list. If that is not the case, addition of a new element to the list or use of the list by another policy will fail.

Some use cases like those driven by dynamic policy changes, may result in acceptance of filter policy configuration changes that cannot be programmed in hardware because of the resource exhaustion. If that is the case, when attempting to program a filter entry that uses a match list(s), the operation will fail, the entry will be not programmed, and a notification of that failure will be provided to an operator.

Refer to the SR OS Release Notes for information about objects that can be grouped into a filter match list for FP and CPM filter policies.

4.2.2.1.1 Auto-generation of Filter-policy Address Prefix Match Lists

It is often desired to automatically update a filter policy when the configuration on a router changes. To allow such a touch-less filter policy management, SR OS allows auto-generation of address prefixes for IPv4 or IPv6 address prefix match lists based on operator-configured criteria. When the configuration on a router changes, the match lists address prefixes are automatically updated and, in-turn, all filter policies (CPM or IOM) that use these match lists are automatically updated.

When using auto-generation of address prefixes inside an address prefix match list operators can:

- Specify one or more *regex* expression matches against SR OS configuration per list.
- Specify wildcard matches by specifying *regex* wildcard match expression (“.*”).
- Mix auto-generated entries with statically configured entries within a match list.

The following additional rules apply to auto-generated entries:

- Operational and administrative states of a given router configuration are ignored when auto-generating address prefixes.
- Duplicates are not removed when populated by different auto-generation matches and static configuration.
- A configuration will fail if auto-generation of address prefix would result in filer policy resource exhaustion on a filter entry, system, or line-card level.

Note: See Release notes and CLI section for details on what configuration supports address prefix list auto-generation.

The following may apply to this feature:

If filter policy resources are not available for newly auto-generated address prefixes when a BGP configuration changes, new address-prefixes will not be added to impacted match lists or filter policies as applicable. An operator must free resources and change filter policy configuration or must change BGP configuration to recover from this failure.

4.2.2.2 Embedded Filters

When a large number of standard filter policies are configured in a system, a set of policies will often contain one or more common blocks of entries that define, for example, system-wide and/or service-wide security rules. Prior to introduction of the embedded filters, such common rules would have to be configured separately in each exclusive/template policy.

To simplify management of such common rules across multiple filter policies, the operator can use embedded filter policies. An embedded filter policy is a special type of a filter policy that cannot be deployed directly but instead is used to define a common filter policy rules that are then included in (embedded by) other filter policies in the system. Thanks to embedding, a common set of rules can now be defined and changed in a single place but deployed across multiple filter policies. The following main rules apply when embedding an embedded filter policy:

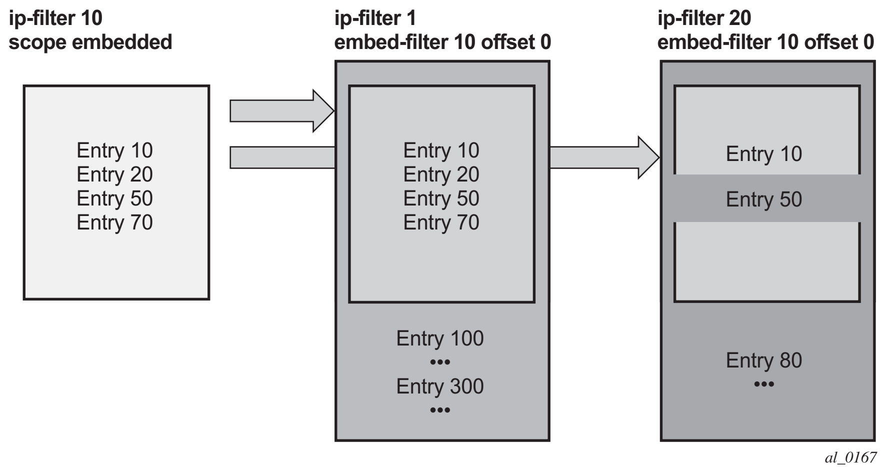
1. An operator can explicitly define an offset at which to embed a given embedded filter into a given embedding filter—the embedded filter entry number X becomes an entry (X + offset) in the embedding filter.
2. An exclusive/template filter policy may embed multiple embedded filter policies as long as the embedded entries do not overlap.
3. A single embedded filter policy may be embedded in many exclusive/template filter policies.
4. When embedding an embedded filter, an operator may wish to change or deactivate an embedded filter policy entry in one of the embedding filter, thus allowing for customizing of the common embedded filter policy rules by the embedding filter. This can be achieved by either defining an entry in the embedding filter that will match ahead of the embedded filter entry or by overwriting the embedded filter entry in the embedding filter.

   For example: If embedded filter 99 has entry 20 that drops packets that match IP source address **src_address**, and filter 200 embeds filter 99 at offset 100, then to *deactivate* the embedded entry 20, an operator could define an entry 120 (embedded entry number 20 + offset 100) in filter policy 200, that has the same match criteria and has either no action defined (this will deactivate the embedded entry and allow continued evaluation of filter policy 200), or has action forward defined (packets will match the new entry and will be forwarded instead of dropped, evaluation of filter policy 200 will stop).
5. Any embedded policy rule edits are automatically applied to all filter policies that embed that embedded filter policy.

6. The system verifies whether system and h/w resources exist when a new embedded filter policy is created, changed or embedded. If resources are not available, the configuration is rejected. In rare cases, filter policy resource check may pass but filter policy can still fail to load due to a resource exhaustion on a line card (for example when other filter policy entries are dynamically configured by applications like RADIUS in parallel). If that is the case, the embedded filter policy configured will be deactivated (configuration will be changed from **activate** to **inactivate**).
7. An embedded filter is never embedded partially into an exclusive/template filter; that is, resources must exist to embed all embedded filter entries in a given exclusive/template filter. Although a partial embedding into a single filter will not take place, an embedded filter may be embedded only in a subset of embedding filters (only those where there are sufficient resources available).

Figure 19 shows implementation of embedded filter policy using IPv4 ACL filter policy example with an embedded filter 10 being used to define common filter rules that are then embedded into filter 1 and 20 (with filter 20 overwriting rule at offset 50).

Figure 19 **Embedded Filter Policy**



Note: Embedded filter policies are supported for line card IP(v4) and IPv6 filter policies only.

4.2.2.3 System-level IPv4/IPv6 Line Card Filter Policy

A system filter policy allows the definition of a common set of policy rules that can then be activated within other exclusive/template filters. IPv4/IPv6 system filter policies supports all IPv4/IPv6 filter policy match rules and actions respectively but system policy entries cannot be the sources of mirroring.

System filter policy cannot be used directly; the active system policy is deployed by activating it within any IPv4 or IPv6 exclusive/template filter policy (chaining the system policy and a given interface policy). When an IPv4/IPv6 filter policy is chained to the active IPv4/IPv6 system filter, system filter rules are evaluated first before any rules of the chaining filter are evaluated (i.e. chaining filter's rules are only matched against if no system filter match took place).

A system filter policy is intended mainly for system-level blacklisting rules, thus it is recommended to use system policies with drop/forward actions. Other actions like, for example, PBR actions, or redirect to ISAs should not be used unless the system filter policy is activated only in filters used by services that support such action. The “nat” action is not supported and should not be configured. Failure to observe these restrictions can lead to undesired behavior as system filter actions are not verified against the services the chaining filters are deployed for.

System filter policies can be populated using CLI/SNMP/Netconf management interfaces and Openflow policy interface. System filter policy entries cannot be populated using flowspec, Radius, or Gx.

System filter policy scale is identical to a corresponding IPv4 or IPv6 filter policy scale. System filter policy consumes single set of H/W resources on each line card as soon as it is activated, regardless of how many IPv4/IPv6 filters chain to that system policy. This optimizes resource allocation when multiple filter policies activate a given system policy.

System filter policy requires chassis mode D.

An example (IPv4) configuration is shown below:

```
*A:vm1>config>filter#
# Configure system-policy
        ip-filter 1 create
            scope system
            entry 5 create
                match protocol *
                    fragment true
                exit
                action drop
            exit
        exit
# Activate it
        system-filter
```

```
            ip 1
        exit
# Use it in another filter:
        ip-filter 10 create
            chain-to-system-filter
            filter-name "test-name"
            embed-filter open-flow "test" offset 100
            exit
        exit
```

4.2.2.4 Primary and Secondary Filter Policy Action for PBR/PBF Redundancy

In some deployments, operators may want to specify a backup PBR/PBF target if the primary target is down. The SR OS allows the configuration of a primary action (**config**>**filter**>{**ip-filter** | **ipv6-filter** | **mac-filter**}>**entry**>**action**) and a secondary action (**config**>**filter**>{**ip-filter** | **ipv6-filter** | **mac-filter**}>**entry**>**action secondary**) as part of a single filter policy entry. The secondary action can only be configured if the primary action is configured.

For Layer 2 PBF redundancy, the operator can configure the following redundancy options:

- **action forward sap** AND **action secondary forward sap**
- **action forward sdp** AND **action secondary forward sdp**
- **action forward sap** AND **action secondary forward sdp**
- **action forward sdp** AND **action secondary forward sap**

For Layer 3 PBR redundancy, an operator can configure any of the following actions as a primary action and any (thus either same or different than primary) of the following as a secondary action. Furthermore, none of the parameters need to be the same between primary and secondary actions. Although the following commands refer to IPv4 in the *ip-address* parameter, they also apply to IPv6.

- **forward next-hop** *ip-address* **router** *router-instance*
- **forward next-hop** *ip-address* **router service-name** *service-name*
- **forward next-hop indirect** *ip-address* **router** *router-instance*
- **forward next-hop indirect** *ip-address* **router service-name** *service-name*

When primary and secondary actions are configured, PBR/PBF uses the primary action if its target is operationally up, or it uses the secondary action if the primary PBR/PBF target is operationally down. If both targets are down, the default action when the target is down (see Table 45), as per the primary action, is used, unless **pbr-down-action-override** is configured.

When PBR/PBF redundancy is configured, the operator can use sticky destination functionality for a given redundant filter entry. When sticky destination is configured (**config**>**filter**>{**ip-filter** | **ipv6-filter** | **mac-filter**}>**entry**>**sticky-dest**), the functionality mimics that of sticky destination configured for redirect policies. To force a switchover from the secondary to primary action when sticky destination is enabled and secondary action is selected, the operator can use the **tools**>**perform**>**filter**>{**ip-filter** | **ipv6-filter** | **mac-filter**}>**entry**>**activate-primary-action** command. Sticky destination can be configured even if no secondary action is configured.

The control plane monitors whether primary and secondary actions can be performed and programs forwarding filter policy to use either the primary or secondary action as required. More generally, the state of PBR/PBF targets is monitored in the following situations:

- when a secondary action is configured
- when sticky destination is configured
- when a **pbr-down-action-override** is configured

The **show**>**filter**>{**ip-filter** | **ipv6-filter** | **mac-filter**} [**entry**] command displays which redundant action is activated or downloaded, including when both PBR/PBF targets are down. The following example shows partial display of the command as applicable for PBF redundancy.

```
*A:vsim-200001# show filter ip 10 entry 1000
…
Primary Action      : Forward (SAP)         <-details  of (primary) action
  Next Hop           : 1/1/1
  Service Id          : Not configured
  PBR Target Status : Does not exist
Secondary Action    : Forward (SAP)        <-details  of secondary action
  Next Hop          : 1/1/2
  Service Id        : Not configured
  PBR Target Status : Does not exist
PBR Down Action     : Forward (pbr-down-action-override) <- PBR down behavior
Downloaded Action   : None                 <- currently downloaded action
Dest. Stickiness    : 1000                         Hold Remain    : 0 <-
 sticky dest details
```

4.2.2.5 Extended Action for Performing Two Actions at a Time

In certain deployment scenarios, for example to realize service function chaining, operators may want to perform a second action in addition to a traffic steering action. The SR OS allows this behavior by configuring an extended action for a given main action. This functionality is supported for Layer 3 traffic steering (that is, PBR) and more specifically for the following main actions:

- **forward esi** (Layer 3 version)
- **forward lsp**
- **forward next-hop** [**indirect**] [**router**]
- **forward next-hop interface**
- **forward redirect-policy**
- **forward router**

Furthermore, the capability to specify an extended action is also supported in the case of PBR redundancy, thus for the following action:

- **forward next-hop** [**indirect**] **router**

The supported extended action is:

- **remark dscp** *dscp-name*

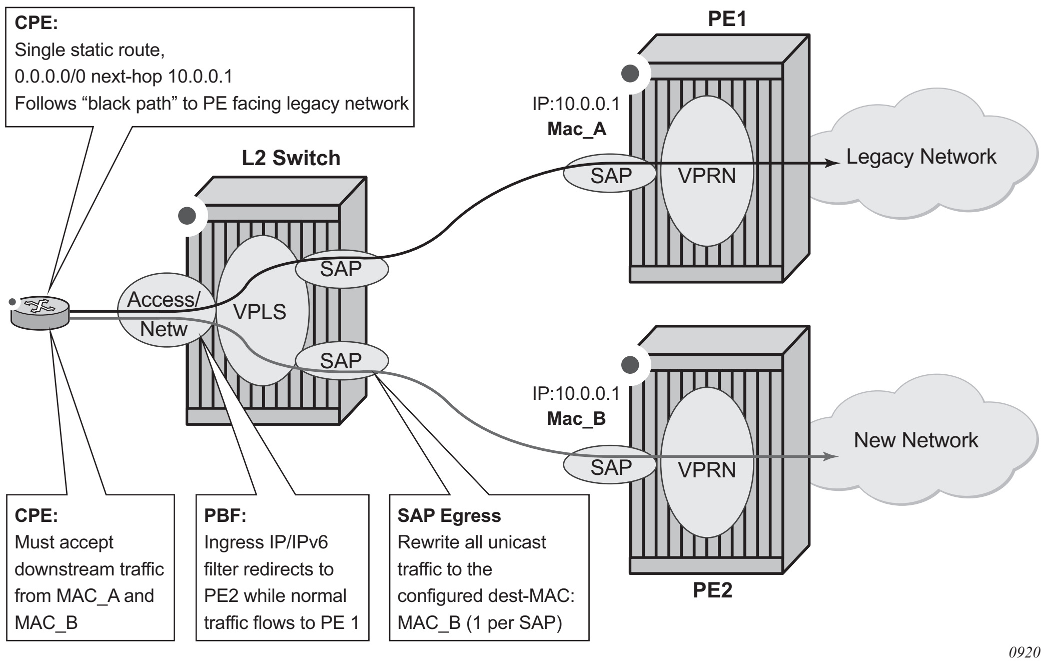
The extended action is available in the following contexts: **config>filter>ip-filter>entry>action>extended-action** and **config>filter>ipv6-filter>entry>action>extended-action**.

If the status of the target of the main action is tracked, which is the case, amongst others, for PBR/PBF redundancy, the extended action listed above will not be performed when the PBR target is down. Moreover, a filter policy containing an entry with the extended action **remark dscp** will be blocked in the following cases: if applied on ingress with the **egress-pbr flag** set, if applied on egress without the **egress-pbr flag** set. The latter case includes actions that are not supported on egress (and for which **egress-pbr** cannot be set).

4.2.2.6 Destination MAC Rewrite when Deploying Policy-Based Forwarding

For Layer 2 Policy Based-Forwarding (PBF) redirect actions, a far-end router may discard redirected packets when the PBF changes the destination IP interface the packet arrives on. This happens when a far-end IP interface uses a different MAC address than the IP interface reachable via normal forwarding (for example one of the routers does not support a configurable MAC address per IP interface). To avoid the discards, operators can deploy egress destination MAC rewrite functionality for VPLS SAPs (**config>service>vpls>sap>egress>dest-mac-rewrite**). Figure 20 illustrates a sample deployment.

Figure 20 **Layer 2 Policy Based Forwarding (PBF) redirect action**



When enabled, all unicast packets have their destination MAC rewritten to operator-configured value on an Layer 2 switch VPLS SAP. Multicast and broadcast packets are unaffected. The feature:

- Is supported for regular and split-horizon group Ethernet SAPs in a regular VPLS Service
- Is expected to be deployed on a SAP that faces far-end IP interface (either a SAP that is the target of PBF action as depicted in the picture above or a VPLS SAP of a downstream Layer 2 switch that is connected to a far-end router – not shown).
- Applies to any unicast egress traffic including LI and mirror.

Caveats:

- Is mutually exclusive with SAP MAC ingress and egress loopback feature: **tools perform service id** *service-id* **loopback eth sap** *sap-id* {**ingress** | **egress**} **mac-swap** *ieee-address*.
- Requires FP2-based hardware.

4.2.2.7 Network-port VPRN Filter Policy

Network-port Layer 3 service-aware filter feature allows operators to deploy VPRN service aware ingress filtering on network ports. A single ingress filter of **scope template** can each be defined for IPv4 and for IPv6 against a VPRN service. The filter applies to all unicast traffic arriving on auto-bind and explicit-spoke network interfaces for that service. The network interface can be either Inter-AS, or Intra-AS. The filter does not apply to traffic arriving on access interfaces (SAP, spoke-sdp, network-ingress (CsC, rVPLS, eVPN).

The same filter can be used on access interfaces of the given VPRN, can embed other filters (including OpenFlow), can be chained to a system filter, and can be used by other Layer 2 or Layer 3 services.

The filter is deployed on all line cards (chassis network mode D is required). There are no limitations related to filter match/action criteria or embedding. The filter is programmed on line cards against ILM entries for this service. All label-types are supported. If an ILM entry has a filter index programmed, that filter is used when the ILM is used in packet forwarding; otherwise, no filter is used on the service traffic.

Caveats:

- Network port Layer 3 service-aware filters do not support flowspec and LI (cannot use filter inside LI infrastructure nor have LI sources within the VPRN filter).

4.2.2.8 ISID MAC Filters

ISID filters are a type of MAC filters that allows filtering based on the ISID values rather than Layer 2 criteria used by MAC filters of type "**normal**" or "**vid**". ISID filters can be deployed on iVPLS PBB SAPs and ePipe PBB SAPs in the following scenarios:

The MMRP usage of the mrp-policy ensures automatically that traffic using Group BMAC is not flooded between domains. However; there could be a small transitory periods when traffic originated from PBB BEB with unicast BMAC destination may be flooded in the BVPLS context as unknown unicast in the BVPLS context for both IVPLS and PBB Epipe. To restrict distribution of this traffic for local PBB services ISID filters can be deployed. The mac-filter configured with ISID match criterion can be applied to the same interconnect endpoint(s), BVPLS SAP or PW, as the mrp-policy to restrict the egress transmission any type of frames that contain a local ISID. The ISID filters will be applied as required on a per B-SAP or B-PW basis just in the egress direction.

The ISID match criteria are exclusive with any other criteria under mac-filter. A new mac-filter type attribute is defined to control the use of ISID match criteria and must be set to ISID to allow the use of ISID match criteria.

4.2.2.9 VID MAC filters

VID Filters are a type of MAC filters that extend the capability of current Ethernet Ports with null or default SAP tag configuration to match and take action on VID tags. Service delimiting tags (for example QinQ 1/1/1:10.20 or dot1q 1/1/1:10, where outer tag 10 and inner tags 20 are service delimiting) allow fine grain control of frame operations based on the VID tag. Service delimiting tags are exact match and are stripped from the frame as illustrated in Figure 21. Exact match or service delimiting Tags do not require VID filters. VID filters can only be used to match on frame tags that are after the service delimiting tags.

With VID Filters operators can choose to match VID tags for up to two tags on ingress or egress or both.

- The outer-tag is the first tag in the packet that is carried transparently through the service.
- The inner-tag is the second tag in the packet that is carried transparently through the service.

VID Filters add the capability to perform VID value filter policies on default tags (1/1/1:* or 1/1/1:x.*, or 1/1/1/:*.0), or null tags (1/1/1, 1/1/1:0 or 1/1/1:x.0). The matching is based on the port configuration and the SAP configuration.

At ingress, the system looks for the two outer-most tags in the frame. If present, any service delimiting tags are removed and not visible to VID MAC filtering. For example:

- 1/1/1:x.y SAP has no tag left for VID MAC filter to match on (outer-tag and inner-tag = 0)
- 1/1/1:x.* SAP has potentially one tag in the * position for VID MAC filter to match on
- SAP such as 1/1/1, 1/1/1:* or 1/1/1:*.* can have as many as 2 tags for VID MAC filter to match on
- For the remaining tags, the left (outermost) tag is what is used as the outer-tag in the MAC VID Filter. The following tag is used as the inner-tag in the filter. If any of these positions do not have tags, a value of 0 is used in the filter. At Egress the VID MAC filter is applied to the frame prior to adding the additional service tags.

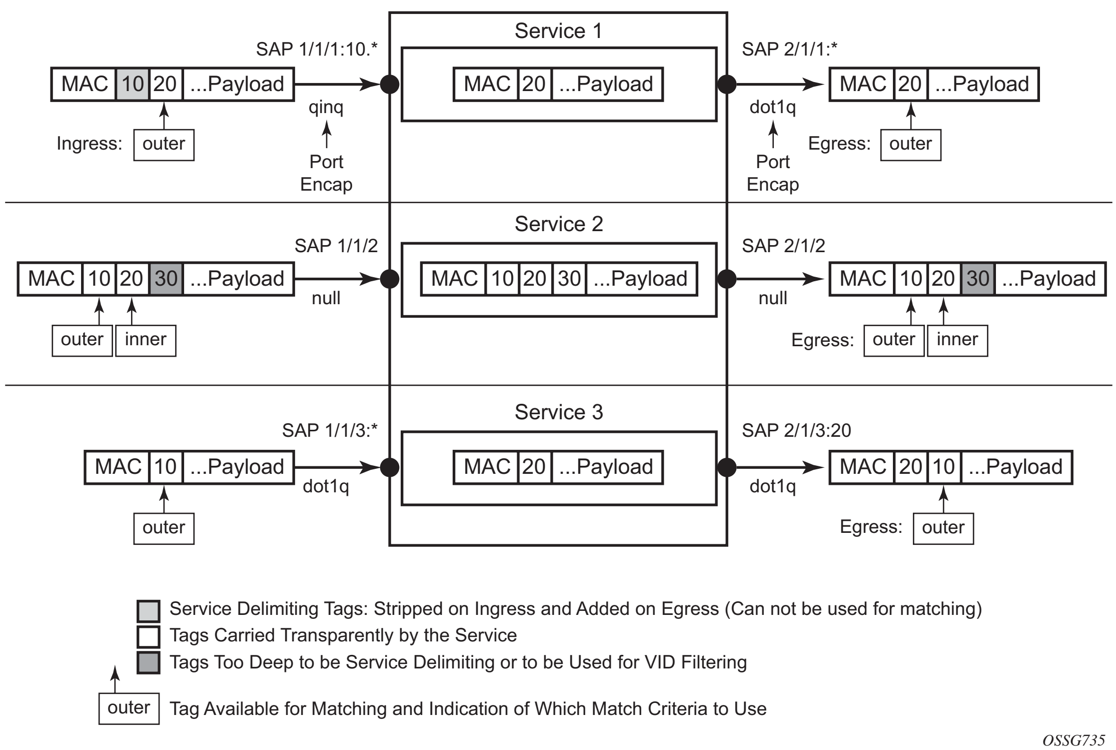
In the industry the QinQ tags are often referred to as the C-VID (Customer VID) and S-VID (service VID). The terms outer tag and inner tag allow flexibility without having to refer to C-TAG and an S-TAG explicitly. The position of inner and outer tags is relative to the port configuration and SAP configuration. Matching of tags is allowed for up to the first two tags on a frame. Since service delimiting tags may be 0, 1 or 2 tags.

The meaning of inner and outer has been designed to be consistent for egress and ingress when the number of non service delimiting tags is consistent. Service 1 in Figure 21 shows a conversion from qinq to a single dot1q example where there is one non-service delimiting tag on ingress and egress. Service 2 shows a symmetric example with two non-service delimiting tags (plus and additional tag for illustration) to two non-service delimiting tags on egress. Service 3 illustrates single non-service delimiting tags on ingress and to two tags with one non-service delimiting tag on ingress and egress.

SAP-ingress QoS setting allows for MAC-criteria type VID which uses the VID filter matching capabilities QoS and VID Filters (moved to QoS guide) on page 313.

A VID filter entry can also be used as a debug or lawful intercept mirror source entry.

Figure 21 **VID Filtering Examples**



VID filters are available on Ethernet SAPs for Epipe, VPLS or I-VPLS including eth-tunnel and eth-ring services.

4.2.2.9.1 Arbitrary Bit Matching of VID Filters

In addition to matching an exact value, a VID filter mask allows masking any set of bits. The masking operation is ((value and vid-mask) = = (tag and vid-mask)). For example: A value of 6 and a mask of 7 would match all VIDs with the lower 3 bits set to 6. VID filters allow explicit matching of VIDs and matching of any bit pattern within the VID tag.

When using VID filters on SAPs only VID filters are allowed on this SAP. Filters of type normal and ISID are not allowed.

An additional check for the “0” VID tag may be required when using certain wild card operations. For example frames with no tags on null encapsulated ports will match a value of 0 in outer tag and inner tag because there are no tags in the frame for matching. If a zero tag is possible but not desired it can be explicitly filtered using exact match on “0” prior to testing other bits for “0”.

configure>system>ethernet>new-qinq-untagged-sap is a special QinQ function for single tagged QinQ frames with a null second tag. Using this in combination with VID filters is not recommended. The outer-tag is the only tag available for filtering on egress for frames arriving from MPLS SDPs or from PBB services even though additional tags may be carried transparently.

4.2.2.9.2 Port Group Configuration Example

Figure 22 **Port Groups**

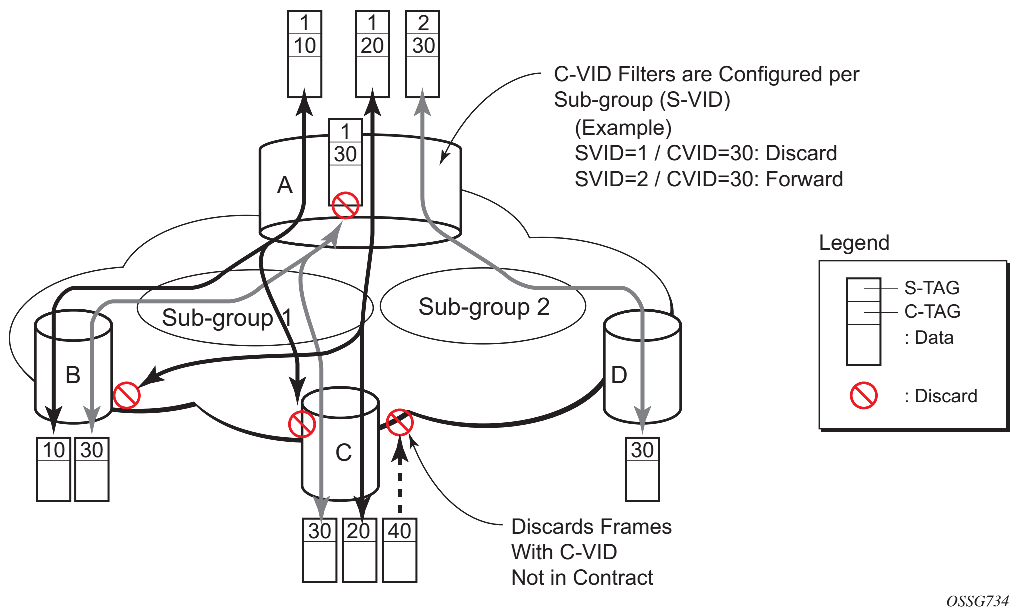


Figure 22 shows a customer use example where some VLANs are prevented from ingressing or egressing certain ports. In the example, port A sap 1/1/1:1.* would have a filter as shown below while port A sap 1/1/1:2.* would not.:

```
mac-filter 4 create
     default-action forward
            type vid
            entry 1 create
                match frame-type ethernet_II
                    outer-tag 30 4095
                exit
                action drop
            exit
        exit
```

4.2.2.10 Redirect Policies

SR OS-based routers support configuring of IPv4 and IPv6 redirect policies. Redirect policies allow specifying multiple redirect target destinations and defining health check test methods used to validate the ability for a given destination to receive redirected traffic. This destination monitoring allows router to react to target destination failures. To specify IPv4 redirect policy, define all destinations to be IPv4. To specify IPv6 redirect policy, define all destinations to be IPv6. IPv4 redirect policy can only be deployed in IPv4 filter policies. IPv6 redirect policy can only be deployed in IPv6 filter policies.

Redirect policy supports the following destination tests:

- **ping test** – with configurable interval, drop-count, and time-out for the test
- **url-test** – with configurable URL to test, interval, drop-count, timeout, and configurable action (disable destination, lower or raise priority) based upon return error code
- **snmp-test** – with configurable OID and Community strings, interval, drop-count, timeout for the test, and configurable action (disable destination, lower or raise priority) based upon SNMP return value.
- **unicast-rt-test** – unicast routing reachability, supported only when router instance is configured for a given redirect policy. The test yields true if the route to the specified destination exists in RTM for the configured router instance.

Each destination is assigned an initial or base priority describing this destination’s relative importance within the policy. The destination with the highest priority value is selected as most-preferred destination and programmed on line cards in filter policies using this redirect policy as an action. Only destinations that are not disabled by the programmed test (if configured) are considered when selecting the most-preferred destination.

In some deployments, it may not be desirable to switch from a currently active, most-preferred redirect-policy destination when a new more-preferred destination becomes available. To support such deployments, operators can enable the sticky destination functionality (**config>filter>redirect-policy>sticky-dest**). When enabled, the currently active destination remains active unless it goes down or an operator forces the switch using the **tools>perform>filter>redirect-policy>activate-best-dest** command. An optional sticky destination *hold-time-up* is available to delay programming the sticky destination in redirect-policy (transition from **action forward** to PBR action to the most-preferred destination). When the timer is enabled, the first destination that comes up will not be programmed and instead the timer is started. Once the timer expires, the most-preferred destination at that time will be programmed (which may be a different destination from the one that started the timer). Note the following:

- When manual switchover to most-preferred destination is executed as described above, the hold-time-up is stopped
- When the timer value is changed, the new value takes immediate effect and the timer is restarted with the new value (or expired if **no-hold-time-up** is configured)

Operational note: unicast-rt-test will fail when performed in the context of a VPRN routing instance when the destination is routable only through **grt-leak** functionality. **ping-test** is recommended in such cases.

Feature caveats:

- Redirect policy is supported for ingress IPv4 and IPv6 filter policies only.
- SNMP and URL tests are not supported for IPv6.
- Different platforms support different scale for redirect policies. Please contact your local Nokia representative to ensure the planned deployment does not exceed recommended scale.

4.2.2.10.1 Router Instance Support for Redirect Policies

There are two modes of deploying redirect policies on VPRN interfaces. The functionality supported depends on the configuration of redirect-policy router option with (**config**>**filter**>**redirect-policy>router**):

- Redirect policy with router option enabled (recommended):
  - When a PBR destination is up, the PBR lookup is performed in the redirect policy's configured routing instance. When that instance differs from the incoming interface where the filter policy using the given redirect policy is deployed, the PBR action is equivalent to forward next-hop router filter policy action.
  - When all PBR destinations are down (or a given hardware does not support action router), action forward is programmed and the PBR lookup is performed in the routing instance of the incoming interface where the filter policy using the given redirect policy is deployed.
  - Any destination tests configured are executed in the routing context specified by the redirect-policy.
  - Changing router configuration for a redirect policy, brings all destinations with a test configured down. The destinations are brought up once the test confirm reachability based on the new redirect policy router configuration.
- Redirect policy without router option disabled (**no router**) or with router options not supported (legacy):

  - When a PBR destination is up, the PBR lookup is performed in the routing instance of the incoming interface where the filter policy using the given redirect policy is deployed.
  - When all PBR destinations are down, action forward is programmed and the PBR lookup is performed in the routing instance of the incoming interface where the filter policy using the given redirect policy is deployed.
  - Any destination tests configured are always executed in the "Base" router instance regardless of the router instance of the incoming interface where the filter policy using the given redirect policy is deployed.

Caveats:

- Only unicast-rt-test and ping-test are supported when router option is enabled.

4.2.2.11 HTTP-redirect (Captive Portal)

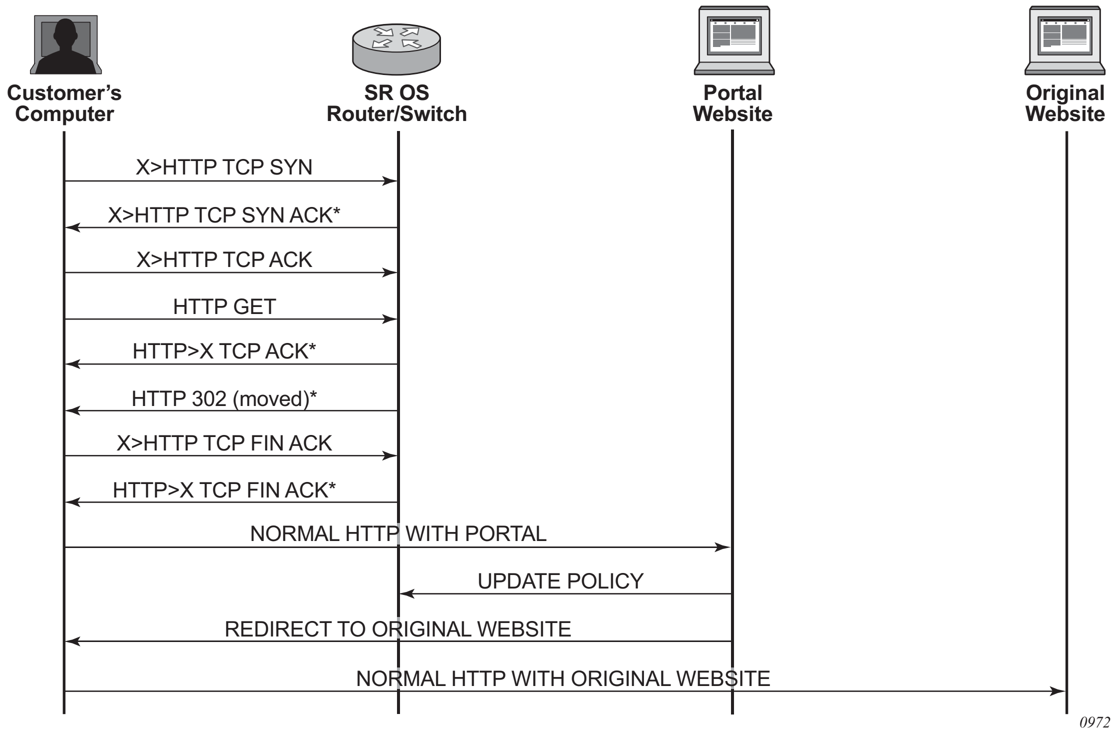
Web redirection policies can be configured on SR OSs/switches. The http redirection action can block a customer’s request from an intended recipient and force the customer to connect to the service’s portal server. 255 unique entries with **http-redirect** are allowed.

4.2.2.11.1 Traffic Flow

The following example provides a brief scenario of a customer connection with web redirection.

1. The customer gets an IP address using DHCP (if the customer is trying to set a static IP he will be blocked by the anti-spoofing filter).
2. The customer tries to connect to a website.
3. The router intercepts the HTTP GET request and blocks it from the network
4. The router then sends the customer an HTTP 302 (service temporarily unavailable/moved). The target URL should then include the customer’s IP and MAC addresses as part of the portal’s URL.
5. The customer’s web browser will then close the original connection and open a new connection to the web portal.
6. The web portal updates the ACL (directly or through SSC) to remove the redirection policy.
7. The customer connects to the original site.

Figure 23 **Web Redirect Traffic Flow**



Starred entries (*) are items the router performs masquerading as the destination, regardless of the destination IP address or type of service.

The following displays information that can optionally be added as variables in the portal URL (http-redirect url):

- $IP – The customer's IP address.
- $MAC – The customer's MAC address.
- $URL – The original requested URL.
- $SAP – The customer's SAP.
- $SUB – The customer's subscriber identification string".
- $CID — A string that represents the circuit-id or interface-id of the subscriber host (hexadecimal format).
- $RID — A string that represents the remote-id of the subscriber host (hexadecimal format).
- $SAPDESC – A configurable string that represents the configured SAP description.

The subscriber identification string is available only when used with subscriber management. Refer to the subscriber management section of the Triple Play Guide and the Router Configuration Guide.

Since most web sites are accessed using the domain name the router allows either DNS queries or responds to DNS with the portal's IP address.

4.2.2.12 Filter Policies and Dynamic Policy-Driven Interfaces

In addition to configuration interfaces like CLI/SNMP, filter policies can be created and modified by dynamic policy-driven interfaces, such as BGP flowspec, OpenFlow, Radius, or XMPP-Python.

For BGP flowspec, routes are learned by a routing instance, and the system auto-creates an embedded filter to contain the rules derived from these routes. The maximum number of rules in the embedded filter of each routing instance can be controlled through configuration. The embedded filter containing the flowspec rules of a routing instance can be inserted into any configured exclusive or template-scope IPv4/IPv6 filter, and the embedding is activated if:

- the filter is applied to the ingress context of an IP interface that supports flowspec
- the IP interfaces to which the filter is applied all belong to the same routing instance, and that routing instance is the one associated with the flowspec routes

The insertion point of the flowspec rules in each embedding filter policy is controlled through offset configuration. For more information, see the BGP flowspec section of the Unicast Routing Protocols Guide.

For Radius, operator can assign filter policies to a subscriber, and populate filter policies used by the subscriber within a preconfigured block reserved for Radius filter entries. See the TPSDA guide and filter RADIUS-related commands for more details.

VSD filters are created dynamically via XMPP and managed via Python script so rules can be inserted into or removed from the proper VSD template or embedded filters. XMPP messages received by the 7750 SR are passed transparently to the Python module to generate the appropriate CLI. More information on VSD filter provisioning, automation, and Python scripting details can be found in the *Layer 2 Services and EVPN Guide*.

For OpenFlow, embedded filter infrastructure is used to inject OpenFlow rules into an existing filter policy. Please see “Hybrid OpenFlow Switch” section for more details.

Policy-controlled auto-created filters are recreated on system reboot. Policy-controlled filter-entries are lost on system reboot and need to be reprogrammed.

4.2.2.13 Filter Policy-based ESM Service Chaining

In some deployments, operators may select to redirect ESM subscribers to Value Added Services (VAS). Various deployment models can be used but often subscribers are assigned to a particular residential tier-of-service, which also defines the VAS available to subscribers of the given tier. The subscribers are redirected to VAS based on tier-of-service rules but such an approach can be hard to manage when many VAS services/tiers of service are desired. Often the only way to identify a subscriber's traffic with a particular tier-of-service is to preallocate IP/IPv6 address pools to a given service tier and use those addresses in VAS PBR match criteria. This creates an application-services to network infrastructure dependency that can be hard to overcome, especially if fast and flexible application service delivery is desired.

Filter policy-based ESM service chaining removes ESM VAS steering to network infrastructure inter-dependency. An operator can configure per tier of service or per individual VAS service upstream and downstream service chaining rules without a need to define subscriber or tier-of-service match conditions. Figure 24 shows a possible ACL model (embedded filters are used for VAS service chaining rules).

On the left in Figure 24, the per-tier-of-service ACL model is depicted. Each tier of service (Gold or Silver) has a dedicated embedded VAS filter ("Gold VAS", "Silver VAS") that contains all steering rules for all service chains applicable to the given tier. Each VAS filter is then embedded by the ACL filter used by a given tier. A subscriber is subject to VAS service chain rules based on the per-tier ACL assigned to that subscriber (for example, via Radius). If a new VAS rule needs to be added, an operator must program that rule in all applicable tiers. Upstream and downstream rules can be configured in a single filter (as shown) or can use dedicated ingress and egress filters.

On the right in Figure 24, the per-VAS-service ACL model is depicted. Each VAS has a dedicated embedded filter ("VAS 1", "VAS 2", "VAS 3") that contains all steering rules for all service chains applicable to that VAS service. A tier of service is then created by embedding multiple VAS-specific filters: Gold: VAS 1, VAS 2, VAS 3; Silver: VAS 1 and VAS 3. A subscriber is subject to VAS service chain rules based on the per-tier ACL assigned to that subscriber. If a new VAS rule needs to be added, an operator needs to program that rule in a single VAS-specific filter only. Again, upstream and downstream rules can be configured in a single filter (as shown) or can use dedicated ingress and egress filters.

Figure 24 **ACL filter modeling for ESM Service Chaining**

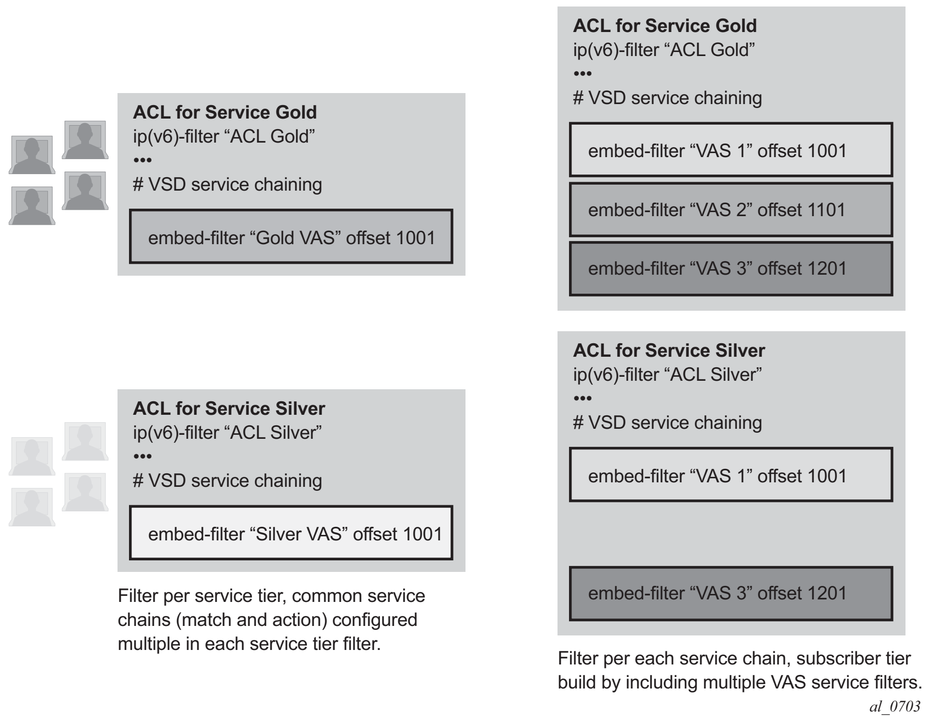


Figure 25 shows upstream VAS service chaining steering using filter policies. Upstream subscriber traffic entering Res-GW is subject to the subscriber's ingress ACL filter assigned to that subscriber by a policy server. If the ACL contains VAS steering rules, the VAS-rule-matching subscriber traffic is steered for VAS processing over a dedicated to-from-access VAS interface in the same or a different routing instance. After the VAS processing, the upstream traffic can be returned to Res-GW by a to-from-network interface (shown in Figure 25) or can be injected to WAN to be routed towards the final destination (not shown).

Figure 25 **Upstream ESM ACL-policy based service chaining**

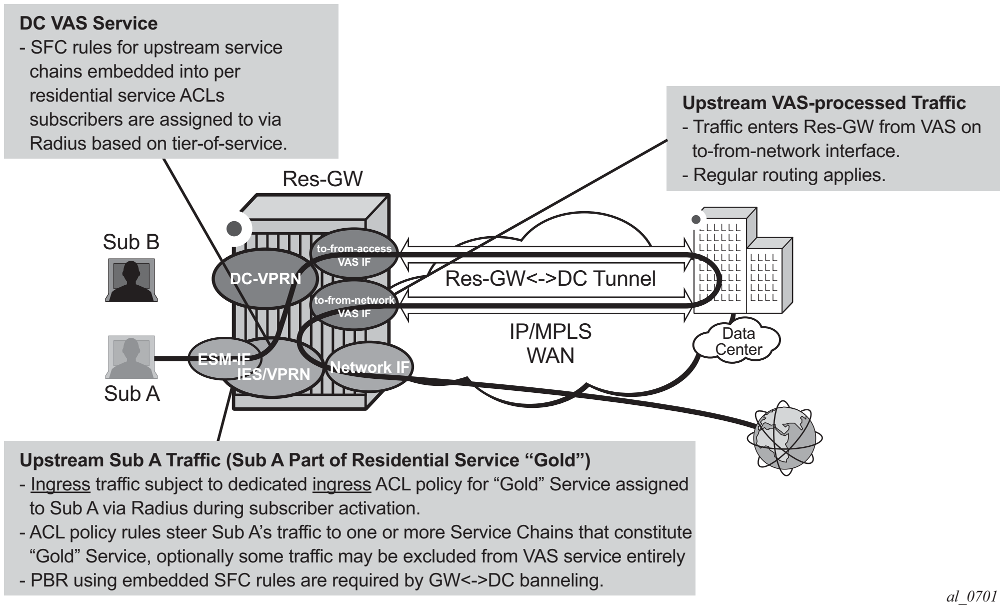
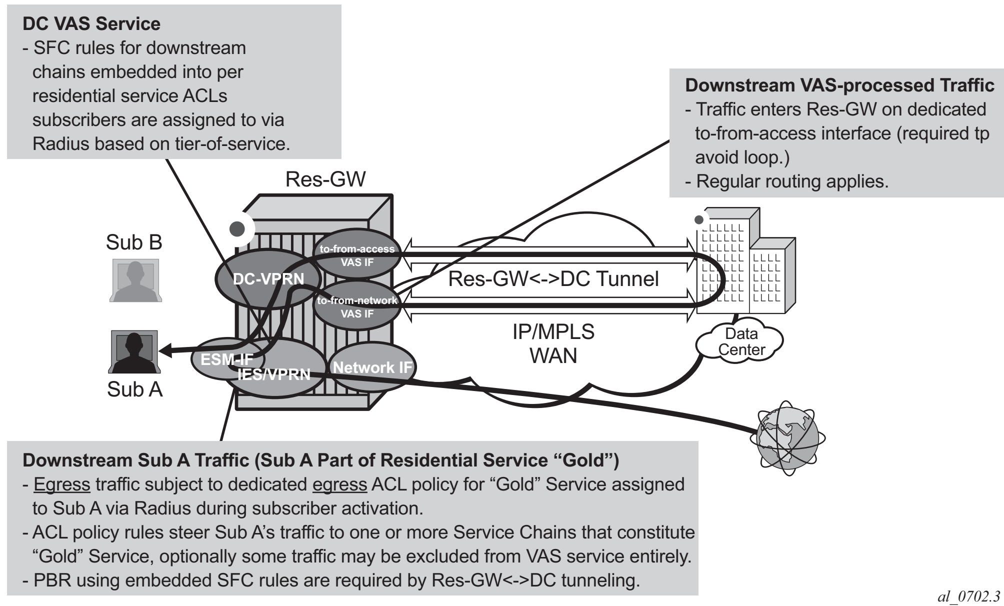


Figure 26 shows downstream VAS service chaining steering using filter policies. Downstream subscriber traffic entering Res-GW is forwarded to a subscriber-facing line card. On that card, the traffic is subject to the subscriber's egress ACL filter policy processing assigned to that subscriber by a policy server. If the ACL contains VAS steering rules, the VAS rule-matching subscriber's traffic is steered for VAS processing over a dedicated to-from-network VAS interface (in the same or a different routing instance). After the VAS processing, the downstream traffic must be returned to Res-GW via a “to-from-network” interface (shown in Figure 26) to ensure the traffic is not redirected to VAS again when the subscriber-facing line card processes that traffic.

Figure 26 Downstream ESM ACL-policy based service chaining



Ensuring the proper settings for the VAS interface type, for upstream and downstream traffic redirected to a VAS and returned after VAS processing, is critical for achieving loop-free network connectivity for VAS services. The available configuration options (**config**>**service**>**vprn**>**if**>**vas-if-type**, **config**>**service**>**ies**>**if**>**vas-if-type** and **config**>**router**>**interface**>**vas-if-type**) are described below:

- deployments that use two separate interfaces for VAS connectivity (recommended, and required if local subscriber-to-subscriber VAS traffic support is required)
  - **to-from-access**
    - upstream traffic arriving from subscribers over access interfaces must be redirected to a VAS PBR target reachable over this interface for upstream VAS processing
    - downstream traffic destined for subscribers after VAS processing must arrive on this interface, so that the traffic is subject to regular routing but is not subject to Application Assurance divert, nor to egress subscriber PBR
    - the interface must not be used for downstream pre-VAS traffic; otherwise routing loops will occur
  - **to-from-network**
    - downstream traffic destined for subscribers arriving from network interfaces must be redirected to a VAS PBR target reachable over this

interface for downstream VAS processing

    - upstream traffic after VAS processing, if returned to the router, must arrive on this interface so that regular routing can be applied
- deployments that use a single interface for VAS connectivity (optional, no local subscriber-to-subscriber VAS traffic support)
  - **to-from-both**
    - both upstream traffic arriving from access interfaces and downstream traffic arriving from the network is redirected to a PBR target reachable over this interface for upstream/downstream VAS processing
    - after VAS processing, traffic must arrive on this interface (optional for upstream), so that the traffic is subject to regular routing but is not subject to AA divert, nor to egress subscriber PBR
    - the interface must be used for downstream pre-VAS traffic; otherwise routing loops will occur

The ESM filter policy-based service chaining allows operators to do the following:

- Steer upstream and downstream traffic per-subscriber with full ACL-flow-defined granularity without the need to specify match conditions that identify subscriber or tier-of-service
- Steer both upstream and downstream traffic on a single Res-GW
- Flexibly assign subscribers to tier-of-service by changing the ACL filter policy a given subscriber uses
- Flexibly add new services to a subscriber or tier-of-service by adding the subscriber-independent filter rules required to achieve steering
- Achieve isolation of VAS steering from other ACL functions like security through the use of embedded filters
- Deploy integrated Application Assurance (AA) as part of a VAS service chain - both upstream and downstream traffic is processed by AA before a VAS redirect
- Select whether to use IP-Src/IP-Dst address hash or IP-Src/IP-Dst address plus TCP/UDP port hash when LAG/ECMP connectivity to DC is used. L4 inputs are not used in hash with IPv6 packets with extension headers present.

ESM filter policy-based traffic steering supports the following:

- IPv4 and IPv6 steering of unicast traffic using IPv4 and IPv6 ACLs
- **action forward redirect-policy** or **action forward next-hop router** for IP steering with TCAM-based load-balancing, fail-to-wire, and sticky destination
- **action forward esi sf-ip vas-interface router** for an integrated service chaining solution

Operational notes:

- Downstream traffic steered towards a VAS on the subscriber-facing IOM is reclassified (FC and profile) based on the subscriber egress QoS policy, and is queued towards the VAS based on the network egress QoS configuration. Packets sent toward VAS will not have DSCP remarked (since they are not yet forwarded to a subscriber). DSCP remarking based on subscriber's egress QoS profile will only apply to traffic ultimately forwarded to the subscriber (after VAS or not subject to VAS).
- If mirroring of subscriber traffic is configured using ACL entry/subscriber/SAP/ port mirror, the mirroring will apply to traffic ultimately forwarded to subscriber (after VAS or not subject to VAS). Traffic that is being redirected to VAS cannot be mirrored using an ACL filter implementing PBR action (the same egress ACL filter entry being a mirror source and specifying egress PBR action is not supported).
- Use dedicated ingress and egress filter policies to prevent accidental match of an ingress PBR entry on egress and vice-versa that will result in forwarding/ dropping of traffic matching the entry (based on the filter's default action configuration).

Caveats:

- This feature requires chassis mode D
- This feature is not supported with HSMDAs on subscriber ingress
- This feature is not supported when the traffic is subject to non-AA ISA on Res-GW
- Traffic that matches an egress filter entry with an egress PBR action cannot be mirrored, cannot be sampled using cflowd, and cannot be logged using filter logging while being redirected to VAS on a sub-facing line card.
- This feature is not supported with LAC/LNS ESM (PPPoE subscriber traffic encapsulated into or de-encapsulated from L2TP tunnels)
- This feature is not supported for system filter policies

4.2.2.14 Policy-Based Forwarding for Deep Packet Inspection in VPLS

The purpose policy-based forwarding is to capture traffic from a customer and perform a deep packet inspection (DPI) and forward traffic, if allowed, by the DPI.

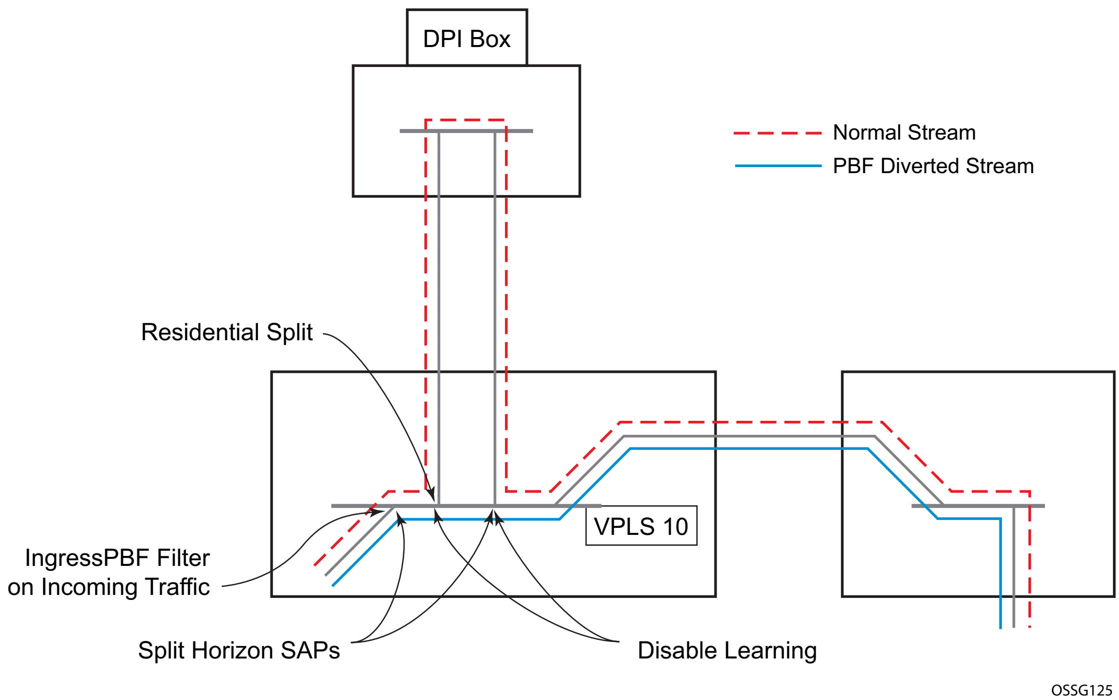
In the following example, the split horizon groups are used to prevent flooding of traffic. Traffic from customers enter at SAP 1/1/5:5. Due to the mac-filter 100 that is applied on ingress, all traffic with dot1p 07 marking will be forwarded to SAP 1/1/22:1, which is the DPI.

DPI performs packet inspection/modification and either drops the traffic or forwards the traffic back into the box through SAP 1/1/21:1. Traffic will then be sent to spoke-sdp 3:5.

SAP 1/1/23:5 is configured to see if the VPLS service is flooding all the traffic. If flooding is performed by the router then traffic would also be sent to SAP 1/1/23:5 (which it should not).

Figure 27 shows an example to configure policy-based forwarding for deep packet inspection on a VPLS service. For information about configuring services, refer to the Layer 2 Services and EVPN Guide: VLL, VPLS, PBB, and EVPN.

Figure 27 **Policy-Based Forwarding for Deep Packet Inspection**



The following displays a VPLS service configuration with DPI example:

```
*A:ALA-48>config>service# info
----------------------------------------------
...
        vpls 10 customer 1 create
            service-mtu 1400
            split-horizon-group "dpi" residential-group create
            exit
            split-horizon-group "split" create
            exit
            stp
```

```
                shutdown
            exit
            sap 1/1/21:1 split-horizon-group "split" create
                disable-learning
                static-mac 00:00:00:31:11:01 create
            exit
            sap 1/1/22:1 split-horizon-group "dpi" create
                disable-learning
                static-mac 00:00:00:31:12:01 create
            exit
            sap 1/1/23:5 create
                static-mac 00:00:00:31:13:05 create
            exit
            no shutdown
        exit
...
----------------------------------------------
*A:ALA-48>config>service#
```

The following displays a MAC filter configuration example:

```
*A:ALA-48>config>filter# info
----------------------------------------------
...
        mac-filter 100 create
            default-action forward
            entry 10 create
                match
                    dot1p 7 7
                exit
                log 101
                action forward sap 1/1/22:1
            exit
        exit
...
----------------------------------------------
*A:ALA-48>config>filter#
```

The following displays the MAC filter added to the VPLS service configuration:

```
*A:ALA-48>config>service# info
----------------------------------------------
...
        vpls 10 customer 1 create
            service-mtu 1400
            split-horizon-group "dpi" residential-group create
            exit
            split-horizon-group "split" create
            exit
            stp
                shutdown
            exit
            sap 1/1/5:5 split-horizon-group "split" create
                ingress
                    filter mac 100
```

```
                    exit
                    static-mac 00:00:00:31:15:05 create
                exit
                sap 1/1/21:1 split-horizon-group "split" create
                    disable-learning
                    static-mac 00:00:00:31:11:01 create
                exit
                sap 1/1/22:1 split-horizon-group "dpi" create
                    disable-learning
                    static-mac 00:00:00:31:12:01 create
                exit
                sap 1/1/23:5 create
                    static-mac 00:00:00:31:13:05 create
                exit
                spoke-sdp 3:5 create
                exit
                no shutdown
            exit
....
----------------------------------------------
*A:ALA-48>config>service#
```

4.3 Filter Configuration Command Reference

4.3.1 Command Hierarchies

- IPv4 Filter Policy Commands
- IPv6 Filter Policy Commands
- MAC Filter Commands
- System Filter Policy Commands
- Redirect Policy Configuration Commands
- Match Filter List Commands
- Log Filter Commands
- Copy Filter Commands

4.3.1.1 IPv4 Filter Policy Commands

config
— **filter**
    — **ip-filter** *filter-id* [**create**]
    — [**no**] **ip-filter** {*filter-id* | *filter-name*}
        — [**no**] **chain-to-system-filter**
        — **default-action** {**drop** | **forward**}
        — **description** *description-string*
        — **no description**
        — **embed-filter** *filter-id* [**offset** *offset*] [{**active** | **inactive**}]
        — **no embed-filter** *filter-id*
        — **embed-filter flowspec** [**router** {*router-instance* | **service-name** *vprn-service-name*}] [**offset** *offset*] [{**active** | **inactive**}]
        — **no embed-filter flowspec**
        — **embed-filter open-flow** *ofs-name* [{**system** | **service** {*service-id* | *service-name*} | **sap** *sap-id*}] [**offset** *offset*] [{**active** | **inactive**}]
        — **no embed-filter open-flow** *ofs-name* [{**system** | **service** {*service-id* | *service-name*} | **sap** *sap-id*}]
        — **embed-filter vsd** *vsd-filter-id* [**offset** *offset*] [{**active**|**inactive**}]
        — **no embed-filter vsd** *vsd-filter-id*
        — **entry** *entry-id* [**create**]
        — **no entry** *entry-id*
            — [**no**] **action** [**secondary**]
                — **drop**
                — **drop packet-length** {{**lt** | **eq** | **gt**} *packet-length-value* | **range** *packet-length-value packet-length-value*}
                — **drop ttl** {{**lt** | **gt** | **eq**} *ttl-value* | **range** *ttl-value ttl-value*}
                — [**no**] **extended-action**
                    — **remark dscp** *dscp-name*
                — **forward**
                — **forward esi service-id** *esi* **service-id** *vpls-service-id*
                — **forward esi sf-ip vas-interface router** *esi* **sf-ip** *ip-address* **vas-interface** *interface-name* **router** {*router-instance* | **service-name** *service-name*}

— **forward lsp** *lsp-name*
— **forward next-hop** [**indirect**] *ip-address*
— **forward next-hop** [**indirect**] *ip-address* **router** {*router-instance* | **service-name** *service-name*}
— **forward next-hop interface** *ip-int-name*
— **forward redirect-policy** *policy-name*
— **forward router** {*router-instance* | **service-name** *service-name*}
— **forward sap** *sap-id*
— **forward sdp** *sdp-id:vc-id*
— **gtp-local-breakout**
— **http-redirect** *rdr-url-string* [**allow-radius-override**]
— **nat** [**nat-policy** *nat-policy-name*]
— **rate-limit** *value*
— **reassemble**
— **remark dscp** *dscp-name*
— **tcp-mss-adjust**
— **description** *description-string*
— **no description**
— **egress-pbr** {**default-load-balancing** | **l4-load-balancing**}
— **no egress-pbr**
— [**no**] **filter-sample**
— [**no**] **interface-disable-sample**
— **log** *log-id*
— **no log**
— **match** [**protocol** *protocol-id*]
— **no match**
— **dscp** *dscp-name*
— **no dscp**
— **dst-ip** {*ip-address***/***mask* | *ip-address ipv4-address-mask* | **ip-prefix-list** *prefix-list-name*}
— **no dst-ip**
— **dst-port** {**lt** | **gt** | **eq**} *dst-port-number*
— **dst-port port-list** *port-list-name*
— **dst-port range** *dst-port-number dst-port-number*
— **no dst-port**
— **fragment** {**true** | **false**}
— **no fragment**
— **icmp-code** *icmp-code*
— **no icmp-code**
— **icmp-type** *icmp-type*
— **no icmp-type**
— **ip-option** *ip-option-value* [*ip-option-mask*]
— **no ip-option**
— **multiple-option** {**true** | **false**}
— **no multiple-option**
— **option-present** {**true** | **false**}
— **no option-present**
— **port** {**lt** | **gt** | **eq**} *port-number*
— **port port-list** *port-list-name*
— **port range** *port-number port-number*
— **no port**
— **src-ip** {*ip-address***/***mask* | *ip-address ipv4-address-mask* | **ip-prefix-list** *prefix-list-name*}
— **no src-ip**

— **src-port** {**lt** | **gt** | **eq**} *src-port-number*
— **src-port** **port-list** *port-list-name*
— **src-port** **range** *src-port-number src-port-number*
— **no src-port**
— **src-route-option** {**true** | **false**}
— **no src-route-option**
— **tcp-ack** {**true** | **false**}
— **no tcp-ack**
— **tcp-syn** {**true** | **false**}
— **no tcp-syn**
— **pbr-down-action-override** {**drop** | **forward** | **filter-default-action**}
— **no pbr-down-action-override**
— **sticky-dest** *hold-time-up*
— **sticky-dest** **no-hold-time-up**
— **no sticky-dest**
— **filter-name** *filter-name*
— **no filter-name**
— **renum** *old-entry-id new-entry-id*
— **scope** {**exclusive** | **template** | **embedded** | **system**}
— **no scope**
— **shared-radius-filter-wmark** **low** *low-watermark* **high** *high-watermark*
— **no shared-radius-filter-wmark**
— **sub-insert-credit-control** **start-entry** *entry-id* **count** *count*
— **no sub-insert-credit-control**
— **sub-insert-radius** **start-entry** *entry-id* **count** *count*
— **no sub-insert-radius**
— **sub-insert-shared-pccrule** **start-entry** *entry-id* **count** *count*
— **no sub-insert-shared-pccrule**
— **sub-insert-shared-radius** **start-entry** *entry-id* **count** *count*
— **no sub-insert-shared-radius**
— **sub-insert-wmark** **low** *low-watermark* **high** *high-watermark*
— **no sub-insert-wmark**

4.3.1.2 IPv6 Filter Policy Commands

These commands do not apply to the 7450 ESS (except in mixed mode).

config
— **filter**
— **ipv6-filter** *filter-id* [**create**]
— [**no**] **ipv6-filter** {*filter-id* | *filter-name*}
— [**no**] **chain-to-system-filter**
— **default-action** {**drop** | **forward**}
— **description** *description-string*
— **no description**
— **embed-filter** *filter-id* [**offset** *offset*] [{**active** | **inactive**}]
— **no embed-filter** *filter-id*
— **embed-filter** **flowspec** [**router** {*router-instance* | **service-name** *vprn-service-name*}] [**offset** *offset*] [{**active** | **inactive**}]
— **no embed-filter** **flowspec**

— **embed-filter open-flow** *ofs-name* [{**system** | **service** {*service-id* | *service-name*} | **sap** *sap-id*}] [**offset** *offset*] [{**active** | **inactive**}]
— **no embed-filter open-flow** *ofs-name* [{**system** | **service** {*service-id* | *service-name*} | **sap** *sap-id*}]
— **embed-filter vsd** *vsd-filter-id* [**offset** *value*] [{**active** | **inactive**}]
— **no embed-filter vsd** *vsd-filter-id*
— **entry** *entry-id* [**create**]
— **no entry** *entry-id*
    — [**no**] **action** [**secondary**]
        — **drop**
        — **drop hop-limit** {{**lt** | **eq** | **gt**} *hop-limit-value* | **range** *hop-limit-value hop-limit-value*}
        — **drop payload-length** {{**lt** | **eq** | **gt**} *payload-length-value* | **range** *payload-length-value payload-length-value*}
        — [**no**] **extended-action**
            — **remark dscp** *dscp-name*
        — **forward**
        — **forward esi service-id** *esi* **service-id** *vpls-service-id*
        — **forward esi sf-ip vas-interface router** *esi* **sf-ip** *ipv6-address* **vas-interface** *interface-name* **router** {*router-instance* | **service-name** *service-name*}
        — **forward lsp** *lsp-name*
        — **forward next-hop** [**indirect**] *ipv6-address*
        — **forward next-hop** [**indirect**] *ipv6-address* **router** {*router-instance* | **service-name** *service-name*}
        — **forward redirect-policy** *policy-name*
        — **forward router** {*router-instance* | **service-name** *service-name*}
        — **forward sap** *sap-id*
        — **forward sdp** *sdp-id:vc-id*
        — **http-redirect** *rdr-url-string* [**allow-radius-override**]
        — **nat nat-type** *nat-type* [**nat-policy** *nat-policy-name*]
        — **rate-limit** *value*
        — **remark dscp** *dscp-name*
        — **tcp-mss-adjust**
    — **description** *description-string*
    — **no description**
    — **egress-pbr** {**default-load-balancing** | **l4-load-balancing**}
    — **no egress-pbr**
    — [**no**] **filter-sample**
    — [**no**] **interface-disable-sample**
    — **log** *log-id*
    — **no log**
    — **match** [**next-header** *next-header*]
    — **no match**
        — **ah-ext-hdr** {**true** | **false**}
        — **no ah-ext-hdr**
        — **dscp** *dscp-name*
        — **no dscp**
        — **dst-ip** {*ipv6-address***/***prefix-length* | *ipv6-address ipv6-address-mask* | **ipv6-prefix-list** *prefix-list-name*}
        — **no dst-ip**
        — **dst-port** {**lt** | **gt** | **eq**} *dst-port-number*
        — **dst-port port-list** *port-list-name*
        — **dst-port range** *dst-port-number dst-port-number*

— **no dst-port**
— **esp-ext-hdr** {**true** | **false**}
— **no esp-ext-hdr**
— **flow-label** *flow-label* [*mask*]
— **no flow-label**
— **fragment** {**true** | **false** | **first-only** | **non-first-only**}
— **no fragment**
— **hop-by-hop-opt** {**true** | **false**}
— **no hop-by-hop-opt**
— **icmp-code** *icmp-code*
— **no icmp-code**
— **icmp-type** *icmp-type*
— **no icmp-type**
— **port** {**lt** | **gt** | **eq**} *port-number*
— **port port-list** *port-list-name*
— **port range** *port-number port-number*
— **no port**
— **routing-type0** {**true** | **false**}
— **no routing-type0**
— **src-ip** {*ipv6-address***/***prefix-length* | *ipv6-address ipv6-address-mask* | **ipv6-prefix-list** *prefix-list-name*}
— **no src-ip**
— **src-port** {**lt** | **gt** | **eq**} *src-port-number*
— **src-port port-list** *port-list-name*
— **src-port range** *src-port-number src-port-number*
— **no src-port**
— **tcp-ack** {**true** | **false**}
— **no tcp-ack**
— **tcp-syn** {**true** | **false**}
— **no tcp-syn**
— **pbr-down-action-override** {**drop** | **forward** | **filter-default-action**}
— **no pbr-down-action-override**
— **sticky-dest** *hold-time-up*
— **sticky-dest no-hold-time-up**
— **no sticky-dest**
— **filter-name** *filter-name*
— **no filter-name**
— **renum** *old-entry-id new-entry-id*
— **scope** {**exclusive** | **template** | **embedded** | **system**}
— **no scope**
— **shared-radius-filter-wmark low** *low-watermark* **high** *high-watermark*
— **no shared-radius-filter-wmark**
— **sub-insert-credit-control start-entry** *entry-id* **count** *count*
— **no sub-insert-credit-control**
— **sub-insert-radius start-entry** *entry-id* **count** *count*
— **no sub-insert-radius**
— **sub-insert-shared-pccrule start-entry** *entry-id* **count c***ount*
— **no sub-insert-shared-pccrule**
— **sub-insert-shared-radius start-entry** *entry-id* **count c***ount*
— **no sub-insert-shared-radius**
— **sub-insert-wmark low** *low-watermark* **high** *high-watermark*
— **no sub-insert-wmark**

4.3.1.3 MAC Filter Commands

config
- **filter**
  - **mac-filter** *filter-id* [**create**]
  - [**no**] **mac-filter** {*filter-id* | *filter-name*}
    - **default-action** {**drop** | **forward**}
    - **description** *description-string*
    - **no description**
    - **embed-filter vsd** *vsd-filter-id* [**offset** *value*] [{**active** | **inactive**}]
    - **no embed-filter vsd** *vsd-filter-id*
    - **entry** *entry-id* [**create**]
    - **no entry** *entry-id*
      - [**no**] **action** [**secondary**]
        - **drop**
        - **forward**
        - **forward esi service-id** *esi vpls-service-id*
        - **forward sap** *sap-id*
        - **forward sdp** *sdp-id:vc-id*
        - **http-redirect** *url*
        - **rate-limit** *value*
      - **description** *description-string*
      - **no description**
      - **log** *log-id*
      - **no log**
      - **match** [**frame-type** {**802dot3** | **802dot2-llc** | **802dot2-snap** | **ethernet_II**}]
      - **no match**
        - **dot1p** *dot1p-value* [*dot1p-mask*]
        - **no dot1p**
        - **dsap** *dsap-value* [*dsap-mask*]
        - **no dsap**
        - **dst-mac** *ieee-address* [*ieee-address-mask*]
        - **no dst-mac**
        - **etype** *0x0600..0xffff*
        - **no etype**
        - **inner-tag** *value* [*vid-mask*]
        - **no inner-tag**
        - **isid** *value* [**to** *higher-value*]
        - **no isid**
        - **outer-tag** *value* [*vid-mask*]
        - **no outer-tag**
        - **snap-oui** {**zero** | **non-zero**}
        - **no snap-oui**
        - **snap-pid** *snap-pid*
        - **no snap-pid**
        - **ssap** *ssap-value* [*ssap-mask*]
        - **no ssap**
        - **src-mac** *ieee-address* [*ieee-address-mask*]
        - **no src-mac**
      - **pbr-down-action-override** {**drop** | **forward** | **filter-default-action**}
      - **no pbr-down-action-override**
      - **sticky-dest** *hold-time-up*

— **sticky-dest no-hold-time-up**
— **no sticky-dest**
— **filter-name** *filter-name*
— **no filter-name**
— **renum** *old-entry-id new-entry-id*
— **scope** {**exclusive** | **template**}
— **no scope**
— **type** *filter-type*

4.3.1.4 System Filter Policy Commands

config
— **filter**
— **system-filter**
— [**no**] **ip** *ip-filter-id*
— [**no**] **ipv6** *ipv6-filter-id*

4.3.1.5 Redirect Policy Configuration Commands

config
— **filter**
— **redirect-policy** *redirect-policy-name* [**create**]
— **no redirect-policy** *redirect-policy-name*
— **description** *description-string*
— **no description**
— **destination** *ip-address* [**create**]
— **no destination** *ip-address*
— **description** *description-string*
— **no description**
— [**no**] **ping-test**
— **drop-count** *consecutive-failures* [**hold-down** *seconds*]
— **no drop-count**
— **interval** *seconds*
— **no interval**
— **timeout** *seconds*
— **no timeout**
— **priority** [*priority*]
— **no priority**
— [**no**] **shutdown**
— **snmp-test** *test-name* [**create**]
— **no snmp-test** *test-name*
— **drop-count** *consecutive-failures* [**hold-down** *seconds*]
— **no drop-count**
— **interval** *seconds*
— **no interval**
— **oid** *oid-string* **community** *community-string*
— **no oid**

— **return-value** *return-value* **type** *return-type* [**disable** | **lower-priority** *priority* | **raise-priority** *priority*]
— **no return-value** *return-value* **type** *return-type*
— **timeout** *seconds*
— **no timeout**
— [**no**] **unicast-rt-test**
— **url-test** *test-name* [**create**]
— **no url-test** *test-name*
— **drop-count** *consecutive-failures* [**hold-down** *seconds*]
— **no drop-count**
— **interval** *seconds*
— **no interval**
— **return-code** *return-code-1* [*return-code-2*] [**disable** | **lower-priority** *priority* | **raise-priority** *priority*]
— **no return-code** *return-code-1* [*return-code-2*]
— **timeout** *seconds*
— **no timeout**
— **url** *url-string* [**http-version** *version-string*]
— **no url**
— **router** *router-instance*
— **router service-name** *service-name*
— **no router**
— [**no**] **shutdown**
— **sticky-dest** *hold-time-up*
— **sticky-dest no-hold-time-up**
— **no sticky-dest**

4.3.1.6 Match Filter List Commands

config
— **filter**
— **match-list**
— **ip-prefix-list** *ip-prefix-list-name* [**create**]
— **no ip-prefix-list** *ip-prefix-list-name*
— [**no**] **apply-path**
— **bgp-peers** *index* **group** *reg-exp* **neighbor** *reg-exp*
— **no bgp-peers** *index*
— **description** *description-string*
— **no description**
— [**no**] **prefix** *ip-prefix/prefix-length*
— **ipv6-prefix-list** *ipv6-prefix-list-name* [**create**]
— **no ipv6-prefix-list** *ipv6-prefix-list-name*
— [**no**] **apply-path**
— **bgp-peers** *index* **group** *reg-exp* **neighbor** *reg-exp*
— **no bgp-peers** *index*
— **description** *description-string*
— **no description**
— [**no**] **prefix** *ipv6-prefix/prefix-length*
— **port-list** *port-list-name* [**create**]
— **no port-list** *port-list-name*
— **description** *description-string*

— **no description**
— [**no**] **port** *port-number*
— [**no**] **port range** *start end*

4.3.1.7 Log Filter Commands

config
— **filter**
— **log** *log-id* [**create**]
— **no log** *log-id*
— **description** *description-string*
— **no description**
— **destination** {**memory** *num-entries* | **syslog** *syslog-id*}
— **no destination**
— [**no**] **shutdown**
— **summary**
— [**no**] **shutdown**
— **summary-crit dst-addr**
— **summary-crit src-addr**
— **no summary-crit**
— [**no**] **wrap-around**

4.3.1.8 Copy Filter Commands

config
— **filter**
— **copy**
— **ip-filter** *src-filter-id* [**src-entry** *src-entry-id*] **to** *dst-filter-id* [**dst-entry** *dst-entry-id*] [**overwrite**]
— **mac-filter** *src-filter-id* [**src-entry** *src-entry-id*] **to** *dst-filter-id* [**dst-entry** *dst-entry-id*] [**overwrite**]
— **ipv6-filter** *src-filter-id* [**src-entry** *src-entry-id*] **to** *dst-filter-id* [**dst-entry** *dst-entry-id*] [**overwrite**]

4.3.2 Command Descriptions

4.3.2.1 Generic Commands

description

Syntax **description** *description-string*
no description

Context config>filter>ip-filter
config>filter>ipv6-filter
config>filter>ip-filter>entry
config>filter>ipv6-filter>entry
config>filter>log
config>filter>mac-filter
config>filter>mac-filter>entry
config>filter>redirect-policy
config>filter>redirect-policy>destination
config>filter>match-list>ip-prefix-list
config>filter>match-list>ipv6-prefix-list
config>filter>match-list>port-list

Description This command creates a text description stored in the configuration file for a configuration context.

The **no** form of the command removes any description string from the context.

Default **no description**

Parameters *description-string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

4.3.2.2 Global Filter Commands

ip-filter

Syntax **ip-filter** *filter-id* [**create**]
[**no**] **ip-filter** {*filter-id* **|** *filter-name*}

Context config>filter

Description This command creates a configuration context for the specified IPv4 filter policy if it does not exist, and enables the context to configure the specified IPv4 filter policy.

The **no** form of the command deletes the IPv4 filter policy. A filter policy cannot be deleted until it is removed from all objects where it is applied.

Default No IPv4 filter policy is created by default.

Parameters *filter-id* — specifies the IPv4 filter policy ID expressed as a decimal integer

Values 1 to 65535

create — Keyword required to create the configuration context. Once it is created, the context can be enabled with or without the **create** keyword.

filter-name — A string of up to 64 characters uniquely identifying this IPv4 filter policy.

ipv6-filter

Syntax **ipv6-filter** *filter-id* [**create**]
[**no**] **ipv6-filter** {*filter-id* **|** *filter-name*}

Context config>filter

Description This command creates a configuration context for the specified IPv6 filter policy if it does not exist, and enables the context to configure the specified IPv6 filter policy.

The **no** form of the command deletes the IPv6 filter policy. A filter policy cannot be deleted until it is removed from all objects where it is applied.

Default No IPv6 filter policy is created by default.

Parameters *filter-id* — specifies the IPv6 filter policy ID expressed as a decimal integer

Values 1 to 65535

create — Keyword required to create the configuration context. Once it is created, the context can be enabled with or without the **create** keyword.

filter-name — A string of up to 64 characters uniquely identifying this IPv6 filter policy.

system-filter

Syntax **system-filter**

Context config>filter

Description This command enables the context to activate system filter policies.

Default n/a

mac-filter

Syntax **mac-filter** *filter-id* [**create**]
[**no**] **mac-filter** {*filter-id* **|** *filter-name*}

Context config>filter

Description This command, creates a configuration context for the specified MAC filter policy if it does not exist, and enables the context to configure the specified MAC filter policy.

The **no** form of the command deletes the MAC filter policy. A filter policy cannot be deleted until it is removed from all objects where it is applied.

Default No MAC filter policy is created by default.

Parameters *filter-id* — specifies the MAC filter policy ID expressed as a decimal integer

Values 1 to 65535

create — Keyword required to create the configuration context. Once it is created, the context can be enabled with or without the **create** keyword.

filter-name — A string of up to 64 characters uniquely identifying this MAC filter policy.

redirect-policy

Syntax **redirect-policy** *redirect-policy-name* [**create**]
no redirect-policy *redirect-policy-name*

Context config>filter

Description This command, creates a configuration context for the specified redirect policy if it does not exist, and enables the context to configure the redirect policy.

The **no** form of the command removes the redirect policy from the filter configuration only if the policy is not referenced in a filter and the filter is not in use (applied to a service or network interface).

Default No redirect policy is created by default.

Parameters *redirect-policy-name* — specifies the redirect policy name. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes. There is no limit to the number of redirect policies that can be configured.

create — Keyword required to create the configuration context. Once it is created, the context can be enabled with or without the **create** keyword.

log

Syntax **log** *log-id* [**create**]
no log *log-id*

Context config>filter

Description This command, creates a configuration context for the specified filter log if it does not exist, and enables the context to configure the specified filter log.

The **no** form of the command deletes the filter log. The log cannot be deleted if there are filter entries configured to write to the log. All filter entry logging associations need to be removed before the log can be deleted.

Default **log 101**

Special Cases **Filter log 101 —** Filter log 101 is the default log and is automatically created by the system. Filter log 101 is always a memory filter log and cannot be changed to a Syslog filter log. The log size defaults to 1000 entries, the filter log description is set to "Default filter log". The number of entries and **wrap-around** behavior can be modified.

Parameters *log-id* — specifies the filter log ID expressed as a decimal integer

Values 101 to 199

create — Keyword required to create the configuration context. Once it is created, the context can be enabled with or without the **create** keyword.

4.3.2.3 Filter Log Commands

destination

Syntax **destination memory** *num-entries*
destination syslog *syslog-id*
no destination

Context config>filter>log

Description This command configures the destination for filter log entries for the filter log ID.

Filter logs can be sent to either memory (**memory**) or to an existing Syslog server definition (**syslog**).

If the filter log destination is **memory**, the maximum number of entries in the log must be specified.

The **no** form of the command deletes the filter log association.

Default destination memory 1000

Parameters **memory** *num-entries* **—** specifies the destination of the filter log ID is a memory log. The *num-entries* value is the maximum number of entries in the filter log expressed as a decimal integer.

Values 10 to 50000

syslog *syslog-id* **—** specifies the destination of the filter log ID is a Syslog server. The *syslog-id* parameter is the number of the Syslog server definition.

Values 1 to 10

shutdown

Syntax [**no**] **shutdown**

Context config>filter>log
config>filter>log>summary

Description Administratively enables/disables (AdminUp/AdminDown) an entity. Downing an entity does not change, reset or remove any configuration settings or statistics. Many objects must be shutdown before they may be deleted.

The **shutdown** command administratively downs an entity. Administratively downing an entity changes the operational state of the entity to down.

Unlike other commands and parameters where the default state will not be indicated in the configuration file, **shutdown** and **no shutdown** are always indicated in system generated configuration files.

The **no** form of the command puts an entity into the administratively enabled state.

Default no shutdown for **config**>**filter**>**log** and shutdown for **config**>**filter**>**log**>**summary**

summary

Syntax **summary**

Context config>filter>log

Description This command enables the context to configure log summarization. These settings will only be taken into account when syslog is the log destination.

Default n/a

summary-crit

Syntax **summary-crit dst-addr**
summary-crit src-addr
no summary-crit

Context config>filter>log>summary

Description This command defines the key of the index of the minitable. If key information is changed while summary is administratively enabled (no shutdown), the filter summary minitable is flushed and recreated with different key information. Log packets received during the reconfiguration time will be handled as if summary was not active.

The **no** form of the command reverts to the default parameter.

Default summary-crit src-addr

Parameters **dst-addr —** specifies that received log packets are summarized based on the destination IPv4, IPv6, or MAC address

src-addr — specifies that received log packets are summarized based on the source IPv4, IPv6 or MAC address

wrap-around

Syntax [**no**] **wrap-around**

Context config>filter>log

Description This command configures a memory filter log to log until full or to store the most recent log entries (circular buffer).

Specifying **wrap-around** configures the memory filter log to store the most recent filter log entries (circular buffer). When the log is full, the oldest filter log entries are overwritten with new entries.

The **no** form of the command configures the memory filter log to accept filter log entries until full. When the memory filter log is full, filter logging for the log filter ID ceases.

Default wrap-around

4.3.2.4 ACL Filter Policy Commands

default-action

Syntax **default-action** {**drop | forward**}

Context config>filter>ip-filter
config>filter>ipv6-filter
config>filter>mac-filter

Description This command defines the default action to be applied to packets not matching any entry in this ACL filter policy or to packets for that match a PBF/PBR filter entry for which the PBF/PBR target is down and **pbr-down-action-override** per-entry is set to **filter-default-action**.

Default default-action drop

Parameters **drop —** default action is to drop a packet

forward — default action is to forward a packet

chain-to-system-filter

Syntax [**no**] **chain-to-system-filter**

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command chains this filter to a currently active system filter. When the filter is chained to the system filter, the system filter rules are executed first, and the filter rules are only evaluated if no match on the system filter was found.

The **no** form of the command detaches this filter from the system filter.

Operational note:

If no system filter is currently active, the command has no effect.

Default no chain-to-system-filter

ip

Syntax [**no**] **ip** *ip-filter-id*

Context config>filter>system-filter

Description This command activates an IPv4 system filter policy. Once activated, all IPv4 ACL filter policies that chain to the system filter (**config**>**filter**>**ip-filter**>**chain-to-system-filter**) will automatically execute system filter policy rules first.

The **no** form of the command deactivates the system filter policy.

Default None of the IPv4 system filters is available by default.

Parameters *ip-filter-id* — an existing IPv4 filter policy with scope **system**. This parameter can either be expressed as a decimal integer, or as an ASCII string of up to 64 characters.

Values 1 to 65535 or the filter policy name (*filter-name*, 64 char max)

ipv6

Syntax [**no**] **ipv6** *ipv6-filter-id*

Context config>filter>system-filter

Description This command activates an IPv6 system filter policy. Once activated, all IPv6 ACL filter policies that chain to the system filter (**config**>**filter**>**ipv6-filter**>**chain-to-system-filter**) will automatically execute system filter policy rules first.

The **no** form of the command deactivates the system filter policy.

Default None of the IPv6 system filters are available by default.

Parameters *ipv6-filter-id* — an existing IPv6 filter policy with scope **system**. This parameter can either be expressed as a decimal integer, or as an ASCII string of up to 64 characters

Values 1 to 65535 or the filter policy name (*filter-name*, 64 char max)

embed-filter

Syntax **embed-filter** *filter-id* [**offset** *offset*] [{**active** | **inactive**}]
no embed-filter *filter-id*

embed-filter flowspec [**router** {*router-instance* **| service-name** *vprn-service-name*}] [**offset** *value*] [{**active | inactive**}]
no embed-filter flowspec
embed-filter open-flow *ofs-name* [{**system | service** {*service-id* **|** *service-name*} **| sap** *sap-id*}] [**offset** *offset*] [{**active | inactive**}]
no embed-filter open-flow *ofs-name* [{**system | service** {*service-id* **|** *service-name*} **| sap** *sap-id*}]
embed-filter vsd *vsd-filter-id* [**offset** *value*] [{**active | inactive**}]
no embed-filter vsd *vsd-filter-id*

Context config>filter>ip-filter
config>filter>ipv6-filter
config>filter>mac-filter

Description This command embeds a previously defined IPv4, IPv6, or MAC embedded filter policy or Hybrid OpenFlow switch instance into this exclusive, template or system filter policy at the specified offset value. Rules derived from the BGP flowspec can also be embedded into template filter policies only.

Note: For MAC filters, embedding is supported for VSD filters or filter entries only.

The **embed-filter open-flow** *ofs-name* form of this command enables OpenFlow (OF) in GRT either by embedding the specified OpenFlow switch (OFS) instance with **switch-defined-cookie** disabled, or by embedding rules with sros-cookie:type “grt-cookie”, value 0 from the specified OFS instance with **switch-defined-cookie** enabled. The embedding filter can only be deployed in GRT context or be unassigned.

The **embed-filter open-flow** *ofs-name* **system** form of this command enables OF in system filters by embedding rules with sros-cookie:type “system-cookie”, value 0 from the specified OFS instance with **switch-defined-cookie** enabled. The embedding filter can only be of scope **system**.

The **embed-filter open-flow** *ofs-name* **service** {*service-id* **|** *service-name*} form of this command enables OF in VPRN/VPLS filters by embedding rules with sros-cookie:type “service-cookie”, value **service-id** from the specified OFS instance with **switch-defined-cookie** enabled – per service rules. The embedding filter can only be deployed in the specified VPRN/VPLS service. A single VPLS service can only support OF rules per SAP or per service.

The **embed-filter open-flow** *ofs-name* **sap** *sap-id* form of this command enables OF in VPLS SAP filters by embedding rules with sros-cookie:type “service-cookie”, value *service-id* and flow match conditions specifying the sap-id from the specified OFS instance with **switch-defined-cookie** enabled – per SAP OF rules. The embedding filter must be of type exclusive and can only be deployed on the specified SAP in the context of the specified VPLS service. A single VPLS service can only support OF rules per SAP or per service.

The **no embed-filter open-flow** *ofs-name* form of this command removes the OF embedding for the GRT context.

The **embed-filter flowspec** form of this command enables the embedding of rules derived from BGP flowspec routes into the filter policy that is being configured. The optional router parameter specifies the routing instance source of the BGP flowspec routes; if the parameter is not specifies, the routing instance is derived automatically from the context in which the filter policy is applied. Flowspec rules associated with one routing instance cannot be embedded in a filter applied to an interface of a different routing instance. Also, once flowspec rules associated with one routing instance are embedded into a filter, that filter policy cannot be applied to an interface of a different routing instance.

The **no embed-filter flowspec** form of this command removes the flowspec filter embedding from this filter policy.

The **embed-filter vsd** *vsd-filter-id* command refers to the VSD filter ID encoded _tmnx_vsd_filter-id. The filter is created dynamically and managed exclusively using the Python script, so rules can be inserted and removed in the proper VSD filters. The command is supported with IP, IPv6, and MAC filters. For more information on VSD filter provisioning, automation, and the Python script, refer to the Layer 2 Services and EVPN User Guide.

The **no embed-filter vsd** *vsd-filter-id* form of this command removes the VSD filter embedding from this filter policy.

The **no embed-filter** *filter-id* form of this command removes the embedding from this filter policy.

Please see the description of embedded filter policies in this guide for further operational details.

Default No embedded filter policies are included in a filter policy by default

Parameters *filter-id* — specifies a previously defined embedded filter policy.

open-flow *ofs-name* — specifies the name of the currently configured Hybrid OpenFlow Switch (OFS) instance.

Not including the **system**, **service** or **sap** parameters will specify OF in a GRT instance context by default. This allows embedding of OF rules into filters deployed in GRT instances from OFS with **switch-defined-cookie** disabled, or embedding rules from OFS with **switch-defined-cookie** enabled, when the FlowTable cookie encodes sros-cookie:type “grt-cookie”.

vsd *vsd-filter-id* **—** creates an embedded filter (filter ID: _tmnx_vsd_*filter-id*) for population by Nuage VSD

system — used for OF control of system filters. Allows embedding of OF rules into system filters from OFS with **switch-defined-cookie** enabled. Only the rules with cookie value encoding “system-cookie” are embedded.

service *{service-id* **|** *service-name}* — used for OF control of VPRN or VPLS services. Allows embedding of OF rules into a VPRN or VPLS access or network filters. Only the rules with cookie value encoding the specified service ID are embedded into the filter. The embedding filter can only be deployed in the context of the specified service.

service-id — specifies an existing VPRN or VPLS service ID that the embedding filter can be used for

service-name — specifies an existing VPRN or VPLS service name that the embedding filter can be used for

sap *sap-id* — used for OF control of VPLS services when a PortID and VLAN ID match is required. Allows embedding of OF rules with a PortID and VLAN ID match into exclusive VPLS SAP filters. Only the rules with cookie value encoding the VPLS service, and flow table match encoding the specified SAP are embedded into the filter. The embedding filter can only be deployed in the context of the specified SAP.

sap-id — specifies an existing SAP that the embedding filter can be used for

flowspec — keyword to indicate that rules derived from BGP flowspec routes should be embedded into (or removed from, in case of the **no** form) the filter.

router-instance — specifies a router instance

offset — an embedded filter entry X will have an entry X + offset in the embedding filter

Values 0 to 65536

Default 0

active — specifies that embedded filter entries are to be included in this embedding filter policy and activated on applicable line cards – default if no keyword is specified and omitted in info command (but not info detail), or when saving configuration.

inactive — specifies that no embedded filter policy entries are to be included in this embedding filter policy. The embedding is configured but will not do anything.

filter-name

Syntax **filter-name** *filter-name*
no filter-name

Context config>filter>ip-filter
config>filter>ipv6-filter
config>filter>mac-filter

Description This command configures filter-name attribute of a given filter. filter-name, when configured, can be used instead of filter ID to reference the given policy in the CLI.

Default no filter-name

Parameters *filter-name* — a string of up to 64 characters uniquely identifying this filter policy

The following restrictions apply to the *filter-name*:

– Policy names may not begin with a number (0-9).

– Policy names may not begin with the underscore “_” character (e.g. _myPolicy). Names that start with underscore are reserved for system generated names.

– “fSpec-x” (where x is any number) cannot be used as a user defined filter name.

scope

Syntax **scope** {**exclusive** | **template** | **embedded** | **system**}
scope {**exclusive** | **template**}
no scope

Context config>filter>ip-filter
config>filter>ipv6-filter
config>filter>mac-filter

Description This command configures the filter policy scope as exclusive, template, embedded or system.

The scope of the policy cannot be changed when:

- the scope is **template** and the policy is applied to one or more services or network interfaces
- the scope is **embedded** and the policy is embedded by another policy

Changing the scope to/from system is only allowed when a policy is not active and the policy has no entries configured.

The **no** form of the command sets the scope of the policy to the default of **template**.

Default **scope template**

Parameters **exclusive —** specifies that the policy can only be applied to a single entity. Attempting to assign the policy to a second entity will result in an error message.

template — specifies that the policy can be applied to multiple entities

embedded — specifies that the policy cannot be applied directly. The policy defines embedded filter rules, which are embedded by other exclusive/template/system filter policies. The **embedded** scope is supported for IPv4 and IPv6 filter policies only.

system — specifies that the policy defines system-wide filter rules. To apply system policy rules, activate system filter and chain exclusive/template ACL filter policy to the system filter. The **system** scope is supported for IPv4 and IPv6 filter policies only.

shared-radius-filter-wmark

Syntax **shared-radius-filter-wmark low** *low-watermark* **high** *high-watermark*
no shared-radius-filter-wmark

Context config>filter>ip-filter

config>filter>ipv6-filter

Description This command configures the low and high watermark for the number of RADIUS shared filters reporting

Default **no shared-radius-filter-wmark**

Parameters **low** *low-watermark* **—** specifies the utilization of the filter ranges for filter entry insertion, at which a table full alarm will be raised by the agent

Values 0 to 8000

high *high-watermark* **—** specifies the utilization of the filter ranges for filter entry insertion, at which a table full alarm will be cleared by the agent

Values 1 to 8000

sub-insert-credit-control

Syntax **sub-insert-credit-control start-entry** *entry-id* **count** *count*
no sub-insert-credit-control

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command inserts point information for credit control for the filter.

The **no** form of the command reverts to the default.

Default no sub-insert-credit-control

Parameters **entry** *entry-id* **—** identifies a filter on this system

Values 1 to 65535

count *count* **—** specifies the count

Values 1 to 65535

sub-insert-radius

Syntax **sub-insert-radius start-entry** *entry-id* **count** *count*
no sub-insert-radius

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command inserts point information for RADIUS for the filter.

The **no** form of the command reverts to the default.

Default no sub-insert-radius

Parameters **entry** *entry-id* **—** specifies at what place the filter entries received from RADIUS will be inserted in the filter

Values 1 to 65535

count *count* **—** specifies the count

Values 1 to 65535

sub-insert-shared-pccrule

Syntax **sub-insert-shared-pccrule start-entry** *entry-id* **count c***ount*
no sub-insert-shared-pccrule

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command defines the range of filter and QoS policy entries that are reserved for shared entries received in Flow-Information AVP via Gx interface (PCC rules – Policy and Charging Control). The **no** form of this command disables the insertion, which will result in a failure of PCC rule installation.

Default no sub-insert-shared-pccrule

Parameters **start-entry** *entry-id* **—** specifies the lowest entry in the range

Values 1 to 65535

count count — specifies the number of entries in the range

Values 1 to 65535

sub-insert-shared-radius

Syntax **sub-insert-shared-radius start-entry** *entry-id* **count c***ount*
no sub-insert-shared-radius

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command configures the insert point for shared host rules from RADIUS.

Default no sub-insert-shared-radius

Parameters **entry** *entry-id* **—** identifies a filter on this system

Values 1 to 65535

count *count* **—** specifies the count

Values 1 to 65535

sub-insert-wmark

Syntax **sub-insert-wmark low** *low-watermark* **high** *high-watermark*
no sub-insert-wmark

Context config>filter>ip-filter
config>filter>ipv6-filter

Description This command configures the low and high watermark percentage for inserted filter entry usage reporting.

The **no** form of the command reverts to the default.

Default sub-insert-wmark low 90 high 95

Parameters **low** *low-watermark* — specifies the utilization of the filter ranges for filter entry insertion, at which a table full alarm will be cleared by the agent

Values 0 to 100

high *high-watermark* **—** specifies the utilization of the filter ranges for filter entry insertion, at which a table full alarm will be raised by the agent

Values 0 to 100

type

Syntax **type** *filter-type*

Context config>filter>mac-filter

Description This command configures the MAC Filter Policy sub-type as being either normal, ISID or VID.

Default **type normal**

Parameters *filter-type* — specifies which type of entry this MAC filter can contain

Values **normal** — Regular match criteria are allowed; ISID or VID filter match criteria not allowed.
isid — Only ISID match criteria are allowed.
vid — Only VID match criteria are allowed on ethernet_II frame types.

4.3.2.5 General Filter Entry Commands

entry

Syntax **entry** *entry-id* [**create**]
no entry *entry-id*

Context config>filter>ip-filter
config>filter>ipv6-filter
config>filter>mac-filter

Description This command creates or edits an IPv4, IPv6, or MAC filter entry. Multiple entries can be created using unique *entry-id* numbers within the filter. Entries must be sequenced from most to least explicit.

An entry may not have any match criteria defined (in which case everything matches) but must have at least the keyword **action** for it to be considered complete. Entries without the **action** keyword will be considered incomplete and hence will be rendered inactive.

The **no** form of the command removes the specified entry from the filter. Entries removed from the filter are immediately removed from all services or network ports where that filter is applied.

Default No entry is created by default for any filter policy.

Parameters *entry-id* — uniquely identifies a match criteria and the corresponding action. It is recommended that multiple entries be given *entry-id* in staggered increments. This allows users to insert a new entry in an existing policy without requiring to renumber all the existing entries. The parameter is expressed as a decimal integer.

Values 1 to 65535

create — keyword required to create the configuration context. Once the context is created, the user can enable the context with or without the **create** keyword.

action

Syntax [**no**] **action** [**secondary**]

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry
config>filter>mac-filter>entry

Description This command enters the context to configure a primary (no option specified) or secondary (**secondary** option specified) action to be performed on packets matching this filter entry. An ACL filter entry remains inactive (is not programmed in hardware) until a specific action is configured for that entry.

A primary action supports any filter entry action, a secondary action is used for redundancy and defines a redundant L3 PBR action for an L3 PBR primary action or a redundant L2 PBF action for a L2 PBF primary action.

The **no** form of this command removes the specific action configured in the context of the action command. The primary action cannot be removed if a secondary action exists.

Default no action

Parameters **secondary** — secondary action to be performed on packets matching this filter entry. A secondary action can only be configured if a primary action is configured.

log

Syntax **log** *log-id*
no log

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry
config>filter>mac-filter>entry

Description This command associates a filter log to the current filter policy entry and therefore enables logging for that filter entry.

The filter log must exist before a filter entry can be enabled to use the filter log.

The **no** form of the command disables logging for the filter entry.

Default no log

Parameters *log-id* — the filter log ID expressed as a decimal integer

Values 101 to 199

pbr-down-action-override

Syntax **pbr-down-action-override** {**drop | forward | filter-default-action**}
no pbr-down-action-override

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry
config>filter>mac-filter>entry

Description This command allows overriding the default action that is applied for entries with PBR/PBF action defined, when the PBR/PBF target is down.

The **no** form of the command preserves default behavior when PBR/PBF target is down.

Default no pbr-down-action-override

Parameters **drop —** packets matching the entry will be dropped if PBR/PBF target is down

forward — packets matching the entry will be forwarded if PBR/PBF target is down

filter-default-action — packets matching the entry will be processed as per **default-action** configuration for this filter if PBR/PBF target is down

sticky-dest

Syntax **sticky-dest** *hold-time-up*
sticky-dest no-hold-time-up
no sticky-dest

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry
config>filter>mac-filter>entry

Description This command configures sticky destination behavior for redundant PBR/PBF actions. Configuring sticky destination has an effect on PBR/PBF actions whether or not a secondary action is configured.

The *hold-time-up* parameter allows the operator to delay programming of a PBR/PBF action for a specified amount of time. The timer is only started when transitioning from all configured targets being down (that is, the primary target if no secondary target is configured, or both the primary and secondary targets when both are configured) to at least one target being up.

When the timer expires, the primary PBR/PBF action is programmed if its target is up. If the primary PBR/PBF target is down and a secondary PBR/PBF action has been configured and its target is up, then this secondary PBR/PBF action is programmed. In all other cases, no specific programming occurs when the timer expires.

When sticky destination is configured and the secondary PBR/PBF target is up and its associated action is programmed, it is not automatically replaced by the primary PBR/PBF action when its target transitions from down to up. In this situation, programming the primary PBR/PBF action can be forced using the **activate-primary-action** tools command.

Changing the value of the timer while the timer is running takes effect immediately (that is, the timer is restarted immediately using the new value).

The no form of the command disables sticky destination behavior.

Default no sticky-dest

Parameters *hold-time-up* **—** initial delay in seconds. Zero is equivalent to **no-hold-time-up** (no delay).

Values 0 to 65535 seconds

4.3.2.6 IP (v4/v6) Filter Entry Commands

action

Syntax

drop
drop packet-length {{**lt** | **eq** | **gt**} *packet-length-value* **| range** *packet-length-value packet-length-value*}
drop ttl {{**lt** | **eq** | **gt**} *ttl-value* **| range** *ttl-value ttl-value*}
forward
forward esi *esi* **service-id** *vpls-service-id*
forward esi *esi* **sf-ip** *ip-address* **vas-interface** *interface-name* **router** {*router-instance* **| service-name** *service-name*}
forward lsp *lsp-name*
forward next-hop [**indirect**] *ip-address*
forward next-hop [**indirect**] *ip-address* **router** {*router-instance* **| service-name** *service-name*}
forward next-hop interface *ip-int-name*
forward redirect-policy *policy-name*
forward router {*router-instance* **| service-name** *service-name*}
forward sap *sap-id*
forward sdp *sdp-id:vc-id*
gtp-local-breakout
http-redirect *rdr-url-string* [**allow-radius-override**]
nat [**nat-policy** *nat-policy-name*]
rate-limit *value*
reassemble
remark dscp *dscp-name*
tcp-mss-adjust

Context

config>filter>ip-filter>entry
config>filter>ip-filter>entry>action
config>filter>ip-filter>entry>action>extended-action

Description

This command (under the **config**>**filter**>**ip-filter**>**entry** context) sets the context for specific action commands to be performed (under the **config**>**filter**>**ip-filter**>**entry**>**action** context) on packets matching this filter entry.

The following commands are available under the **config**>**filter**>**ip-filter**>**entry**>**action** context:

- **drop**

  A packet matching the entry will be dropped.
- **drop packet-length**

  A packet matching the entry will be dropped only if “Total Length” field in the packet’s IPv4 header meets the configured condition.
- **drop ttl**

A packet matching the entry will be dropped only if “Time-to-live” field in the packet’s IPv4 header meets the configured condition.

- **forward**

  A packet matching the entry will be forwarded using regular routing.

- **forward esi service-id**

  A packet matching the entry will be forwarded to ESI identified first appliance in Nuage service chain using EVPN-resolved VXLAN tunnel in the specified VPLS service.

- **forward esi sf-ip vas-interface router**

  A packet matching the entry will be forwarded to ESI/SF-IP identified first appliance in Nuage service chain using EVPN-resolved VXLAN tunnel over the configured VAS interface in the specified VPRN service.

- **forward lsp**

  A packet matching the entry will be forwarded using the specified lsp.

- **forward next-hop**

  A packet matching the entry will be forwarded in the routing context of the incoming interface using direct or indirect IPv4 address in the routing lookup.

- **forward next-hop router**

  A packet matching the entry will be forwarded in the configured routing context using direct or indirect IPv4 address in the routing lookup.

- **forward next-hop interface**

  A packet matching the entry will be forwarded using the configured local interface.

- **forward redirect-policy**

  A packet matching the entry will be forwarded using **forward next-hop** or **forward next-hop router** and the IP address of destination selected by the configured redirect policy. If no destination is selected, packets are subject to **action forward**.

- **forward router**

  A packet matching the entry will be routed in the configured routing instance and not in the incoming interface routing instance.

- **forward sap**

  A packet matching the entry will be forwarded using the configured SAP.

- **forward sdp**

  A packet matching the entry will be forwarded using the configured SDP.

- **gtp-local-breakout**

  A packet matching the entry will be forwarded to NAT instead of being GTP tunneled to mobile operator’s PGW or GGSN.

- **http-redirect**

  An HTTP GET packet matching an entry is forwarded to CPM for HTTP captive portal processing; when configured with **allow-radius-override**, the system overwrites the configured *rdr-url-string* with the URL returned from Radius.

- **nat**

  A packet matching the entry will be forwarded to NAT.

- **rate-limit**

Enables ACL rate limiting for packets matching the entry of this ACL filter policy. Rate limiters are configured by default with MBS = CBS = 10-ms-of-the-rate and high-prio-only = 0.

- **reassemble**

  A packet matching the entry will be forwarded to the reassembly function.

- **remark**

  Enables and configures the remarking of the DiffServ Code Points of packets matching the criteria of the IPv4 filter policy entry. Packets are remarked regardless of QoS-based in-profile or out-of-profile classification. QoS-based DSCP remarking is overridden.

- **tcp-mss-adjust**

  Configures the Maximum Segment Size (MSS) adjustment for TCP packets. A packet matching the entry will be forwarded to the ISA BB.

Default No specific action is configured by default.

Parameters *dscp-name* — specifies the DSCP value to write

Values be, ef, cp1, cp2, cp3, cp4, cp5, cp6, cp7, cp9, cs1, cs2, cs3, cs4, cs5, nc1, nc2, af11, af12, af13, af21, af22, af23, af31, af32, af33, af41, af42, af43, cp11, cp13, cp15, cp17, cp19, cp21, cp23, cp25, cp27, cp29, cp31, cp33, cp35, cp37, cp39, cp41, cp42, cp43, cp44, cp45, cp47, cp49, cp50, cp51, cp52, cp53, cp54, cp55, cp57, cp58, cp59, cp60, cp61, cp62, cp63

esi — specifies a 10-byte Ethernet Segment Identifier

ip-address — specifies the IPv4 address of a direct or indirect next hop to which to forward matching packets

ip-int-name — specifies the name of an egress IP interface where matching packets will be forwarded from. This parameter is only valid for unnumbered point-to-point interfaces. If the string contains special characters (such as #, $, spaces), the entire string must be enclosed within double quotes.

interface-name — specifies the (maximum 32-character) name of an egress R-VPLS IP interface used to forward the packets using ESI redirect for VPRN/IES service

lsp-name — specifies an existing RSVP-TE or MPLS-TP LSP that supports LSP redirect

nat-policy-name — specifies the NAT policy to be used in NAT redirect

policy-name — specifies an IPv4 redirect policy configured in the **config**>**filter**>**redirect-policy** context

sap-id — specifies an existing VPLS Ethernet SAP

sdp-id:vc-id — specifies an existing VPLS SDP

packet-length-value — specifies integer value to be compared against “Total Length” field in the packet’s IPv4 header

rdr-url-string — specifies the HTTP web address that will be sent to the user’s browser

router-instance — specifies “Base” or an existing VPRN service ID *service-name* — specifies an existing VPRN service name

ttl-value — Specifies an integer value to be compared against "Time-to-live" field in the packet's IPv4 header

value — specifies the rate-limit value in Kb per second. A rate of 0 results in all traffic being dropped. A rate of **max** results in all traffic being forwarded.

Values 0 to 2000000000 **|** max

vpls-service-id — specifies an existing VPLS service ID or service name

lt — specifies "less than". **lt** cannot be used with the lowest possible numerical value for the parameter

eq — specifies "equal to". **gt** cannot be used with the highest possible numerical value for the parameter.

gt — specifies "greater than"

range — specifies an inclusive range. When **range** is used, the start of the range (first value entered) must be smaller than the end of the range (second value entered).

action

Syntax
drop
drop hop-limit {{**lt | eq | gt**} *hop-limit-value* **| range** *hop-limit-value hop-limit-value*}
drop payload-length {{**lt | eq | gt**} *payload-length***-***value* **| range** *payload-length***-***value payload-length***-***value*}
forward
forward esi *esi* **service-id** *vpls-service-id*
forward esi *esi* **sf-ip** *ipv6-address* **vas-interface** *interface-name* **router** {*router-instance* **| service-name** *service-name*}
forward lsp *lsp-name*
forward next-hop [**indirect**] *ipv6-address*
forward next-hop [**indirect**] *ipv6-address* **router** {*router-instance* **| service-name** *service-name*}
forward redirect-policy *policy-name*
forward router {*router-instance* **| service-name** *service-name*}
forward sap *sap-id*
forward sdp *sdp-id:vc-id*
http-redirect *rdr-url-string* [**allow-radius-override**]
nat nat-type *nat-type* [**nat-policy** *nat-policy-name*]
rate-limit *value*
remark dscp *dscp-name*
tcp-mss-adjust

Context
config>filter>ipv6-filter>entry
config>filter>ipv6-filter>entry>action
config>filter>ipv6-filter>entry>action>extended-action

Description This command (under the **config**>**filter**>**ipv6-filter**>**entry** context) sets the context for specific action commands to be performed (under the **config**>**filter**>**ipv6-filter**>**entry**>**action** context) on packets matching this filter entry.

The following commands are available in the **config**>**filter**>**ipv6-filter**>**entry**>**action** context:

- **drop**

  A packet matching the entry will be dropped.
- **drop hop-limit**

  A packet matching the entry will be dropped only if the “Hop Limit” field in the packet’s IPv6 header matches the configured condition.
- **drop payload-length**

  A packet matching the entry will be dropped only if the “Payload Length” field in the packet’s IPv6 header matches the configured condition.
- **forward**

  A packet matching the entry will be forwarded using regular routing.
- **forward esi service-id**

  A packet matching the entry will be forwarded to the ESI identified as the first appliance in the Nuage service chain using an EVPN-resolved VXLAN tunnel in the specified VPLS service.
- **forward esi sf-ip vas-interface router**

  A packet matching the entry will be forwarded to ESI/SF-IP identified as the first appliance in Nuage service chain using EVPN-resolved VXLAN tunnel over the configured VAS interface in the specified VPRN service.
- **forward lsp**

  A packet matching the entry will be forwarded using the specified LSP.
- **forward next-hop**

  A packet matching the entry will be forwarded in the routing context of the incoming interface using a direct or indirect IPv6 address in the routing lookup.
- **forward next-hop**

  forward next-hop router

  A packet matching the entry will be forwarded in the configured routing context using a direct or indirect IPv6 address in the routing lookup.
- **forward redirect-policy**

  A packet matching the entry will be forwarded using **forward next-hop** or **forward next-hop router** and the IP address of the destination selected by the configured redirect policy. If no destination is selected, packets are subject to **action forward**.
- **forward router**

  A packet matching the entry will be routed in the configured routing instance and not in the incoming interface routing instance.
- **forward sap**

  A packet matching the entry will be forwarded using the configured SAP.

- **forward sdp**

  A packet matching the entry will be forwarded using the configured SDP.
- **http-redirect**

  An HTTP GET packet matching an entry is forwarded to the CPM for HTTP captive portal processing. When **allow-radius-override** is configured, the system overwrites the configured *redirect-url-string* with the URL returned from RADIUS.
- **nat**

  A packet matching the entry will be forwarded to NAT.
- **rate-limit**

  Enables ACL rate limiting for packets matching the entry of this ACL filter policy. Rate limiters are configured by default with MBS = CBS = 10-ms-of-the-rate and high-prio-only = 0.
- **remark**

  Enables and configures the remarking of the DiffServ Code Points of packets matching the criteria of the IPv6 filter policy entry. Packets are remarked regardless of QoS-based in-profile or out-of-profile classification. QoS-based DSCP remarking is overridden.
- **tcp-mss-adjust**

  Configures the Maximum Segment Size (MSS) adjustment for TCP packets. A packet matching the entry will be forwarded to the ISA BB.

Default No specific action is configured by default.

Parameters *dscp-name* — specifies the DSCP value to write

Values be, ef, cp1, cp2, cp3, cp4, cp5, cp6, cp7, cp9, cs1, cs2, cs3, cs4, cs5, nc1, nc2, af11, af12, af13, af21, af22, af23, af31, af32, af33, af41, af42, af43, cp11, cp13, cp15, cp17, cp19, cp21, cp23, cp25, cp27, cp29, cp31, cp33, cp35, cp37, cp39, cp41, cp42, cp43, cp44, cp45, cp47, cp49, cp50, cp51, cp52, cp53, cp54, cp55, cp57, cp58, cp59, cp60, cp61, cp62, cp63

esi — specifies a 10-byte Ethernet Segment Identifier

hop-limit-value — specifies an integer value to be compared against the “Hop Limit” field in the packet’s IPv6 header

Values 0 to 255

interface-name — specifies the name of an egress R-VPLS IP interface used to forward the packets using ESI redirect for VPRN/IES service

ipv6-address — specifies the IPv6 address of a direct or indirect next hop to which to forward matching packets

lsp-name — specifies an existing RSVP-TE or MPLS-TP LSP that supports LSP redirect

nat-policy-name — specifies the NAT policy to be used in NAT redirect

nat-type — specifies the nat-type to be either dslite or nat64 *policy-name* — specifies an IPv6 redirect policy configured in the **config**>**filter**>**redirect-policy** context

sap-id — specifies an existing VPLS Ethernet SAP

sdp-id:vc-id — specifies an existing VPLS SDP

payload-length-value — specifies an integer value to be compared against the “Payload Length” field in the packet’s IPv6 header

rdr-url-string — specifies the HTTP web address that will be sent to the user’s browser

router-instance — specifies “Base” or an existing VPRN service ID

service-name — specifies an existing VPRN service name

value — specifies the rate-limit value in Kbits per second. A rate of 0 results in all traffic being dropped. A rate of **max** results in all traffic being forwarded.

Values 0 to 2000000000 **|** max

lt — specifies “less than”. **lt** cannot be used with the lowest possible numerical value for the parameter.

eq — specifies “equal to”

gt — specifies “greater than”. **gt** cannot be used with the highest possible numerical value for the parameter.

range — specifies an inclusive range. When **range** is used, the start of the range (first value entered) must be smaller than the end of the range (second value entered).

extended-action

Syntax [**no**] **extended-action**

Context config>filter>ip-filter>entry>action
config>filter>ipv6-filter>entry>action

Description This command enables the context to configure an extended action for a filter entry's PBR action (configured under **config>filter>ip-filter>entry>action** and **config>filter>ipv6-filter>entry>action** context). The extended action is executed in addition to the configured PBR action.

The no version of the command removes the extended action.

Default No extended action is configured by default.

remark

Syntax **remark dscp** *dscp-name*

Context config>filter>ip-filter>entry>action>extended-action config>filter>ipv6-filter>entry>action>extended-action

Description Enables and configures the remarking of the DiffServ Code Points of packets matching the criteria of the IPv4/IPv6 filter policy entry, in conjunction with a PBR action. Packets are remarked regardless of QoS-based in-profile or out-of-profile classification. QoS-based DSCP remarking is overridden. If the status of the PBR target is tracked and it is down, the extended action will not be executed; otherwise, the extended action will be performed.

Default By default DSCP remarking is not configured.

Parameters *dscp-name* — specifies the DSCP value to write

Values be, ef, cp1, cp2, cp3, cp4, cp5, cp6, cp7, cp9, cs1, cs2, cs3, cs4, cs5, nc1, nc2, af11, af12, af13, af21, af22, af23, af31, af32, af33, af41, af42, af43, cp11, cp13, cp15, cp17, cp19, cp21, cp23, cp25, cp27, cp29, cp31, cp33, cp35, cp37, cp39, cp41, cp42, cp43, cp44, cp45, cp47, cp49, cp50, cp51, cp52, cp53, cp54, cp55, cp57, cp58, cp59, cp60, cp61, cp62, cp63

egress-pbr

Syntax **egress-pbr** {**default-load-balancing | l4-load-balancing**}
no egress-pbr

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry

Description This command specifies that the configured PBR action is applicable to egress processing. The command should only be enabled in ACL policies used by residential subscribers. Enabling **egress-pbr** on filters not deployed for residential subscribers is not blocked but may lead to unexpected behavior and thus should be avoided.

The **no** form of this command removes the **egress-pbr** designation of the filter entry's action.

Default no egress-pbr

Parameters **default-load-balancing** — sets load-balancing to the default (hash based on SA/DA of the packet)

l4-load-balancing — includes TCP/UDP port (if available) in the hash

filter-sample

Syntax [**no**] **filter-sample**

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry

Description This command enables cflowd sampling for packets matching this filter entry.

If the cflowd is either not enabled or set to **cflowd interface** mode, this command is ignored.

The **no** form disables the cflowd sampling using this filter entry.

Default **no filter-sample**

interface-disable-sample

Syntax [**no**] **interface-disable-sample**

Context config>filter>ip-filter>entry
config>filter>ipv6-filter>entry

Description This command disables cflowd sampling for packets matching this filter entry, for the IP interface set to **cflowd interface** mode. This allows the option to not sample specific types of traffic when interface sampling is enabled.

If the cflowd is either not enabled or set to **cflowd acl** mode, this command is ignored.

The **no** form of this command enables sampling.

Default **no interface-disable-sample**

match

Syntax **match** [**protocol** *protocol-id*]
no match

Context config>filter>ip-filter>entry

Description This command enables the context to enter match criteria for the filter entry. When the match criteria have been satisfied the action associated with the match criteria is executed.

A **match** context may consist of multiple match criteria, but multiple **match** statements cannot be entered per entry. More precisely, the command can be entered multiple times but this only results in modifying the *protocol-id*, and does not affect the underlying match criteria configuration.

The **no** form of the command removes all the match criteria from the filter entry and sets the *protocol-id* of the match command to **none** (keyword). As per above, **match protocol none** is however not equivalent to **no match**.

Default **match next-header none**

Parameters **protocol** *protocol-id* **—** The **protocol** keyword configures an IP protocol to be used as an IP filter match criterion. The protocol type such as TCP or UDP is identified by its respective protocol number.

protocol-id — Configures the decimal value representing the IP protocol to be used as an IP filter match criterion. Well known protocol numbers include ICMP(1), TCP(6), UDP(17).

Default Value: none (keyword)

Values 0 to 255 in decimal format. Values can also be specified in hexadecimal format, in binary format, or using the following keywords:

none, **icmp**, **igmp**, **ip**, **tcp**, **egp**, **igp**, **udp**, **rdp**, **ipv6**, **ipv6-route**, **ipv6-frag**, **idrp**, **rsvp**, **gre**, **ipv6-icmp**, **ipv6-no-nxt**, **ipv6-opts**, i**so-ip**, **eigrp**, **ospf-igp**, **ether-ip**, **encap**, **pnni**, **pim**, **vrrp**, **l2tp**, **stp**, **ptp**, **isis**, **crtp**, **crudp**, **sctp**

***** — udp/tcp wildcard

Table 46 **Protocol ID Descriptions**

Protocol	Protocol ID	Description
icmp	1	Internet Control Message
igmp	2	Internet Group Management
ip	4	IP in IP (encapsulation)
tcp	6	Transmission Control
egp	8	Exterior Gateway Protocol
igp	9	Any private interior gateway (used by Cisco for IGRP)
udp	17	User Datagram
rdp	27	Reliable Data Protocol
ipv6	41	IPv6
ipv6-route	43	Routing Header for IPv6
ipv6-frag	44	Fragment Header for IPv6
idrp	45	Inter-Domain Routing Protocol
rsvp	46	Reservation Protocol
gre	47	General Routing Encapsulation
ipv6-icmp	58	ICMP for IPv6
ipv6-no-nxt	59	No Next Header for IPv6
ipv6-opts	60	Destination Options for IPv6
iso-ip	80	ISO Internet Protocol
eigrp	88	EIGRP

Table 46 **Protocol ID Descriptions (Continued)**

Protocol	Protocol ID	Description
ospf-igp	89	OSPFIGP
ether-ip	97	Ethernet-within-IP Encapsulation
encap	98	Encapsulation Header
pnni	102	PNNI over IP
pim	103	Protocol Independent Multicast
vrrp	112	Virtual Router Redundancy Protocol
l2tp	115	Layer Two Tunneling Protocol
stp	118	Spanning Tree Protocol
ptp	123	Performance Transparency Protocol
isis	124	ISIS over IPv4
crtp	126	Combat Radio Transport Protocol
crudp	127	Combat Radio User Datagram
sctp	132	Stream Control Transmission Protocol

match

Syntax **match** [**next-header** *next-header*]
no match

Context config>filter>ipv6-filter>entry

Description This command enables the context to enter match criteria for the filter entry. When the match criteria have been satisfied the action associated with the match criteria is executed.

A **match** context may consist of multiple match criteria, but multiple **match** statements cannot be entered per entry. More precisely, the command can be entered multiple times but this only results in modifying the *next-header*, and does not affect the underlying match criteria configuration.

The **no** form of the command removes all the match criteria from the filter entry and sets the *next-header* of the match command to **none** (keyword). As per above, **match next-header none** is however not equivalent to **no match**.

Default **match protocol none**

Parameters **next-header** *next-header* — specifies the IPv6 next header to match. This parameter is analogous to the protocol parameter used in IPv4 Filter match command.

Default Value: none (keyword)

Values [1 to 42 | 45 to 49 | 52 to 59 | 61 to 255] — in decimal format. Values can also be specified in hexadecimal format, in binary format, or using the following keywords:

none, **icmp**, **igmp**, **ip**, **tcp**, **egp**, **igp**, **udp**, **rdp**, **ipv6**, **idrp**, **rsvp**, **gre**, **ipv6-icmp**, **ipv6-no-nxt**, **iso-ip**, **eigrp**, **ospf-igp**, **ether-ip**, **encap**, **pnni**, **pim**, **vrrp**, **l2tp**, **stp**, **ptp**, **isis**, **crtp**, **crudp**, **sctp**

***** — udp/tcp wildcard

dscp

Syntax **dscp** *dscp-name*
no dscp

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures a DiffServ Code Point (DSCP) name to be used as an IP filter match criterion.

The **no** form of the command removes the DSCP match criterion.

Default **no dscp**

Parameters *dscp-name* — configures a DSCP name. The DiffServ code point may only be specified by its name.

Values be, ef, cp1, cp2, cp3, cp4, cp5, cp6, cp7, cp9, cs1, cs2, cs3, cs4, cs5, nc1, nc2, af11, af12, af13, af21, af22, af23, af31, af32, af33, af41, af42, af43, cp11, cp13, cp15, cp17, cp19, cp21, cp23, cp25, cp27, cp29, cp31, cp33, cp35, cp37, cp39, cp41, cp42, cp43, cp44, cp45, cp47, cp49, cp50, cp51, cp52, cp53, cp54, cp55, cp57, cp58, cp59, cp60, cp61, cp62, cp63

dst-ip

Syntax **IPv4: dst-ip** {*ip-address/mask* | *ip-address ipv4-address-mask* | **ip-prefix-list** *prefix-list-name*]}
no dst-ip
IPv6: dst-ip {*ipv6-address/prefix-length* | *ipv6-address ipv6-address-mask* | **ipv6-prefix-list** *prefix-list-name*}
no dst-ip

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures a destination address range to be used as a filter policy match criterion.

To match on the IPv4 or IPv6 destination address, specify the address and its associated mask, e.g., 10.1.0.0/16. The conventional notation of 10.1.0.0 255.255.0.0 can also be used for IPv4.

The **no** form of this command removes the destination IPv4 or IPv6 address match criterion.

Default **no dst-ip**

Parameters *ip-address* — specifies the destination IPv4 address in dotted decimal notation

Values a.b.c.d

mask — specifies the length in bits of the subnet mask

Values 1 to 32

ipv4-address-mask — specifies the subnet mask in dotted decimal notation

Values a.b.c.d (dotted quad equivalent of mask length)

ip-prefix-list or **ipv6-prefix-list** *prefix-list-name* — specifies to use a list of IP prefixes referred to by *prefix-list-name*, which is a string of up to 32 characters of printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

ipv6-address — the IPv6 prefix for the IP match criterion in hex digits

Values x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x: [0..FFFF]H
d: [0..255]D

prefix-length — the IPv6 prefix length for the specified *ipv6-address* expressed as a decimal integer

Values 1 to 128

ipv6-address-mask — eight 16-bit hexadecimal pieces representing bit match criteria

Values x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x: [0..FFFF]H
d: [0..255]D

dst-port

Syntax **dst-port** {**lt** | **gt** | **eq**} *dst-port-number*
dst-port port-list *port-list-name*
dst-port range *dst-port-number dst-port-number*
no dst-port

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures a destination TCP, UDP, or SCTP port number or port range for an IP filter match criterion. An entry containing Layer 4 non-zero match criteria will not match non-initial (2nd, 3rd, etc) fragments of a fragmented packet since only the first fragment contains the Layer 4 information. Similarly an entry containing "**dst-port eq** 0" match criterion, may match non-initial fragments when the destination port value is not present in a packet fragment and other match criteria are also met.

The **no** form of the command removes the destination port match criterion.

Default no dst-port

Parameters **lt | gt | eq —** specifies the operator to use relative to *dst-port-number* for specifying the port number match criteria

lt specifies all port numbers less than *dst-port-number* match.

gt specifies all port numbers greater than *dst-port-number* match.

eq specifies that *dst-port-number* must be an exact match.

dst-port-number — the destination port number to be used as a match criteria expressed as a decimal integer, as well as in hexadecimal or binary format. The following value is for decimal integer format only.

Values 0 to 65535

port-list *port-list-name* — specifies to use a list of ports referred to by *port-list-name*, which is a string of up to 32 characters of printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

range *dst-port-number dst-port-number* **—** specifies inclusive port range between two *dst-port-number* values

flow-label

Syntax **flow-label** *flow-label* [*mask*]
no flow-label

Context config>filter>ipv6-filter>entry>match

Description This command configures the flow-label and optional mask match condition.

The **no** form of the command reverts to the default.

Default no flow-label

Parameters *flow-label* — specifies the flow label to be used as a match criterion. Value can be expressed as a decimal integer, as well as in hexadecimal or binary format. The following value shows decimal integer format only.

Values 0 to 1048575

mask — specifies the flow label mask value for this policy IPv6 Filter entry. Value can be expressed as a decimal integer, as well as in hexadecimal or binary format. The following value shows decimal integer format only.

Values 0 to 1048575

fragment

Syntax

IPv4:
fragment {**true** | **false**}
no fragment
IPv6:
fragment {**true** | **false** | **first-only** | **non-first-only**}
no fragment

Context

config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description

This command specifies match criterion for fragmented packets.

The **no** form of the command removes the match criterion.

Default

no fragment

Parameters

true — specifies to match on all fragmented IP packets

false — specifies to match on all non-fragmented IP packets

first-only — Matches if a packet is an initial fragment of a fragmented IPv6 packet

non-first-only — Matches if a packet is a non-initial fragment of a fragmented IPv6 packet

ah-ext-hdr

Syntax

ah-ext-hdr {**true** | **false**}
no ah-ext-hdr

Context

config>filter>ipv6-filter>entry>match

Description

This command enables match on existence of AH Extension Header in the IPv6 filter policy.

The **no** form of this command ignores AH Extension Header presence/absence in a packet when evaluating match criteria of a given filter policy entry.

Default

no ah-ext-hdr

Parameters

true — matches a packet with an AH Extension Header

false — match a packet without an AH Extension Header

esp-ext-hdr

Syntax **esp-ext-hdr** {**true** | **false**}
no esp-ext-hdr

Context config>filter>ipv6-filter>entry>match

Description This command enables match on existence of ESP Extension Header in the IPv6 filter policy.

The **no** form of this command ignores ESP Extension Header presence/absence in a packet when evaluating match criteria of a given filter policy entry.

Default no esp-ext-hdr

Parameters **true** — matches a packet with an ESP Extension Header

false **—** match a packet without an ESP Extension Header

hop-by-hop-opt

Syntax **hop-by-hop-opt** {**true** | **false**}
no hop-by-hop-opt

Context config>filter>ipv6-filter>entry>match

Description This command enables match on existence of Hop-by-Hop Options Extension Header in the IPv6 filter policy.

The **no** form of this command ignores Hop-by-Hop Options Extension Header presence/absence in a packet when evaluating match criteria of a given filter policy entry.

Default no hop-by-hop-opt

Parameters **true —** matches a packet with a Hop-by-Hop Options Extension header

false — matches a packet without a Hop-by-Hop Options Extension header

icmp-code

Syntax **icmp-code** *icmp-code*
no icmp-code

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description Configures matching on ICMP/ICMPv6 code field in the ICMP/ICMPv6 header of an IPv4 or IPv6 packet as a filter match criterion. An entry containing Layer 4 non-zero match criteria will not match non-initial (2nd, 3rd, etc.) fragments of a fragmented packet since only the first fragment contains the Layer 4 information. Similarly an entry containing "**icmp-code** 0" match criterion, may match non-initial fragments when the Layer 4 header is not present in a packet fragment and other match criteria are also met.

The **no** form of the command removes the criterion from the match entry.

Default no icmp-code

Parameters *icmp-code* — the ICMP/ICMPv6 code value that must be present to match. Value can be expressed as a decimal integer, as well as in hexadecimal or binary format, or even using keywords. The following value shows decimal integer only.

Values 0 to 255

icmp-type

Syntax **icmp-type** *icmp-type*
no icmp-type

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures matching on the ICMP/ICMPv6 type field in the ICMP/ICMPv6 header of an IPv4 or IPv6 packet as a filter match criterion. An entry containing Layer 4 non-zero match criteria will not match non-initial (2nd, 3rd, etc.) fragments of a fragmented packet since only the first fragment contains the Layer 4 information. Similarly an entry containing "**icmp-type** 0" match criterion, may match non-initial fragments when the Layer 4 header is not present in a packet fragment and other match criteria are also met.

The **no** form of the command removes the criterion from the match entry.

Default no icmp-type

Parameters *icmp-type* — the ICMP/ICMPv6 type value that must be present to match. Value can be expressed as a decimal integer, as well as in hexadecimal or binary format, or even using keywords. The following value shows decimal integer only.

Values 0 to 255

ip-option

Syntax **ip-option** *ip-option-value* [*ip-option-mask*]
no ip-option

Context config>filter>ip-filter>entry>match

Description This command configures matching packets with a specific IP option or a range of IP options in the first option of the IP header as an IP filter match criterion.

The option-type octet contains 3 fields:

1 bit copied flag (copy options in all fragments)

2 bits option class

5 bits option number

The **no** form of the command removes the match criterion.

Default no ip-option

Parameters *ip-option-value* — enter the 8 bit option-type as a decimal integer, binary, or hexadecimal format. The mask is applied as an AND to the option byte, the result is compared with the option-value.

The decimal value entered for the match should be a combined value of the eight bit option type field and not just the option number. Thus to match on IP packets that contain the Router Alert option (option number = 20), enter the option type of 148 (10010100).

Values 0 to 255

ip-option-mask — optional parameter may be used when specifying a range of option numbers to use as the match criteria

This 8 bit mask can be configured using the following formats:

Table 47 **ip-option-mask Formats**

Format Style	Format Syntax	Example
Decimal	DDD	20
Hexadecimal	0xHH	0x14
Binary	0bBBBBBBBB	0b0010100

Default 255 (decimal) (exact match)

Values 1 to 255 (decimal)

multiple-option

Syntax **multiple-option** {**true** | **false**}
no multiple-option

Context config>filter>ip-filter>entry>match

Description This command configures matching packets that contain one or more than one option fields in the IP header as an IP filter match criterion.

The **no** form of the command removes the checking of the number of option fields in the IP header as a match criterion.

Default no multiple-option

Parameters **true —** specifies matching on IP packets that contain more than one option field in the header

false — specifies matching on IP packets that do not contain multiple option fields present in the header

option-present

Syntax **option-present** {**true** | **false**}
no option-present

Context config>filter>ip-filter>entry>match

Description This command configures matching packets that contain any IP options in the IP header as an IP filter match criterion.

The **no** form of the command removes the checking of IP options in the IP header as a match criterion.

Default no option-present

Parameters **true —** specifies matching on all IP packets that contain any IP options in the IP header. A match will occur for all packets that have any IP option present. An option field of zero is considered as no option present.

false — specifies matching on IP packets that do not have any IP option present in the IP header. (an option field of zero). An option field of zero is considered as no option present.

port

Syntax **port** {**lt** | **gt** | **eq**} *port-number*
port port-list *port-list-name*
port range *port-number port-number*
no port

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures a TCP/UDP/SCTP source or destination port match criterion in IPv4 and IPv6 CPM (SCTP not supported) and/or ACL filter policies. A packet matches this criterion if the packet TCP/UDP/SCTP (as configured by protocol/next-header match) source OR destination port matches either the specified port value or a port in the specified port range or port-list. .

Operational Note: This command is mutually exclusive with src-port and dst-port commands. Configuring "port eq 0", may match non-initial fragments where the source/ destination port values are not present in a packet fragment if other match criteria are also met.

The **no** form of this command deletes the specified port match criterion.

Default no port

Parameters **lt | gt | eq —** specifies the operator to use relative to *port-number* for specifying the port number match criteria

lt — specifies all port numbers less than *port-number* match

gt — specifies all port numbers greater than *port-number* match

eq — specifies that the *port-number* must be an exact match

port-number — specifies a source or destination port to be used as a match criterion. The port number can be expressed as a decimal integer, as well as in hexadecimal or binary format. The following value shows a decimal integer only.

Values 0 to 65535

port-list *port-list-name* **—** specifies an inclusive range of source or destination port values to be used as match criteria

range *port-number port-number* **—** specifies an inclusive range of source or destination port values to be used as match criteria

routing-type0

Syntax **routing-type0** {**true | false**}
no routing-type0

Context config>filter>ipv6-filter>entry>match

Description This command enables match on existence of Routing Type Extension Header type 0 in the IPv6 filter policy.

The **no** form of this command ignores Routing Type Extension Header type 0 presence/ absence in a packet when evaluating match criteria of a given filter policy entry.

Default no routing-type0

Parameters **true —** match if a packet contains Routing Type Extension Header type 0

false — match if a packet does not contain Routing Type Extension Header type 0

src-ip

Syntax **src-ip** {*ip-address/mask* | *ip-address ipv4-address-mask* | **ip-prefix-list** *prefix-list-name*}
src-ip {*ipv6-address/prefix-length* | *ipv6-address ipv6-address-mask* | **ipv6-prefix-list** *prefix-list-name*}
no src-ip

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures a source IPv4 or IPv6 address range to be used as an IP filter match criterion.

To match on the source IPv4 or IPv6 address, specify the address and its associated mask, for example, 10.1.0.0/16 for IPv4. The conventional notation of 10.1.0.0 255.255.0.0 may also be used for IPv4.

The **no** form of the command removes the source IP address match criterion.

Default no src-ip

Parameters *ip-address* — specifies the destination IPv4 address specified in dotted decimal notation

Values a.b.c.d

mask — specifies the length in bits of the subnet mask

Values 1 to 32

ipv4-address-mask — specifies the subnet mask in dotted decimal notation

Values a.b.c.d (dotted quad equivalent of mask length)

ip-prefix-list or **ipv6-prefix-list** *prefix-list-name* — specifies to use a list of IP prefixes referred to by prefix-list-name, which is a string of up to 32 characters of printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

ipv6-address — the IPv6 prefix for the IP match criterion in hex digits.

Values x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x: [0..FFFF]H
d: [0..255]D

prefix-length — the IPv6 prefix length for the specified *ipv6-address* expressed as a decimal integer.

Values 1 to 128

ipv6-address-mask — eight 16-bit hexadecimal pieces representing bit match criteria.

Values x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x: [0..FFFF]H
d: [0..255]D

src-port

Syntax **src-port** {**lt | gt | eq**} *src-port-number*
src-port port-list *port-list-name*
src-port range *src-port-number src-port-number*
no src-port

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures a source TCP, UDP, or SCTP port number, port range, or port match list for an IP filter match criterion. An entry containing Layer 4 non-zero match criteria will not match non-initial (2nd, 3rd, etc.) fragments of a fragmented packet since only the first fragment contains the Layer 4 information. Similarly an entry containing "**src-port eq** 0" match criterion, may match non-initial fragments when the source port value is not present in a packet fragment and other match criteria are also met.

The **no** form of the command removes the source port match criterion.

Default no src-port

Parameters **lt | gt | eq —** specifies the operator to use relative to *src-port-number* for specifying the port number match criteria

lt specifies all port numbers less than *src-port-number* match.

gt specifies all port numbers greater than *src-port-number* match.

eq specifies that *src-port-number* must be an exact match.

src-port-number — The source port number to be used as a match criteria expressed as a decimal integer, and in hexadecimal or binary format. Below shows decimal integer only.

Values 0 to 65535

port-list *port-list-name* — specifies to use a list of ports referred to by *port-list-name*, which is a string of up to 32 characters of printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

range *src-port-number src-port-number* **—** specifies inclusive port range between two src-port-number values.

src-route-option

Syntax **src-route-option** {**true** | **false**}
no source-route-option

Context config>filter>ip-filter>entry>match

Description This command enables source route option match conditions. When enabled, this filter should match if a (strict or loose) source route option is present/not present at any location within the IP header, as per the value of this object. The **no** form of the command removes the criterion from the match entry.

Default no src-route-option

Parameters **true —** enables source route option match conditions

false — disables source route option match conditions

tcp-ack

Syntax **tcp-ack** {**true** | **false**}
no tcp-ack

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures matching on the ACK bit being set or reset in the control bits of the TCP header of an IP packet as an IP filter match criterion. An entry containing Layer 4 non-zero match criteria will not match non-initial (2nd, 3rd, etc.) fragments of a fragmented packet since only the first fragment contains the Layer 4 information.

The **no** form of the command removes the criterion from the match entry.

Default no tcp-ack

Parameters **true —** specifies matching on IP packets that have the ACK bit set in the control bits of the TCP header of an IP packet

false — specifies matching on IP packets that do not have the ACK bit set in the control bits of the TCP header of the IP packet

tcp-syn

Syntax **tcp-syn** {**true** | **false**}
no tcp-syn

Context config>filter>ip-filter>entry>match
config>filter>ipv6-filter>entry>match

Description This command configures matching on the SYN bit being set or reset in the control bits of the TCP header of an IP packet as an IP filter match criterion. An entry containing Layer 4 non-zero match criteria will not match non-initial (2nd, 3rd, etc.) fragments of a fragmented packet since only the first fragment contains the Layer 4 information.

The SYN bit is normally set when the source of the packet wants to initiate a TCP session with the specified destination IP address.

The **no** form of the command removes the criterion from the match entry.

Default no tcp-syn

Parameters **true —** specifies matching on IP packets that have the SYN bit set in the control bits of the TCP header

false — specifies matching on IP packets that do not have the SYN bit set in the control bits of the TCP header

4.3.2.7 Match List Configuration Commands

match-list

Syntax **match-list**

Context config>filter

Description This command enables the configuration context for match lists to be used in filter policies (IOM/FP and CPM).

Default n/a

ip-prefix-list

Syntax **ip-prefix-list** *ip-prefix-list-name* [**create**]
no ip-prefix-list *ip-prefix-list-name*

Context config>filter>match-list

Description This command creates a list of IPv4 prefixes for match criteria in IPv4 ACL and CPM filter policies.

The **no** form of this command deletes the specified list.

Operational Notes:

An **ip-prefix-list** must contain only IPv4 address prefixes.

An IPv4 prefix match list cannot be deleted if it is referenced by a filter policy.

Please see general description related to match-list usage in filter policies.

Default n/a

Parameters *ip-prefix-list-name* — a string of up to 32 printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

ipv6-prefix-list

Syntax **ipv6-prefix-list** *ipv6-prefix-list-name* [**create**]
no ipv6-prefix-list *ipv6-prefix-list-name*

Context config>filter>match-list

Description This command creates a list of IPv6 prefixes for match criteria in ACL and CPM IPv6 filter policies.

The **no** form of this command deletes the specified list.

Operational Notes:

An **ipv6-prefix-list** must contain only IPv6 address prefixes.

An IPv6 prefix match list cannot be deleted if it is referenced by a filter policy.

Please see general description related to match-list usage in filter policies.

Default n/a

Parameters *ipv6-prefix-list-name* — a string of up to 32 printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

apply-path

Syntax **apply-path**
no apply-path

Context config>filter>match-list>ip-prefix-list
config>filter>match-list>ipv6-prefix-list

Description This command enables the context to configure auto-generation of address prefixes for IPv4 or IPv6 address prefix match lists. The context in which the command is executed governs whether IPv4 or IPv6 prefixes will be auto-generated.

The **no** form of this command removes all auto-generation configuration under the apply-path context.

Default no apply path

bgp-peers

Syntax **bgp-peers** *index* **group** *reg-exp* **neighbor** *reg-exp*
no bgp-peers *index*

Context config>filter>match-list>ip-prefix-list>apply-path
config>filter>match-list>ipv6-prefix-list>apply-path

Description This command configures auto-generation of IPv4 or IPv6 address prefixes (as required by the context the command is executed within) based on the base router BGP instance configuration.

The **no** form of this command removes the bgp-peers configuration for auto-generation of address prefixes for the specified index value.

Default No embedded filter policies are included in a filter policy.

Parameters **group** — configures a match against base router BGP instance group configuration.

Regex wildcard match (.*) can be used to match against any group.

neighbor — configures a match against base router BGP instance neighbor configuration

Regex wildcard match (.*) can be used to match against any neighbor.

index — An integer from 1 to 255 enumerating bgp-peers auto-generation configuration within this list.

reg-exp — regular expression defining a match string to be used to auto generate address prefixes. Matching is performed from the least significant digit. For example a string **10.0** matches all neighbors with addresses starting with **10**; like **10.0.x.x** or **10.0xx.x.x**.

port-list

Syntax **port-list** *port-list-name* [**create**]
no port-list *port-list-name*

Context config>filter>match-list

Description This command creates a list of TCP/UDP/SCTP port values or ranges for match criteria in IPv4 and IPv6 ACL and CPM filter policies.

The **no** form of this command deletes the specified list.

Operational notes:

SCTP port match is supported in ACL filter policies only.

A port-list must contain only TCP/UDP/SCTP port values or ranges.

A TCP/UDP/SCTP port match list cannot be deleted if it is referenced by a filter policy.

Please see general description related to match-list usage in filter policies.

Default By default no port list is created.

Parameters *port-list-name* — A string of up to 32 characters of printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

port

Syntax [**no**] **port** *port-number*
[**no**] **port range** *start end*

Context config>filter>match-list>port-list

Description This command adds a port or a range of ports to an existing port match list. The **no** form of this command deletes the specified port or range of ports form the list.

Default No port is in the list by default.

Parameters *port-number* — specifies the port number to add to the list. The port number can be expressed as a decimal integer, as well as in hexadecimal or binary format. Below shows decimal integer only.

Values 0 to 65535

range *start end* — specifies an inclusive port range between two port numbers values. The *start* of the range and *end* of the range can be expressed as decimal integers, as well as in hexadecimal or binary format. The following value shows decimal integer only.

Values 0 to 65535

prefix

Syntax [**no**] **prefix** *ipv6-prefix/prefix-length*

Context config>filter>match-list>ipv6-prefix-list

Description This command adds an IPv6 address prefix to an existing IPv6 address prefix match list.

The **no** form of this command deletes the specified prefix from the list.

Operational Notes:

To add set of different prefixes, execute the command with all unique prefixes. The prefixes are allowed to overlap IPv6 address space.

An IPv6 prefix addition will be blocked, if resource exhaustion is detected anywhere in the system because of filter policies that use this IPv6 address prefix list.

Default No prefixes are in the list by default

Parameters *ipv6-prefix* — an IPv6 address prefix written as hexadecimal numbers separated by colons with host bits set to 0. One string of zeros can be omitted so 1010::700:0:217A is equivalent to 1010:0:0:0:0:700:0:217A

Values x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x: [0..FFFF]H
d: [0..255]D

prefix-length — length of the entered IPv6 prefix

Values 1 to 128

prefix

Syntax [**no**] **prefix** *ip-prefix/prefix-length*

Context config>filter>match-list>ip-prefix-list

Description This command adds an IPv4 address prefix to an existing IPv4 address prefix match list.

The **no** form of this command deletes the specified prefix from the list.

Operational Notes:

To add set of unique prefixes, execute the command with all unique prefixes. The prefixes are allowed to overlap IPv4 address space.

An IPv4 prefix addition will be blocked, if resource exhaustion is detected anywhere in the system because of filter policies that use this IPv4 address prefix list.

Default No prefixes are in the list by default.

Parameters *ip-prefix* — a valid IPv4 address prefix in dotted decimal notation

Values 0.0.0.0 to 255.255.255.255 (host bit must be 0)

prefix-length — length of the entered IPv4 prefix

Values 0 to 32

4.3.2.8 MAC Filter Entry Commands

action

Syntax
drop
forward
forward esi *esi* **service-id** *vpls-service-id*
forward sap *sap-id*
forward sdp *sdp-id:vc-id*
http-redirect *url*
rate-limit *value*

Context
config>filter>mac-filter>entry
config>filter>mac-filter>entry>action

Description
The action command (under the **config**>**filter**>**mac-filter**>**entry** context) sets the context for specific action commands to be performed (under the **config**>**filter**>**mac-filter**>**entry**>**action** context) on packets matching this filter entry.

The following commands are available under the **config**>**filter**>**mac-filter**>**entry**>**action** context:

- **drop**
  A packet matching the entry will be dropped.
- **forward**
  A packet matching the entry will be forwarded using regular routing.
- **forward esi service-id**
  A packet matching the entry will be forwarded to an ESI identified first appliance in Nuage service chain using EVPN-resolved VXLAN tunnel in the specified VPLS service.
- **forward sap**
  A packet matching the entry will be forwarded using the configured SAP.
- **forward sdp**
  A packet matching the entry will be forwarded using the configured SDP.
- **http-redirect**
  Unsupported
- **rate-limit**
  Enables ACL rate limiting for packets matching the entry of this ACL filter policy. Rate limiters are configured by default with MBS = CBS = 10-ms-of-the-rate and high-prio-only = 0.

Default
no specific action is configured by default

Parameters
esi — specifies a 10-Byte Ethernet Segment Identifier

sap-id — specifies an existing VPLS Ethernet SAP *sdp-id:vc-id* — specifies an existing VPLS SDP

url — specifies the HTTP web address that will be sent to the user's browser

value — specifies the rate-limit value in Kbits per second. A rate of 0 results in all traffic being dropped. A rate of **max** results in all traffic being forwarded.

Values 0 to 2000000000 **|** max

vpls-service-id — specifies an existing VPLS service ID or service name

match

Syntax **match** [**frame-type** {**802dot3 | 802dot2-llc | 802dot2-snap | ethernet_II**}]
no match

Context config>filter>mac-filter>entry

Description This command creates the context for entering/editing match criteria for the filter entry and specifies an Ethernet frame type for the entry.

A **match** context may consist of multiple match criteria, but multiple **match** statements cannot be entered per entry.

The **no** form of the command removes the match criteria for the *entry-id*.

Default n/a

Parameters **frame-type** *keyword* **—** The **frame-type** keyword configures an Ethernet frame type to be used for the MAC filter match criteria.

Default **802dot3**

Values 802dot3, 802dot2-llc, 802dot2-snap, ethernet_II

802dot3 — specifies the frame type is Ethernet IEEE 802.3

802dot2-llc — specifies the frame type is Ethernet IEEE 802.2 LLC

802dot2-snap — specifies the frame type is Ethernet IEEE 802.2 SNAP

ethernet_II — specifies the frame type is Ethernet Type II

4.3.2.9 MAC Filter Match Criteria

dot1p

Syntax **dot1p** *dot1p-value* [*dot1p-mask*]
no dot1p

Context config>filter>mac-filter>entry>match

Description Configures an IEEE 802.1p value or range to be used as a MAC filter match criterion.

When a frame is missing the 802.1p bits, specifying an dot1p match criterion will fail for the frame and result in a non-match for the MAC filter entry.

The **no** form of the command removes the criterion from the match entry.

Egress **dot1p** value matching will only match if the customer payload contains the 802.1p bits. For example, if a packet ingresses on a null encapsulated SAP and the customer packet is IEEE 802.1Q or 802.1p tagged, the 802.1p bits will be present for a match evaluation. On the other hand, if a customer tagged frame is received on a dot1p encapsulated SAP, the tag will be stripped on ingress and there will be no 802.1p bits for a MAC filter match evaluation; in this case, any filter entry with a dot1p match criterion specified will fail.

Default no dot1p

Parameters *dot1p-value* — the IEEE 802.1p value in decimal

Values 0 to 7

dot1p-mask — a 3-bit mask that can be configured using the decimal integer, hexadecimal or binary format

Table 48 **dot1p-mask Formats**

Format Style	Format Syntax	Example
Decimal	D	4
Hexadecimal	0xH	0x4
Binary	0bBBB	0b100

To select a range from 4 up to 7 specify *dot1p-value* of 4 and a *dot1p-mask* of 0b100 for value and mask.

Default **7 (decimal)**

Values 1 to 7 (decimal)

dsap

Syntax **dsap** *dsap-value* [*dsap-mask*]
no dsap

Context config>filter>mac-filter>entry>match

Description Configures an Ethernet 802.2 LLC DSAP value or range for a MAC filter match criterion.

This is a one-byte field that is part of the 802.2 LLC header of the IEEE 802.3 Ethernet Frame.

The snap-pid field, etype field, ssap and dsap fields are mutually exclusive and may not be part of the same match criteria.

Use the **no** form of the command to remove the dsap value as the match criterion.

Default no dsap

Parameters *dsap-value* — the 8-bit dsap match criteria value. Can be expressed in decimal integer, hexadecimal or binary format

Values 0 to 255

dsap-mask — optional parameter that may be used when specifying a range of dsap values to use as the match criteria

This 8 bit mask can be configured using the decimal integer, hexadecimal or binary formats described in Table 49.

Table 49 **dsap-mask Formats**

Format Style	Format Syntax	Example
Decimal	DDD	240
Hexadecimal	0xHH	0xF0
Binary	0bBBBBBBBB	0b11110000

Default **255 (exact match)**

0x00 to 0xFF

Values 0 to 255

dst-mac

Syntax **dst-mac** *ieee-address* [*ieee-address-mask*]
no dst-mac

Context config>filter>mac-filter>entry>match

Description Configures a destination MAC address or range to be used as a MAC filter match criterion.

The **no** form of the command removes the destination mac address as the match criterion.

Default no dst-mac

Parameters *ieee-address* — The MAC address to be used as a match criterion.

Values HH:HH:HH:HH:HH:HH or HH-HH-HH-HH-HH-HH where H is a hexadecimal digit. Note that both upper and lower case are supported.

ieee-address-mask — a 48-bit mask to match a range of MAC address values

To configure so that all packets with a destination MAC OUI value of 00:03:FA are subject to a match condition then the entry should be specified as: 00:03:FA:00:00:00 FF:FF:FF:00:00:00

Default **ff:ff:ff:ff:ff:ff (exact match)**

Values HH:HH:HH:HH:HH:HH or HH-HH-HH-HH-HH-HH

where H is a hexadecimal digit. to 0xFFFFFFFFFFFF

Note that both upper and lower case are supported.

etype

Syntax **etype** *0x0600..0xffff*
no etype

Context config>filter>mac-filter>entry>match

Description Configures an Ethernet type II Ethertype value to be used as a MAC filter match criterion.

The Ethernet type field is a two-byte field used to identify the protocol carried by the Ethernet frame. For example, 0800 is used to identify the IPv4 packets.

The Ethernet type field is used by the Ethernet version-II frames. IEEE 802.3 Ethernet frames do not use the type field. For IEEE 802.3 frames, use the dsap, ssap or snap-pid fields as match criteria.

The snap-pid field, etype field, ssap and dsap fields are mutually exclusive and may not be part of the same match criteria.

The **no** form of the command removes the previously entered etype field as the match criteria.

Default no etype

Parameters *0x0600..0xffff* — the Ethernet type II frame Ethertype value to be used as a match criterion expressed in decimal integer or hexadecimal format

Values 1536 to 65535 or 0x0600 to 0xFFFF

isid

Syntax **isid** *value* [**to** *higher-value*]

no isid

Context config>filter>mac-filter>entry>match

Description This command configures an ISID value or a range of ISID values to be matched by the mac-filter parent. The pbb-etype value for the related SAP (inherited from the ethernet port configuration) or for the related SDP binding (inherited from SDP configuration) will be used to identify the ISID tag.

The **no** form of this command removes the ISID match criterion.

Default no isid

Parameters *value* — specifies the ISID value, 24 bits as a decimal integer. When just one present identifies a particular ISID to be used for matching.

Values 0 to 16777215

to *higher-value* — Identifies a range of ISIDs to be used as matching criteria.

inner-tag

Syntax **inner-tag** *value* [*vid-mask*]
no inner-tag

Context config>filter>mac-filter>entry>match

Description This command configures the matching of the second tag that is carried transparently through the service. The inner-tag on ingress is the second tag on the frame if there are no service delimiting tags. Inner tag is the second tag before any service delimiting tags on egress but is dependent in the ingress configuration and may be set to 0 even in cases where additional tags are on the frame. This allows matching VLAN tags for explicit filtering or QoS setting when using default or null encapsulations.

The inner-tag is not applicable in ingress on dot1Q SAPs. The inner-tag may be populated on egress depending on the ingress SAP type.

On QinQ SAPs of null and default that do not strip tags inner-tag will contain the second tag (which is still the second tag carried transparently through the service.) On ingress SAPs that strip any tags, inner-tag will contain 0 even if there are more than 2 tags on the frame.

The optional *vid-mask* is defaulted to 4095 (exact match) but may be specified to allow pattern matching. The masking operation is ((value and vid-mask) = = (tag and vid-mask)). A value of 6 and a mask of 7 would match all VIDs with the lower 3 bits set to 6.

For QoS the VID type cannot be specified on the default QoS policy.

The default vid-mask is set to 4095 for exact match.

Default no inner-tag

outer-tag

Syntax **outer-tag** *value* [*vid-mask*]
no outer-tag

Context config>filter>mac-filter>entry>match

Description This command configures the matching of the first tag that is carried transparently through the service. Service delimiting tags are stripped from the frame and outer tag on ingress is the first tag after any service delimiting tags. Outer tag is the first tag before any service delimiting tags on egress. This allows matching VLAN tags for explicit filtering or QoS setting when using default or null encapsulations.

On dot1Q SAPs outer-tag is the only tag that can be matched. On dot1Q SAPs with exact match (sap 2/1/1:50) the outer-tag will be populated with the next tag that is carried transparently through the service or 0 if there is no additional VLAN tags on the frame.

On QinQ SAPs that strip a single service delimiting tag, outer-tag will contain the next tag (which is still the first tag carried transparently through the service.) On SAPs with two service delimiting tags (two tags stripped) outer-tag will contain 0 even if there are more than 2 tags on the frame.

The optional *vid-mask* is defaulted to 4095 (exact match) but may be specified to allow pattern matching. The masking operation is ((value & vid-mask) = = (tag & vid-mask)). A value of 6 and a mask of 7 would match all VIDs with the lower 3 bits set to 6.

For QoS the VID type cannot be specified on the default QoS policy.

The default vid-mask is set to 4095 for exact match.

Default no outer-tag

snap-oui

Syntax **snap-oui** {**zero** | **non-zero**}
no snap-oui

Context config>filter>mac-filter>entry>match

Description This command configures an IEEE 802.3 LLC SNAP Ethernet Frame OUI zero or non-zero value to be used as a MAC filter match criterion.

The **no** form of the command removes the criterion from the match criteria.

Default no snap-oui

Parameters **zero —** specifies to match packets with the three-byte OUI field in the SNAP-ID set to zero

non-zero — specifies to match packets with the three-byte OUI field in the SNAP-ID not set to zero

snap-pid

Syntax **snap-pid** *snap-pid*
no snap-pid

Context config>filter>mac-filter>entry>match

Description Configures an IEEE 802.3 LLC SNAP Ethernet Frame PID value to be used as a MAC filter match criterion.

This is a two-byte protocol id that is part of the IEEE 802.3 LLC SNAP Ethernet Frame that follows the three-byte OUI field.

The snap-pid field, etype field, ssap and dsap fields are mutually exclusive and may not be part of the same match criteria.

The snap-pid match criterion is independent of the OUI field within the SNAP header. Two packets with different three-byte OUI fields but the same PID field will both match the same filter entry based on a snap-pid match criteria.

The **no** form of the command removes the snap-pid value as the match criteria.

Default no snap-pid

Parameters *snap-pid* — the two-byte snap-pid value to be used as a match criterion. The value can be expressed in decimal integer or hexadecimal format.

Values 0 to 65535 or 0x0000 to 0xFFFF

src-mac

Syntax **src-mac** *ieee-address* [*ieee-address-mask*]
no src-mac

Context config>filter>mac-filter>entry>match

Description Configures a source MAC address or range to be used as a MAC filter match criterion.

The **no** form of the command removes the source mac as the match criteria.

Default no src-mac

Parameters *ieee-address* — The 48-bit IEEE mac address to be used as a match criterion.

Values HH:HH:HH:HH:HH:HH or HH-HH-HH-HH-HH-HH where H is a hexadecimal digit; both upper and lower case are supported.

ieee-address-mask — a 48-bit mask to match a range of MAC address values.

To configure so that all packets with a source MAC OUI value of 00:03:FA are subject to a match condition then the entry should be specified as: 00:03:FA:00:00:00 FF:FF:FF:00:00:00

Default ff:ff:ff:ff:ff:ff (exact match)

Values HH:HH:HH:HH:HH:HH or HH-HH-HH-HH-HH-HH where H is an hexadecimal digit; both upper and lower case are supported.

ssap

Syntax **ssap** *ssap-value* [*ssap-mask*]
no ssap

Context config>filter>mac-filter>entry>match

Description This command configures an Ethernet 802.2 LLC SSAP value or range for a MAC filter match criterion.

This is a one-byte field that is part of the 802.2 LLC header of the IEEE 802.3 Ethernet Frame.

The snap-pid field, etype field, ssap and dsap fields are mutually exclusive and may not be part of the same match criteria.

The **no** form of the command removes the ssap match criterion.

Default no ssap

Parameters *ssap-value* — the 8-bit ssap match criteria value in decimal, hexadecimal or binary

Values 0 to 255

ssap-mask — optional parameter that may be used when specifying a range of ssap values to use as the match criteria

This 8 bit mask and the ssap value can be configured as described in Table 50.

Table 50 **8-bit Mask Syntax**

Format Style	Format Syntax	Example
Decimal	DDD	240
Hexadecimal	0xHH	0xF0
Binary	0bBBBBBBBB	0b11110000

Default none

Values 0 to 255

4.3.2.10 Policy and Entry Maintenance Commands

copy

Syntax **copy ip-filter** *src-filter-id* [**src-entry** *src-entry-id*] **to** *dst-filter-id* [**dst-entry** *dst-entry-id*] [**overwrite**]
copy ipv6-filter *src-filter-id* [**src-entry** *src-entry-id*] **to** *dst-filter-id* [**dst-entry** *dst-entry-id*] [**overwrite**]
copy mac-filter *src-filter-id* [**src-entry** *src-entry-id*] **to** *dst-filter-id* [**dst-entry** *dst-entry-id*] [**overwrite**]

Context config>filter

Description This command copies existing filter list entries for a specific filter ID to another filter ID. The **copy** command is a configuration level maintenance tool used to create new filters using existing filters. It also allows bulk modifications to an existing policy with the use of the **overwrite** keyword.
If **overwrite** is not specified, an error will occur if the destination policy ID exists.

Default n/a

Parameters **ip-filter —** keyword indicates that the *src-filter-id* and the *dst-filter-id* are IPv4 filter IDs

ipv6-filter — keyword indicates that the *src-filter-id* and the *dst-filter-id* are IPv6 filter IDs

mac-filter — keyword indicates that the *src-filter-id* and the *dst-filter-id* are MAC filter IDs

src-filter-id — identifies the source filter policy from which the copy command will attempt to copy. The filter policy must exist within the context of the preceding keyword (**ip-filter**, **ipv6-filter** or **mac-filter**).

dst-filter-id — identifies the destination filter policy to which the copy command will attempt to copy. If the **overwrite** keyword does not follow, the filter policy ID cannot already exist within the system for the filter type the copy command is issued for. If the **overwrite** keyword is present, the destination policy ID may or may not exist.

overwrite — the keyword specifies that the destination filter ID may exist. If it does, everything in the existing destination filter ID will be completely overwritten with the contents of the source filter ID. If the destination filter ID exists, either **overwrite** must be specified or an error message will be returned. If **overwrite** is specified, the function of copying from source to destination occurs in a ‘break before make’ manner and therefore should be handled with care.

renum

Syntax **renum** *old-entry-id new-entry-id*

Context config>filter>ip-filter
config>filter>ipv6-filter

config>filter>mac-filter

Description This command renumbers existing MAC or IPv4/IPv6 filter entries to properly sequence filter entries.

This may be required in some cases since the OS exits when the first match is found and executes the actions according to the accompanying action command. This requires that entries be sequenced correctly from most to least explicit.

Default n/a

Parameters *old-entry-id* — enter the entry number of an existing entry, as a decimal integer.

Values 1 to 65535

new-entry-id — enter the new entry-number to be assigned to the old entry, as a decimal integer.

Values 1 to 65535

4.3.2.11 Redirect Policy Commands

destination

Syntax **destination** *ip-address* [**create**]
no destination *ip-address*

Context config>filter>redirect-policy

Description This command defines a destination in a redirect policy. More than one destination can be configured. Whether a destination IPv4/IPv6 address will receive redirected packets depends on the effective priority value after evaluation.

The most preferred destination is programmed in hardware as action forward next-hop. If all destinations are down (as determined by the supported tests), action forward is programmed in hardware. All destinations within a given policy must be either IPv4 or (exclusive) IPv6. The redirect policy with IPv4 destinations configured can only be used by IPv4 filter policies. The redirect policy with IPv6 destinations configured can only be used by IPv6 filter policies.

Default **no destination**

Parameters *ip-address* — specifies the IPv4 address (in dotted decimal notation) or IPv6 address to send the redirected traffic to

Values IPv4 address: ip-address: a.b.c.d
IPv6-address: x:x:x:x:x:x:x:x (eight 16-bit pieces)
x:x:x:x:x:x:d.d.d.d
x: [0..FFFF]H
d: [0..255]D

sticky-dest

Syntax **sticky-dest no-hold-time-up**
sticky-dest *hold-time-up*
no sticky-dest

Context config>filter>redirect-policy

Description This command configures sticky destination behavior for redirect policy. When enabled, the active destination is not changed to a new better destination, unless the active destination goes down or manual switch is forced using the **tools>perform>filter>redirect-policy>activate-best-dest** command.

The *hold-time-up* parameter allows the operator to delay programming of the PBR to the most-preferred destination for a specified amount of time when the first destination comes up (action forward remains in place). When the first destination comes up, the timer is started and upon the expiry, the current most-preferred destination is selected (which may differ from the one that triggered the timer to start) and programmed as a sticky PBR destination. Changing the value of the timer, while the timer is running takes immediate effect.

The **no** form of the command disables sticky destination behavior.

Default no sticky-dest

Parameters *hold-time-up* — Initial delay in seconds.

Values 0 to 65535
where 0 is equivalent to **no-hold-time-up**

ping-test

Syntax [**no**] **ping-test**

Context config>filter>redirect-policy>dest

Description This command configures parameters to perform connectivity ping tests to validate the ability for the destination to receive redirected traffic.

Default no ping-test

drop-count

Syntax **drop-count** *consecutive-failures* [**hold-down** *seconds*]
no drop-count

Context config>filter>redirect-policy>dest>ping-test
config>filter>redirect-policy>dest>snmp-test
config>filter>redirect-policy>dest>url-test

Description This command specifies the number of consecutive requests that must fail for the destination to be declared unreachable and the time to hold destination unreachable before repeating tests.

Default **drop-count** 3 **hold-down** 0

Parameters *consecutive-failures* — specifies the number of consecutive ping test failures before declaring the destination down

Values 1 to 60

hold-down *seconds* **—** The amount of time, in seconds, that the system should be held down if any of the test has marked it unreachable.

Values 0 to 86400

interval

Syntax **interval** *seconds*
no interval

Context config>filter>redirect-policy>dest>ping-test
config>filter>redirect-policy>dest>snmp-test
config>filter>redirect-policy>dest>url-test

Description This command specifies the amount of time, in seconds, between consecutive requests sent to the far end host.

Default interval 1

Parameters *seconds* — specifies the amount of time, in seconds, between consecutive requests sent to the far end host

Values 1 to 60

timeout

Syntax **timeout** *seconds*
no timeout

Context config>filter>redirect-policy>dest>ping-test
config>filter>redirect-policy>dest>snmp-test
config>filter>redirect-policy>dest>url-test

Description Specifies the amount of time, in seconds, that is allowed for receiving a response from the far-end host. If a reply is not received within this time the far-end host is considered unresponsive.

Default timeout 1

Parameters *seconds* — specifies the amount of time, in seconds, that is allowed for receiving a response from the far end host

Values 1 to 60

priority

Syntax **priority** *priority*
no priority

Context config>filter>redirect-policy>dest

Description Redirect policies can contain multiple destinations. Each destination is assigned an initial or base **priority** which describes its relative importance within the policy.

Default priority 100

Parameters *priority* — the priority, expressed as a decimal integer, used to weigh the destination's relative importance within the policy

Values 1 to 255

snmp-test

Syntax **snmp-test** *test-name*
no snmp-test *test-name*

Context config>filter>redirect-policy>dest

Description This command enables the context to configure SNMP test parameters.

Default n/a

Parameters *test-name* — specifies the name of the SNMP test. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

oid

Syntax **oid** *oid-string* **community** *community-string*
no oid

Context config>filter>redirect-policy>dest>snmp-test

Description This command specifies the OID of the object to be fetched from the destination.

Default no oid

Parameters *oid-string* — specifies the object identifier (OID) in the OID field

community *community-string* **—** The SNMP v2 community string or the SNMP v3 context name used to conduct this SNMP test.

return-value

Syntax **return-value** *return-value* **type** *return-type* [**disable** | **lower-priority** *priority* | **raise-priority** *priority*]
no return-value *return-value* **type** *return-type*

Context config>filter>redirect-policy>dest>snmp-test

Description This command specifies the criterion to adjust the priority based on the test result. Multiple criteria can be specified with the condition that they are not conflicting or overlap. If the returned value is within the specified range, the priority can be disabled, lowered or raised.

Default n/a

Parameters *return-value* — specifies the SNMP value against which the test result is matched

Values A maximum of 256 characters.

type *return-type* — specifies the SNMP object type against which the test result is matched

Values integer, unsigned, string, ip-address, counter, time-ticks, opaque

disable — The keyword that specifies that the destination may not be used for the amount of time specified in the hold-time command when the test result matches the criterion.

lower-priority *priority* **—** specifies the amount to lower the priority of the destination

Values 1 to 255

raise-priority *priority* **—** specifies the amount to raise the priority of the destination

Values 1 to 255

unicast-rt-test

Syntax **unicast-rt-test**
no unicast-rt-test

Context config>filter>redirect-policy>dest

Description This command configures a unicast route test for this destination. A destination is eligible for redirect if a valid unicast route to that destination exists in the routing instance specified by **config>filter>redirect-policy>router**. The unicast route test is mutually exclusive with other redirect-policy test types.

The test cannot be configured if **no router** is configured for this redirect policy.

The **no** form of the command disables the test.

Default no unicast-rt-test

url-test

Syntax **url-test** *test-name*
no url-test *test-name*

Context config>filter>redirect-policy>dest

Description The context to enable URL test parameters. IP filters can be used to selectively cache some web sites.

Default n/a

Parameters *test-name* **—** The name of the URL test. Allowed values are any string up to 32 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

return-code

Syntax **return-code** *return-code-1* [*return-code-2*] [**disable** | **lower-priority** *priority* | **raise-priority** *priority*]
no return-code *return-code-1* [*return-code-2*]

Context config>filter>redirect-policy>dest>url-test

Description Return codes are returned when the URL test is performed. Values for the specified range are the return codes which can be given back to the system as a result of the test been performed.

For example, error code 401 for HTTP is “page not found.” If, while performing this test, the URL is not reachable, you can lower the priority by 10 points so that other means of reaching this destination are prioritized higher than the older one.

Default n/a

Parameters *return-code-1, return-code-2* — specifies a range of return codes. When the URL test return-code falls within the specified range, the corresponding action is performed.

Values *return-code-1*: 1 to 4294967294
return-code-2: 2 to 4294967295

disable **—** specifies that the destination may not be used for the amount of time specified in the hold-time command when the return code falls within the specified range

lower-priority *priority* **—** specifies the amount to lower the priority of the destination when the return code falls within the specified range

raise-priority *priority* **—** specifies the amount to raise the priority of the destination when the return code falls within the specified range

url

Syntax **url** *url-string* [**http-version** *version-string*]
no url

Context config>filter>redirect-policy>dest>url-test

Description This command specifies the URL to be probed by the URL test.

Default n/a

Parameters *url-string* — Specify a URL up to 255 characters in length.

http-version *version-string* **—** specifies the HTTP version, 80 characters in length

router

Syntax **router** *router-instance*
router service-name *service-name*
no router

Context config>filter>redirect-policy

Description This command enhances VRF support in redirect policies. When a router instance is specified, the configured destination tests are run in the specified router instance, and the PBR action is executed in the specified router instance. If no destination is active or if the hardware does not support PBR action “next-hop router”, action forward will be executed (i.e. routing will be performed in the context of the incoming interface routing instance).

The **no** form of the command preserves backward-compatibility. Tests always run in the “Base” routing instance context, and the PBR action executes in the routing context of the ingress interface that the filter using this redirect policy is deployed on.

Default no router

Parameters *router-instance* — specifies a router instance in the form of **router-name** or **service-id**

Values **router-name** — Base
service-id — an existing Layer 3 service [1 to 2147483647]

service-name **—** specifies the name of a configured Layer 3 service

shutdown

Syntax [**no**] **shutdown**

Context config>filter>redirect-policy
config>filter>redirect-policy>destination

Description Administratively enables/disabled (AdminUp/AdminDown) an entity. Downing an entity does not change, reset or remove any configuration settings or statistics. Many objects must be shutdown before they may be deleted.

The **shutdown** command administratively downs an entity. Administratively downing an entity changes the operational state of the entity to down.

Unlike other commands and parameters where the default state will not be indicated in the configuration file, **shutdown** and **no shutdown** are always indicated in system generated configuration files.

The **no** form of the command puts an entity into the administratively enabled state.

Default no shutdown

4.4 Configuring Filter Policies with CLI

This section provides information to configure filter policies using the command line interface.

Topics in this section include:

- Common Configuration Tasks
  - Creating an IPv4 Filter Policy
  - Creating an IPv6 Filter Policy
  - Creating a MAC Filter Policy
  - Creating a Match List for Filter Policies
  - Applying Filter Policies
  - Creating a Redirect Policy
- Filter Management Tasks
  - Renumbering Filter Policy Entries
  - Modifying a Filter Policy
  - Deleting a Filter Policy
  - Modifying a Redirect Policy
  - Deleting a Redirect Policy
  - Copying Filter Policies

4.5 Common Configuration Tasks

This section provides a brief overview of the tasks that must be performed for both IP and MAC filter configurations and provides the CLI commands.

To configure a filter policy, perform the following tasks:

- Creating an IPv4 Filter Policy
- Creating an IPv6 Filter Policy
- Creating a MAC Filter Policy
- Creating a Match List for Filter Policies
- Applying Filter Policies
- Creating a Redirect Policy

4.5.1 Creating an IPv4 Filter Policy

Configuring and applying filter policies is optional. Each filter policy must have the following:

- The filter type specified (IP)
- A filter policy ID
- A default action, either drop or forward
- Filter policy scope specified, either *exclusive* or *template*
- At least one filter entry with matching criteria specified
- Optionally, an existing filter policy can have a Filter Name assigned, that can then be used in CLI to reference that filter policy including assigning it to SAPs and/or network interfaces.

4.5.1.1 IPv4 Filter Entry

Within a filter policy, configure filter entries which contain criteria against which ingress, egress, or network traffic is matched. The action specified in the entry determine how the packets are handled, such as dropping or forwarding.

- Enter a filter entry ID. The system does not dynamically assign a value.
- Assign an action.
- Specify matching criteria.

The following displays an IPv4 filter entry configuration example.

```
A:ALA-7>config>filter>ip-filter# info
----------------------------------------------
            description "filter-main"
            scope exclusive
            entry 10 create
                description "no-91"
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.0.100/24
                exit
                no action
            exit
----------------------------------------------
A:ALA-7>config>filter>ip-filter#
```

4.5.1.1.1 Configuring the HTTP-Redirect Option

If http-redirect is specified as an action, a corresponding forward entry must be specified before the redirect. Http-redirect is not supported on the 7450 ESS-1 model.

The following displays an http-redirect configuration example:

```
A:ALA-48>config>filter>ip-filter# info
----------------------------------------------
            description "Captive Portal Filter"
            scope template
            entry 10 create
                description "Allow DNS"
                match protocol udp
                    dst-port eq 53
                exit
                action forward
            exit
            entry 20 create
                description "Allow Captive Portal"
                match protocol tcp
                    dst-ip 100.0.0.2/32
                    dst-port eq 80
                exit
                action forward
            exit
            entry 30 create
                description "HTTP Redirect to Captive Portal"
                match protocol tcp
                    dst-port eq 80
                exit
                action http-redirect "http://100.0.0.2/login.cgi?mac=$MAC$sap=$S
AP&ip=$IP&orig_url=$URL"
            exit
----------------------------------------------
A:ALA-48>config>filter>ip-filter#
```

4.5.1.1.2 Cflowd Filter Sampling

Within a filter entry, you can specify that traffic matching the associated IPv4 filter entry is sampled. if the IPv4 interface is set to cflowd acl mode. Enabling filter-sample enables the cflowd tool.

The following displays an IPv4 filter entry configuration example.

```
A:ALA-7>config>filter>ip-filter# info
----------------------------------------------
            description "filter-main"
            scope exclusive
            entry 10 create
                description "no-91"
                filter-sample
```

```
                interface-disable-sample
                match
                exit
                action forward redirect-policy redirect1
            exit
----------------------------------------------
A:ALA-7>config>filter>ip-filter#
```

Within a filter entry, you can also specify that traffic matching the associated IPv4 filter entry is not sampled by cflowd if the IPv4 interface is set to cflowd interface mode. The following displays an IPv4 filter entry configuration example:

```
A:ALA-7>config>filter>ip-filter# info
----------------------------------------------
            description "filter-main"
            scope exclusive
            entry 10 create
                description "no-91"
                no filter-sample
                no interface-disable-sample
                match
                exit
                action forward redirect-policy redirect1
            exit
----------------------------------------------
A:ALA-7>config>filter>ip-filter#
```

4.5.2 Creating an IPv6 Filter Policy

Configuring and applying IPv6 filter policies is optional. IPv6 Filter Policy must be configured separately from IP (IPv4) filter policy. The configuration mimics IP Filter policy configuration. Please see Creating an IPv4 Filter Policy.

4.5.3 Creating a MAC Filter Policy

Configuring and applying filter policies is optional. Each filter policy must have the following:

- The filter policy type specified (MAC normal, MAC isid, MAC vid).
- A filter policy ID.
- A default action, either drop or forward.
- Filter policy scope, either *exclusive* or *template.*
- At least one filter entry, with a match criterion defined.

4.5.3.1 MAC Filter Policy

The following example displays a MAC filter policy configuration:

```
A:ALA-7>config>filter# info
----------------------------------------------
...
        mac-filter 90 create
            description "filter-west"
            scope exclusive
            type normal
        exit
----------------------------------------------
A:ALA-7>config>filter#
```

4.5.3.2 MAC ISID Filter Policy

The following example displays an ISID filter configuration:

```
A;ALA-7>config>filter# info
----------------------------------------------
mac-filter 90 create
     description "filter-wan-man"
     scope template
     type isid
     entry 1 create
          description "drop-local-isids"
          match
               isid 100 to 1000
          exit
          action drop
     exit
     entry 2 create
          description "allow-wan-isids"
          match
               isid 150
          exit
          action forward
     exit
```

4.5.3.3 MAC VID Filter Policy

The following example displays a VID filter configuration:

```
A:TOP_NODE>config>filter>mac-filter# info
----------------------------------------------
      default-action forward
      type vic
      entry 1 create
         match frame-type ethernet_II
```

```
              ouiter-tag 85 4095
            exit
            action drop
         exit
         entry 2 create
            match frame-type ethernet_II
              ouiter-tag 43 4095
            exit
            action drop
         exit
----------------------------------------------
A:TOP_NODE>config>filter>mac-filter#
```

4.5.3.4 MAC Filter Entry

Within a filter policy, configure filter entries which contain criteria against which ingress, egress, or network traffic is matched. The action specified in the entry determine how the packets are handled, such as dropping or forwarding.

- Enter a filter entry ID. The system does not dynamically assign a value.
- Assign an action.
- Specify matching criteria.

The following displays a MAC filter entry configuration example:

```
A:sim1>config>filter# info
----------------------------------------------
        mac-filter 90 create
            entry 1 create
                description "allow-104"
                match
                exit
                action drop
            exit
        exit
----------------------------------------------
A:sim1>config>filter#
```

4.5.4 Creating a Match List for Filter Policies

IP filter policies support usage of match lists as a single match criteria. To create a match list you must:

- Specify a type of a match list (IPv4 address prefix for example).
- Define a unique match list name (IPv4PrefixBlacklist for example).
- Specify at least one list argument (a valid IPv4 address prefix for example).

Optionally a description can also be defined.

The following example displays an IPv4 address prefix list configuration and its usage in an IPv4 filter policy:

```
*A:ala-48>config>filter# info
----------------------------------------------
      match-list
        ip-prefix-list "IPv4PrefixBlacklist"
           description "default IPv4 prefix blacklist"
           prefix 10.0.0.0/21
           prefix 10.254.0.0/24
        exit
     exit
     ip-filter 10
        scope template
        filter-name "IPv4PrefixBlacklistFilter"
        entry 10
           match
              src-ip ip-prefix-list IPv4PrefixBlacklist
           exit
           action drop
        exit
      exit
---------------------------------------------
```

4.5.5 Applying Filter Policies

Filter policies can be associated with the following entities:

Table 51 **Applying Filter Policies**

IP Filter Policies	MAC Filter Policies
Epipe SAP, spoke SDP	Epipe SAP, spoke SDP
Fpipe SAP, spoke SDP	N/A
IES interface SAP	N/A
Ipipe SAP, spoke SDP	N/A
VPLS mesh SDP, spoke SDP, SAP	VPLS mesh SDP, spoke SDP, SAP
VPRN interface SAP, spoke SDP	N/A

4.5.5.1 Apply IP (v4/v6) and MAC Filter Policies to a Service

IP and MAC filter policies are applied by associating them with a SAP and/or spoke-sdp in ingress and/or egress direction as desired. Filter ID is used to associate an existing filter policy, or if defined, a Filter Name for that Filter ID policy can be used in the CLI.

The following output displays IP and MAC filters assigned to an ingress and egress SAP and spoke SDP:

```
A:ALA-48>config>service>epipe# info
----------------------------------------------
            sap 1/1/1.1.1 create
                ingress
                    filter ip 10
                exit
                egress
                    filter mac 92
                exit
            exit
            spoke-sdp 8:8 create
                ingress
                    filter ip “epipe sap default filter”
                exit
                egress
                    filter mac 91
                exit
            exit
            no shutdown
----------------------------------------------
A:ALA-48>config>service>epipe#
```

The following output displays an IPv6 filters assigned to an IES service interface:

```
A:ALA-48>config>service>ies# info
----------------------------------------------
            interface "testA" create
                address 192.22.1.1/24
                sap 2/1/3:0 create
                exit
                ipv6
                 ingress
                    filter ipv6 100
                 egress
                    filter ipv6 100
                exit
            exit
...
----------------------------------------------
A:ALA-48>config>service>ies#
```

4.5.5.2 Applying (IPv4/v6) Filter Policies to a Network Port

IP filter policies can be applied to network IP (v4/v6) interfaces. MAC filters cannot be applied to network IP interfaces or to routable IES services. Similarly to applying filter policies to service, IP (v4/v6) filter policies are applied to network interfaces by associating a policy with ingress and/or egress direction as desired. Filter ID is used to associate an existing filter policy, or if defined, a Filter Name for that Filter ID policy can be used in the CLI.

The following displays an IP filter applied to an interface at ingress.

```
A:ALA-48>config>router# info
#------------------------------------------
# IP Configuration
#------------------------------------------
...
        interface "to-104"
            address 10.0.0.103/24
            port 1/1/1
            ingress
                filter ip 10
            exit
            egress
                filter ip “default network egress policy”
            exit
        exit
...
#------------------------------------------
A:ALA-48>config>router#
```

The following displays IPv4 and IPv6 filters applied to an interface at ingress and egress.

```
A:config>router>if# info
----------------------------------------------
            port 1/1/1
            ipv6
                address 3FFE::101:101/120
            exit
            ingress
                filter ip 2
                filter ipv6 1
            exit
            egress
                filter ip 2
                filter ipv6 1
            exit
----------------------------------------------
A:config>router>if#
```

4.5.6 Creating a Redirect Policy

Configuring and applying redirect policies is optional. Each redirect policy must have the following:

- A destination IP address
- A priority (default is 100)
- At least one of the following tests must be enabled:
  - Ping test
  - SNMP test
  - URL test

The following displays a redirection policy configuration:

```
A:ALA-7>config>filter# info
----------------------------------------------
        redirect-policy "redirect1" create
            destination 10.10.10.104 create
                description "SNMP_to_104"
                priority 105
                snmp-test "SNMP-1"
                    interval 30
                    drop-count 30 hold-down 120
                exit
                no shutdown
            exit
            destination 10.10.10.105 create
                priority 95
                ping-test
                    timeout 30
                    drop-count 5
                exit
                no shutdown
            exit
            destination 10.10.10.106 create
                priority 90
                url-test "URL_to_106"
                    url "http://aww.alcatel.com/ipd/"
                    interval 60
                    return-code 2323 4567 raise-priority 96
                exit
                no shutdown
            exit
...
----------------------------------------------
A:ALA-7>config>filter#
```

4.6 Filter Management Tasks

This section discusses the following filter policy management tasks:

- Renumbering Filter Policy Entries
- Modifying a Filter Policy
- Deleting a Filter Policy
- Modifying a Redirect Policy
- Deleting a Redirect Policy
- Copying Filter Policies

4.6.1 Renumbering Filter Policy Entries

The system exits the matching process when the first match is found and then executes the actions in accordance with the specified action. Because the ordering of entries is important, the numbering sequence may need to be rearranged. Entries should be numbered from the most explicit to the least explicit.

The following example illustrates renumbering of filter entries.

Example:

```
config>filter>ip-filter# renum 10 15
config>filter>ip-filter# renum 20 10
config>filter>ip-filter# renum 40 1
```

The following displays the original filter entry order, followed by the reordered filter entries:

```
A:ALA-7>config>filter# info
----------------------------------------------
...
        ip-filter 11 create
            description "filter-main"
            scope exclusive
            entry 10 create
                description "no-91"
                filter-sample
                interface-disable-sample
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.10.103/24
                exit
                action forward redirect-policy redirect1
            exit
            entry 20 create
                match
```

```
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.0.100/24
                exit
                action drop
            exit
            entry 30 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.0.200/24
                exit
                action forward
            exit
            entry 40 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.10.106/24
                exit
                action drop
            exit
        exit
...
----------------------------------------------
A:ALA-7>config>filter#

A:ALA-7>config>filter# info
----------------------------------------------
...
        ip-filter 11 create
            description "filter-main"
            scope exclusive
            entry 1 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.10.106/24
                exit
                action drop
            exit
            entry 10 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.0.100/24
                exit
                action drop
            exit
            entry 15 create
                description "no-91"
                filter-sample
                interface-disable-sample
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.10.103/24
                exit
                action forward redirect-policy
                     redirect1
            exit
            entry 30 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.0.200/24
```

```
                exit
                action forward
            exit
        exit
...
----------------------------------------------
A:ALA-7>config>filter#
```

4.6.2 Modifying a Filter Policy

There are several ways to modify an existing filter policy. A filter policy can be modified dynamically as part of subscriber management dynamic insertion/removal of filter policy entries (see the *Triple Play Guide* for details). A filter policy can be modified indirectly by configuration change to a match list the filter policy uses (as described earlier in this guide). In addition, a filter policy can be directly edited as described below.

To access a specific IP (v4/v6), or MAC filter, you must specify the filter ID, or if defined, filter name. Use the no form of the command to remove the command parameters or return the parameter to the default setting.

Example:
```
config>filter>ip-filter# description "New IP filter
 info"
config>filter>ip-filter# entry 2 create
config>filter>ip-filter>entry$ description "new entry"
config>filter>ip-filter>entry# action drop
config>filter>ip-filter>entry# match dst-ip
 10.10.10.104/32
config>filter>ip-filter>entry# exit
config>filter>ip-filter#
```

The following output displays the modified IP filter output:

```
A:ALA-7>config>filter# info
----------------------------------------------
...
        ip-filter 11 create
            description "New IP filter info"
            scope exclusive
            entry 1 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.10.106/24
                exit
                action drop
            exit
            entry 2 create
                description "new entry"
                match
```

```
                    dst-ip 10.10.10.104/32
                exit
                action drop
            exit
            entry 10 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.0.100/24
                exit
                action drop
            exit
            entry 15 create
                description "no-91"
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.10.103/24
                exit
                action forward
            exit
            entry 30 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.0.200/24
                exit
                action forward
            exit
        exit
..
----------------------------------------------
A:ALA-7>config>filter#
```

4.6.3 Deleting a Filter Policy

Before you can delete a filter, you must remove the filter association from all the applied ingress and egress SAPs and network interfaces by executing **no filter** command in all context where the filter is used.

Example:

```
config>service# epipe 5
config>service>epipe# sap 1/1/2:3
config>service>epipe>sap# ingress
config>service>epipe>sap>ingress# no filter
```

After you have removed the filter from the SAPs network interfaces, you can delete the filter as shown in the following example.

Example:

```
config>filter# no ip-filter 11
```

4.6.4 Modifying a Redirect Policy

To access a specific redirect policy, you must specify the policy name. Use the no form of the command to remove the command parameters or return the parameter to the default setting.

Example:

```
config>filter# redirect-policy redirect1
config>filter>redirect-policy# description "New redirect
 info"
config>filter>redirect-policy# destination 10.10.10.106
config>filter>redirect-policy>dest# no url-test
 "URL_to_106"
config>filter>redirect-policy>dest# url-test
 "URL_to_Proxy"
config>filter>redirect-policy>dest>url-test$ url http://
 www.alcatel.com
config>filter>redirect-policy>dest>url-test# interval 10
config>filter>redirect-policy>dest>url-test# timeout 10
config>filter>redirect-policy>dest>url-test# return-
 code 1
4294967295 raise-priority 255
```

```
A:ALA-7>config>filter# info
----------------------------------------------
...
        redirect-policy "redirect1" create
            description "New redirect info"
            destination 10.10.10.104 create
                description "SNMP_to_104"
                priority 105
                snmp-test "SNMP-1"
                    interval 30
                    drop-count 30 hold-down 120
                exit
                no shutdown
            exit
            destination 10.10.10.105 create
                priority 95
                ping-test
                    timeout 30
                    drop-count 5
                exit
                no shutdown
            exit
            destination 10.10.10.106 create
                priority 90
                url-test "URL_to_Proxy"
                    url "http://www.alcatel.com"
                    interval 10
                    timeout 10
                    return-code 1 4294967295 raise-priority 255
                exit
                no shutdown
```

```
            exit
            no shutdown
        exit
...
----------------------------------------------
A:ALA-7>config>filter#
```

4.6.5 Deleting a Redirect Policy

Before you can delete a redirect policy from the filter configuration, you must remove the policy association from the IP filter.

The following example shows the command usage to replace the configured redirect policy (**redirect1**) with a different redirect policy (**redirect2**) and then removing the **redirect1** policy from the filter configuration.

Example:

```
config>filter>ip-filter 11
config>filter>ip-filter# entry 1
config>filter>ip-filter>entry# action forward redirect-
 policy redirect2
config>filter>ip-filter>entry# exit
config>filter>ip-filter# exit
config>filter# no redirect-policy redirect1
```

```
A:ALA-7>config>filter>ip-filter# info
----------------------------------------------
            description "This is new"
            scope exclusive
            entry 1 create
               filter-sample
               interface-disable-sample
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.10.106/24
                exit
                action forward redirect-policy redirect2
            exit
            entry 2 create
                description "new entry"
...
----------------------------------------------
A:ALA-7>config>filter>ip-filter#
```

4.6.6 Copying Filter Policies

When changes are to be made to an existing filter policy applied to a one or more SAPs/network interfaces, it is recommended to first copy the applied filter policy, then modify the copy and then overwrite the applied policy with the modified copy. This ensures that a policy being modified is not applied when partial changes are done as any filter policy edits are applied immediately to all services where the policy is applied.

New filter policies can also be created by copying an existing policy and renaming the new filter.

The following displays the command usage to copy an existing IP filter (**11**) to create a new filter policy (**12**) that can then be edited. And once edits are completed, it can be used to overwrite existing policy (**11**).

Example: `config>filter# copy ip-filter 11 to 12`

```
A:ALA-7>config>filter# info
----------------------------------------------
...
        ip-filter 11 create
            description "This is new"
            scope exclusive
            entry 1 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.10.106/24
                exit
                action drop
            exit
            entry 2 create
...
        ip-filter 12 create
            description "This is new"
            scope exclusive
            entry 1 create
                match
                    dst-ip 10.10.10.91/24
                    src-ip 10.10.10.106/24
                exit
                action drop
            exit
            entry 2 create
...
----------------------------------------------
A:ALA-7>config>filter#
```

4.7 Show, Clear, Monitor, and Debug Command Reference

- Command Hierarchies
- Command Descriptions

4.7.1 Command Hierarchies

- Show Commands
- Clear Commands
- Monitor Commands
- Debug Commands
- Tools Commands

4.7.1.1 Show Commands

show
- — **filter**
  - — **dhcp** [*filter-id*]
  - — **dhcp6** [*filter-id*]
  - — **ip** [**filter-type** *filter-type*]
  - — **ip** **embedded** [**inactive**]
  - — **ip** *ip-filter-id* **embedded** [**inactive**]
  - — **ip** *ip-filter-id* [**detail**]
  - — **ip** *ip-filter-id* **associations**
  - — **ip** *ip-filter-id* **type** *entry-type*
  - — **ip** *ip-filter-id* **counters** [**type** *entry-type*][**detail**]
  - — **ip** *ip-filter-id* **entry** *entry-id* [**counters**] [**detail**]
  - — **ipv6** [**filter-type** *filter-type*]
  - — **ipv6** **embedded** [**inactive**]
  - — **ipv6** *ipv6-filter-id* **embedded** [**inactive**]
  - — **ipv6** *ipv6-filter-id* [**detail**]
  - — **ipv6** *ipv6-filter-id* **associations**
  - — **ipv6** *ipv6-filter-id* **type** *entry-type*
  - — **ipv6** *ipv6-filter-id* **counters** [**type** *entry-type*]
  - — **ipv6** *ipv6-filter-id* **entry** *entry-id* [**counters**][**detail**]
  - — **log** [**bindings**]
  - — **log** *log-id* [**match** *string*]
  - — **mac** {*mac-filter-id* [**entry** *entry-id*] [**association** | **counters**]}
  - — **match-list**
    - — **ip-prefix-list** [*prefix-list-name*]
    - — **ip-prefix-list** *prefix-list-name* **references**
    - — **ipv6-prefix-list** [*prefix-list-name*]
    - — **ipv6-prefix-list** *prefix-list-name* **references**
    - — **port-list** [*port-list-name*]
    - — **port-list** **p***ort-list-name* **references**
  - — **redirect-policy** [*redirect-policy-name* {**dest** *ip-address*|**associations**}]
  - — **system-filter** [**chained-to**]

4.7.1.2 Clear Commands

clear
— **filter**
— **ip** *filter-id* [**entry** *entry-id*] [**ingress** | **egress**]
— **ipv6** *ipv6-filter-id* [**entry** *entry-id*] [**ingress** | **egress**]
— **log** *log-id*
— **mac** *mac-filter-id* [**entry** *entry-id*] [**ingress** | **egress**]

4.7.1.3 Monitor Commands

monitor
— **filter**
— **ip** *filter-id* **entry** *entry-id* [**interval** *seconds*] [**repeat** *repeat*] [**absolute** | **rate**]
— **ipv6** *ipv6-filter-id* **entry** *entry-id* [**interval** *seconds*] [**repeat** *repeat*] [**absolute** | **rate**]
— **mac** *mac-filter-id* **entry** *entry-id* [**interval** *seconds*] [**repeat** *repeat*] [**absolute** | **rate**]

4.7.1.4 Debug Commands

tools
— **dump**
— **filter**
— **resources**
— **cpm**
— **dest-tracking** {**sap** | **sdp** | **ip** | **ipv6**} [**detail**]
— **egress-pbr** [**detail**]
— **iom** [*slot-number*]
— **ip** *filter-id*
— **ipv6** *filter-id*
— **mac** *filter-id*
— **sticky-dest**

4.7.1.5 Tools Commands

tools
— **perform**
— **filter**
— **ip-filter**
— **entry**
— **activate-primary-action**
— **ipv6-filter**
— **entry**
— **activate-primary-action**
— **mac-filter**

— **entry**
— **activate-primary-action**
— **redirect-policy**
— **activate-best-dest**

4.7.2 Command Descriptions

- Show Commands
- Clear Commands
- Monitor Commands
- Debug Commands

4.7.2.1 Show Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

dhcp

Syntax **dhcp** [*filter-id*]

Context show>filter

Description This command displays DHCP filter information.

Parameters *filter-id* — Displays detailed information for the specified filter ID and its filter entries.

Values 1 — 65535

Output The following is a sample command output for the command when no filter ID is specified.

Sample Output

```
*B:TechPubs>config# show filter dhcp
===============================================================================
DHCP Filters
===============================================================================
Filter-Id   Applied Description
-------------------------------------------------------------------------------
10          No      test-dhcp-filter
-------------------------------------------------------------------------------
Num filter entries: 1
===============================================================================
*B:TechPubs>config#


*B:TechPubs>config# show filter dhcp 10
===============================================================================
DHCP Filter
===============================================================================
Filter-Id    : 10                      Applied      : No
Entries      : 0
```

```
Description  : test-dhcp-filter
-------------------------------------------------------------------------------
Filter Match Criteria
-------------------------------------------------------------------------------
No Match Criteria Found
===============================================================================
*B:TechPubs>config#
```

dhcp6

Syntax **dhcp6** [*filter-id*]

Context show>filter

Description This command displays DHCP6 filter information.

Parameters *filter-id* — displays detailed information for the specified filter ID and its filter entries

Values 1 to 65535

ip

Syntax
ip [**filter-type** *filter-type*]
ip embedded [**inactive**]
ip *ip-filter-id* **embedded** [**inactive**]
ip *ip-filter-id* [**detail**]
ip *ip-filter-id* **associations**
ip *ip-filter-id* **type** *entry-type*
ip *ip-filter-id* **counters** [**type** *entry-type*][**detail**]
ip *ip-filter-id* **entry** *entry-id* [**counters**]

Context show>filter

Description This command shows IPv4 filter information.

Parameters **filter-type** *filter-type* — specifies the type of filter to display

Values config, flowspec, host-common, tms, openflow, vsd

ip-filter-id — specifies the IPv4 filter policy for which to display information. Values can be expressed in different formats; the following shows decimal integer format.

Values 1 to 65535

entry *entry-id* **—** specifies the filter policy entry (of the specified filter policy) for which to display information

Values 1 to 65535

associations — appends, to the detailed filter policy output, information about where the specified filter policy is applied

counters — displays counter information for the specified filter ID. Egress counters count the packets without Layer 2 encapsulation. Ingress counters count the packets with Layer 2 encapsulation.

type *entry-type* **—** specifies type of filter entry to display:

Values fixed, radius-insert, credit-control-insert, flow-spec, embedded, radius-shared, pcc rule (applies only to the 7750 SR)

embedded [inactive] — shows all embeddings, optionally shows inactive embedding only, if *ip-filter-id* is not specified shows all embedded filters

Output **Show Filter (no filter-id specified) —** The following is a sample output of IPv4 filter information when no filter ID is specified. Table 52 describes the command output fields.

Sample Output

```
A:ALA-49# show filter ip
===============================================================================
Configured IP Filters                                              Total:     2
===============================================================================
Filter-Id   Scope     Applied Description
-------------------------------------------------------------------------------
5           Template  Yes
6           Template  Yes

===============================================================================
Host Common IP Filters                                             Total:     2
===============================================================================
Filter-Id                     Description
-------------------------------------------------------------------------------
5:P4                          Auto-created PCC-Rule Ingress Filter
6:P5                          Auto-created PCC-Rule Egress Filter
===============================================================================
Num IP filters: 4
===============================================================================
```

Table 52 **Filter IP Output Fields (No Filter ID Specified)**

Label	Description
Filter Id	the IP filter ID
Scope	Template The filter policy is of type template.
	Exclusive The filter policy is of type exclusive.

Table 52 Filter IP Output Fields (No Filter ID Specified) (Continued)

Label	Description
Applied	No The filter policy ID has not been applied.
	Yes The filter policy ID is applied.
Description	the IP filter policy description

Show Filter (no filter-id specified, embedded keyword specified) — The following is a sample output of IPv4 filter information when no filter ID is specified but the embedded keyword is specified. Table 53 describes the command output fields.

Sample Output

```
*A:Dut-C>config>filter# show filter ip embedded
=================================================================================
IP Filter embedding
=================================================================================
In     From      Priority       Inserted      Status
---------------------------------------------------------------------------------
10     2           50          1/1           OK
       1           100         1/2           OK- 1 entry overwritten

20     2           100         0/5           Failed - out of resources
=================================================================================
```

Table 53 Filter IP Output Fields (No Filter ID Specified, Embedded Keyword Specified)

Label	Description
In	shows embedding filter index
From	shows embedded filters included
Priority	shows priority of embedded filter
Inserted	shows embedded/total number of entries from embedded filter Status: **OK**—embedding operation successful, if any entries are overwritten this will also be indicated **Failed**—embedding failed, the reason is displayed (out of resources)

Show Filter (with filter-id specified) — The following is a sample output of IPv4 filter information with the filter ID specified. Table 54 describes the command output fields.

Sample Output

```
*A:dut-a_a>config>filter>ip-filter>entry>action$ show filter ip 2
===============================================================================
IP Filter
===============================================================================
Filter Id           : 2                              Applied        : No
Scope               : Template                       Def. Action    : Drop
System filter       : Unchained
Radius Ins Pt       : n/a
CrCtl. Ins Pt       : n/a
RadSh. Ins Pt       : n/a
PccRl. Ins Pt       : n/a
Entries             : 1
Description         : (Not Specified)
-------------------------------------------------------------------------------
Filter Match Criteria : IP
-------------------------------------------------------------------------------
Entry               : 1
Description         : (Not Specified)
Log Id              : n/a
Src. IP             : 0.0.0.0/0
Src. Port           : n/a
Dest. IP            : 0.0.0.0/0
Dest. Port          : n/a
Protocol            : Undefined                      Dscp           : Undefined
ICMP Type           : Undefined                      ICMP Code      : Undefined
Fragment            : Off                            Src Route Opt  : Off
Sampling            : Off                            Int. Sampling  : On
IP-Option           : 0/0                            Multiple Option: Off
TCP-syn             : Off                            TCP-ack        : Off
Option-pres         : Off
Egress PBR          : Disabled
Primary Action      : Forward (Next Hop VRF)
   Next Hop          : 1.2.3.4
   Router            : Base
   PBR Target Status : Down
   Extended Action   : Remark DSCP "be"
Secondary Action    : Forward (Next Hop VRF)
   Next Hop          : 3.4.5.6
   Router            : 32
   PBR Target Status : Down
   Extended Action   : Remark DSCP "ef"
PBR Down Action     : Drop (entry-default)
Downloaded Action   : None
Dest. Stickiness    : None                           Hold Remain    : 0
Ing. Matches        : 0 pkts
Egr. Matches        : 0 pkts
===============================================================================
```

Table 54 **Show Filter IP (with Filter ID Specified) Output Fields**

Label	Description
Filter Id	the IP filter policy ID
Applied	No The filter policy ID has not been applied.
	Yes The filter policy ID is applied.
Scope	Template The filter policy is of type template.
	Exclusive The filter policy is of type exclusive.
Def. Action	Forward The default action for the filter ID for packets that do not match the filter entries is to forward.
	Drop The default action for the filter ID for packets that do not match the filter entries is to drop.
System filter	indicates if the filter has been chained to a system filter
Radius Ins Pt	indicates the Radius insertion point, if any
CrCtl. Ins Pt	indicates the Credit Control insertion point, if any
RadSh. Ins Pt	indicates the Radius shared insertion point, if any
PccRl. Ins Pt	indicates the PCC rule insertion point, if any
Entries	the number of entries configured in this filter ID
Description	the IP filter policy entry description string
Filter Match Criteria	IP indicates the filter is an IP filter policy
Entry	the filter ID filter entry ID. If the filter entry ID indicates the entry is (Inactive), then the filter entry is incomplete as no action has been specified.
Description	the IP filter policy entry description string
Log Id	the filter log ID
Src. IP	the source IPv4 address and prefix length match criterion

Table 54 Show Filter IP (with Filter ID Specified) Output Fields (Continued)

Label	Description
Src. Port	the source TCP, UDP, or SCTP port number, port range, or port match list
Dest. IP	the destination IPv4 address and prefix length match criterion
Dest. Port	the destination TCP, UDP, or SCTP port number, port range, or port match list
Protocol	the protocol for the match criteria. Undefined indicates no protocol specified.
Dscp	the DiffServ Code Point (DSCP) name
ICMP Type	the ICMP type match criterion. Undefined indicates no ICMP type specified.
ICMP Code	the ICMP code field in the ICMP header of an IP packet
Fragment	False configures a match on all non-fragmented IP packets
	True configures a match on all fragmented IP packets
	Off Fragments are not a matching criteria. All fragments and non-fragments implicitly match.
Src Route Opt	indicates if the source route option has been set
Sampling	Off specifies that traffic sampling is disabled
	On specifies that traffic matching the associated IP filter entry is sampled
Int. Sampling	Off Interface traffic sampling is disabled.
	On Interface traffic sampling is enabled.
IP-Option	specifies matching packets with a specific IP option or a range of IP options in the IP header for IP filter match criteria

Table 54 **Show Filter IP (with Filter ID Specified) Output Fields (Continued)**

Label	Description
Multiple Option	Off The option fields are not checked.
	On Packets containing one or more option fields in the IP header will be used as IP filter match criteria.
TCP-syn	False configures a match on packets with the SYN flag set to false
	True configured a match on packets with the SYN flag set to true
	Off The state of the TCP SYN flag is not considered as part of the match criteria.
TCP-ack	False configures a match on packets with the ACK flag set to false
	True configures a match on packets with the ACK flag set to true
	Off The state of the TCP ACK flag is not considered as part of the match criteria.
Option-present	Off specifies not to search for packets that contain the option field or have an option field of zero
	On matches packets that contain the option field or have an option field of zero be used as IP filter match criteria
Egress PBR	indicates if the egress-pbr flag is set for this entry
Primary Action	indicates the configured action, if any. Indented sub-labels in the show output provide configured parameters for this action
Secondary Action	indicates the configured secondary action, if any. Indented sub-labels in the show output provide configured parameters for this action.
PBR Target Status	the status of the target of the secondary action
Extended Action	indicates the configured extended action, if any

Table 54 **Show Filter IP (with Filter ID Specified) Output Fields (Continued)**

Label	Description
PBR Down Action	indicates the matching action packets that the entry criteria will be subject to if the targets of the main actions are down
Downloaded Action	the action downloaded by CPM to IOM
Dest. Stickiness	indicates whether stickiness is configured
Hold Remain	the stickiness timer
Ing. Matches	the number of ingress filter matches/hits for the filter entry
Egr. Matches	the number of egress filter matches/hits for the filter entry

Show Filter Associations — The following is a sample output of IPv4 filter information when the **associations** keyword is specified. Table 55 describes the command output fields.

Sample Output

```
A:ALA-49# show filter ip 1 associations
===============================================================================
IP Filter
===============================================================================
Filter Id            : 4                              Applied        : Yes
Scope                : Template                       Def. Action    : Drop
System filter        : Unchained
Radius Ins Pt        : n/a
CrCtl. Ins Pt        : n/a
RadSh. Ins Pt        : n/a
PccRl. Ins Pt        : n/a
Entries              : 1
Description          : (Not Specified)
-------------------------------------------------------------------------------
Filter Association : IP
-------------------------------------------------------------------------------
Service Id           : 2                              Type           : VPLS
  - SAP    1/2/2    (Ingress)
-------------------------------------------------------------------------------
Filter associated with IOM: 1
===============================================================================
```

Table 55 **Filter IP Associations Output Fields**

Label	Description
Filter Id	the IP filter policy ID

Table 55 Filter IP Associations Output Fields (Continued)

Label	Description
Applied	No the filter policy ID has not been applied
	Yes the filter policy ID is applied
Scope	Template the filter policy is of type Template
	Exclusive the filter policy is of type Exclusive
Def. Action	Forward the default action for the filter ID for packets that do not match the filter entries is to forward
	Drop the default action for the filter ID for packets that do not match the filter entries is to drop
System filter	indicates if the filter has been chained to a system filter
Radius Ins Pt	indicates the Radius insertion point, if any
CrCtl. Ins Pt	indicates the Credit Control insertion point, if any
RadSh. Ins Pt	indicates the Radius shared insertion point, if any
PccRl. Ins Pt	indicates the PCC rule insertion point, if any
Entries	the number of entries configured in this filter ID
Description	the IP filter policy description
Filter Association	indicates the filter is an IP filter policy
Service Id	the service ID on which the filter policy ID is applied
Type	the type of service of the service ID
SAP	the Service Access Point on which the filter policy ID is applied
(Ingress)	the filter policy ID is applied as an ingress filter policy on the interface
(Egress)	the filter policy ID is applied as an egress filter policy on the interface

Show Filter Counters — The following is a sample output of IPv4 filter information when the **counters** keyword is specified. Table 56 describes the command output fields.

Egress counters count the packets without Layer 2 encapsulation. Ingress counters count the packets with Layer 2 encapsulation.

Sample Output

```
*A:ALA-48# show filter ip 100 counters
===============================================================================
IP Filter
===============================================================================
Filter Id           : 4                             Applied        : Yes
Scope               : Template                      Def. Action    : Drop
System filter       : Unchained
Radius Ins Pt       : n/a
CrCtl. Ins Pt       : n/a
RadSh. Ins Pt       : n/a
PccRl. Ins Pt       : n/a
Entries             : 1
Description         : (Not Specified)
-------------------------------------------------------------------------------
Filter Match Criteria : IP
-------------------------------------------------------------------------------
Entry               : 4001
Ing. Matches        : 9788619 pkts (978861900 bytes)
Egr. Matches        : 9788619 pkts (978861900 bytes)
===============================================================================
```

Table 56 **Filter IP Counters Output Field Descriptions**

Label	Description
Filter Id	the IP filter policy ID
Applied	No The filter policy ID has not been applied.
	Yes The filter policy ID is applied.
Scope	Template The filter policy is of type Template.
	Exclusive The filter policy is of type Exclusive.

Table 56 **Filter IP Counters Output Field Descriptions (Continued)**

Label	Description
Def. Action	Forward the default action for the filter ID for packets that do not match the filter entries is to forward
	Drop the default action for the filter ID for packets that do not match the filter entries is to drop
System filter	indicates if the filter has been chained to a system filter
Radius Ins Pt	indicates the Radius insertion point, if any
CrCtl. Ins Pt	indicates the Credit Control insertion point, if any
RadSh. Ins Pt	indicates the Radius shared insertion point, if any
PccRl. Ins Pt	indicates the PCC rule insertion point, if any
Entries	the number of entries configured in this filter ID
Description	the IP filter policy description
Filter Match Criteria	IP indicates the filter is an IP filter policy
Entry	the filter ID filter entry ID. If the filter entry ID indicates the entry is (Inactive), then the filter entry is incomplete as no action has been specified.
Ing. Matches	the number of ingress filter matches/hits for the filter entry
Egr. Matches	the number of egress filter matches/hits for the filter entry

ipv6

Syntax **ipv6** [**filter-type** *filter-type*]
ipv6 embedded [**inactive**]
ipv6 *ipv6-filter-id* **embedded** [**inactive**]
ipv6 *ipv6-filter-id* [**detail**]
ipv6 *ipv6-filter-id* **associations**
ipv6 *ipv6-filter-id* **type** *entry-type*
ipv6 *ipv6-filter-id* **counters** [**type** *entry-type*] [**detail**]
ipv6 *ipv6-filter-id* **entry** *entry-id* [**counters**] [**detail**]

Context show>filter

Description This command shows IPv6 filter information.

Parameters *ipv6-filter-id* — Specifies the IPv6 filter policy for which to display information. Values can be expressed in different formats. The following only shows decimal integer format.

Values 1 to 65535

entry *entry-id* **—** Specifies the filter policy entry (of the specified filter policy) for which only to display information..

Values 1 to 65535

filter-type *filter-type* **—** Specifies the type of filter to display.

Values config, flowspec, host-common, tms, openflow, vsd.

associations — Appends, to the detailed filter policy output, information as to where the specified filter policy ID is applied.

counters — Displays counter information. Egress counters count the packets without Layer 2 encapsulation. Ingress counters count the packets with Layer 2 encapsulation.

embedded [inactive] — Shows all embeddings, optionally shows inactive embedding only, if *ipv6-filter-id* is not specified shows all embedded filters.

type *entry-type* **—** Specifies type of filter entry to display:

Values fixed, radius-insert, credit-control-insert, embedded, radius-shared

Output **Show Filter (no filter-id specified) —** The following output is an example of IPv6 filter information when no filter ID is specified, and Table 57 describes the fields.

Sample Output

```
A:ALA-48# show filter ipv6
================================================================================
IP Filters
================================================================================
Filter-Id Scope      Applied Description
--------------------------------------------------------------------------------
100       Template   Yes     test
200       Exclusive  Yes
--------------------------------------------------------------------------------
Num IPv6 filters: 2
================================================================================
A:ALA-48# show filter ipv6 embedded
=================================================
IP Filter embedding
=================================================
In     From      Priority       Inserted      Status
-----------------------------------------------------------------------------------
10     2           50          1/1           OK
       1           100         1/2           OK- 1 entry overwritten

20     2           100         0/5           Failed - out of resources
=================================================
A:ALA-48#
================================================================================
```

```
Configured IP Filters                                              Total:     4
===============================================================================
Filter-Id   Scope     Applied Description
-------------------------------------------------------------------------------
1           Template  No
5           Exclusive No
10          Template  Yes
100         Embedded  N/A
===============================================================================
System IP Filters                                                  Total:     1
===============================================================================
Filter-Id                     Description
-------------------------------------------------------------------------------
_tmnx_ofs_test                of-switch 'test' embedded filter
-------------------------------------------------------------------------------
Num IP filters: 5
==============================================================================
```

Table 57 Filter IPv6 Output Fields

Label	Description
Filter Id	the IP filter ID
Scope	Template The filter policy is of type template.
	Exclusive The filter policy is of type exclusive.
Applied	No The filter policy ID has not been applied.
	Yes The filter policy ID is applied.
Description	the IP filter policy description
In	shows embedding filter index
From	shows embedded filters included
Priority	shows priority of embedded filter
Inserted	shows embedded/total number of entries from embedded filter Status: **OK**—embedding operation successful, if any entries are overwritten this will also be indicated **Failed**—embedding failed, the reason is displayed (out of resources)
In	shows embedding filter index

Show Filter (with filter-id specified) — The following output is an example of IPv6 filter information when filter-id is specified, and Table 58 describes the fields.

Sample Output

```
A:ALA-48# show filter ipv6 100
===============================================================================
IPv6 Filter
===============================================================================
Filter Id     : 100                              Applied        : Yes
Scope         : Template                         Def. Action    : Forward
Entries       : 1
Description : test
-------------------------------------------------------------------------------
Filter Match Criteria : IPv6
-------------------------------------------------------------------------------
Entry         : 10
Log Id        : 101
Src. IP       : ::/0                             Src. Port      : None
Dest. IP      : ::/0                             Dest. Port     : None
Next Header : Undefined                          Dscp           : Undefined
ICMP Type     : Undefined                        ICMP Code      : Undefined
TCP-syn       : Off                              TCP-ack        : Off
Match action : Drop
Ing. Matches : 0                                 Egr. Matches   : 0
===============================================================================
A:ALA-48#
```

Table 58 **Filter IPv6 with Filter-ID Specified Output Fields**

Label	Description
Filter Id	the IP filter policy ID
Scope	Template The filter policy is of type template.
	Exclusive The filter policy is of type exclusive.
Entries	the number of entries configured in this filter ID
Description	the IP filter policy description
Applied	No The filter policy ID has not been applied.
	Yes The filter policy ID is applied.

Table 58 **Filter IPv6 with Filter-ID Specified Output Fields (Continued)**

Label	Description
Def. Action	Forward the default action for the filter ID for packets that do not match the filter entries is to forward
	Drop the default action for the filter ID for packets that do not match the filter entries is to drop
Filter Match Criteria	IP indicates the filter is an IP filter policy
Entry	the filter ID filter entry ID. If the filter entry ID indicates the entry is (Inactive), then the filter entry is incomplete as no action has been specified.
Log Id	the filter log ID
Src. IP	the source IP address and mask match criterion. 0.0.0.0/0 indicates no criterion specified for the filter entry.
Dest. IP	the destination IP address and mask match criterion. 0.0.0.0/0 indicates no criterion specified for the filter entry.
Protocol	the protocol ID for the match criteria. Undefined indicates no protocol specified.
ICMP Type	the ICMP type match criterion. Undefined indicates no ICMP type specified.
Fragment	False configures a match on all non-fragmented IP packets
	True configures a match on all fragmented IP packets
	Off fragments are not a matching criteria. All fragments and nonfragments implicitly match.
Sampling	Off specifies that traffic sampling is disabled
	On specifies that traffic matching the associated IP filter entry is sampled
IP-Option	specifies matching packets with a specific IP option or a range of IP options in the IP header for IP filter match criteria

Table 58 **Filter IPv6 with Filter-ID Specified Output Fields (Continued)**

Label	Description
TCP-syn	False configures a match on packets with the SYN flag set to false
	True configured a match on packets with the SYN flag set to true
	Off The state of the TCP SYN flag is not considered as part of the match criteria
Match action	Default The filter does not have an explicit forward or drop match action specified. If the filter entry ID indicates the entry is (Inactive), then the filter entry is incomplete as no action has been specified.
	Drop drop packets matching the filter entry
	Forward The explicit action to perform is forwarding of the packet. If the action is Forward, then if configured the nexthop information should be displayed, including Nexthop: <IP address>, Indirect: <IP address> or Interface: <IP interface name>.
Ing. Matches	the number of ingress filter matches/hits for the filter entry
Src. Port	the source TCP, UDP, or SCTP port number, port range, or port match list
Dest. Port	the destination TCP, UDP, or SCTP port number, port range, or port match list
Dscp	the DiffServ Code Point (DSCP) name
ICMP Code	the ICMP code field in the ICMP header of an IP packet
Option-present	Off specifies not to search for packets that contain the option field or have an option field of zero
	On matches packets that contain the option field or have an option field of zero be used as IP filter match criteria

Table 58 **Filter IPv6 with Filter-ID Specified Output Fields (Continued)**

Label	Description
Int. Sampling	Off Interface traffic sampling is disabled.
	On Interface traffic sampling is enabled.
Multiple Option	Off The option fields are not checked.
	On Packets containing one or more option fields in the IP header will be used as IP filter match criteria.
TCP-ack	False configures a match on packets with the ACK flag set to false
	True configured a match on packets with the ACK flag set to true
	Off the state of the TCP ACK flag is not considered as part of the match criteria
Egr. Matches	the number of egress filter matches/hits for the filter entry
Ing. Rate-limiter	the number of offered, forwarded, and dropped packet matches for the filter entry

Show Filter Associations — The following output is an example of IPv6 filter information when the **associations** keyword is specified, and Table 59 describes the fields.

Sample Output

```
A:ALA-48# show filter ipv6 1 associations
===============================================================================
IPv6 Filter
===============================================================================
Filter Id     : 1                                Applied        : Yes
Scope         : Template                         Def. Action    : Drop
Entries       : 1
-------------------------------------------------------------------------------
Filter Association : IPv6
-------------------------------------------------------------------------------
Service Id    : 2000                             Type           : IES
 - SAP    1/1/1:2000   (Ingress)
===============================================================================
Filter Match Criteria : IPv6
-------------------------------------------------------------------------------
```

```
Entry        : 10
Log Id       : 101
Src. IP      : ::/0                                Src. Port      : None
Dest. IP     : ::/0                                Dest. Port     : None
Next Header  : Undefined                           Dscp           : Undefined
ICMP Type    : Undefined                           ICMP Code      : Undefined
TCP-syn      : Off                                 TCP-ack        : Off
Match action : Drop
Ing. Matches : 0                                   Egr. Matches   : 0
===============================================================================
A:ALA-48#
```

Table 59 Filter IPv6 Associations Output Fields

Label	Description
Filter Id	the IPv6 filter policy ID
Scope	Template The filter policy is of type Template.
	Exclusive The filter policy is of type Exclusive.
Entries	the number of entries configured in this filter ID
Applied	No the filter policy ID has not been applied
	Yes the filter policy ID is applied
Def. Action	Forward the default action for the filter ID for packets that do not match the filter entries is to forward
	Drop the default action for the filter ID for packets that do not match the filter entries is to drop
Service Id	the service ID on which the filter policy ID is applied
SAP	the Service Access Point on which the filter policy ID is applied
(Ingress)	The filter policy ID is applied as an ingress filter policy on the interface.
(Egress)	The filter policy ID is applied as an egress filter policy on the interface.
Type	the type of service of the service ID

Table 59 Filter IPv6 Associations Output Fields (Continued)

Label	Description
Entry	the filter ID filter entry ID. If the filter entry ID indicates the entry is Inactive, the filter entry is incomplete, no action was specified.
Log Id	the filter log ID.
Src. IP	the source IP address and mask match criterion. 0.0.0.0/0 indicates no criterion specified for the filter entry.
Dest. IP	the destination IP address and mask match criterion. 0.0.0.0/0 indicates no criterion specified for the filter entry.
Protocol	the protocol ID for the match criteria. Undefined indicates no protocol specified.
ICMP Type	the ICMP type match criterion. Undefined indicates no ICMP type specified.
Fragment	False configures a match on all non-fragmented IP packets
	True configures a match on all fragmented IP packets
	Off Fragments are not a matching criteria. All fragments and nonfragments implicitly match.
Sampling	Off specifies that traffic sampling is disabled
	On specifies that traffic matching the associated IP filter entry is sampled
IP-Option	specifies matching packets with a specific IP option or a range of IP options in the IP header for IP filter match criteria
TCP-syn	False configures a match on packets with the SYN flag set to false
	True configures a match on packets with the SYN flag set to true
	Off The state of the TCP SYN flag is not considered as part of the match criteria.

Table 59 **Filter IPv6 Associations Output Fields (Continued)**

Label	**Description**
Match action	Default The filter does not have an explicit forward or drop match action specified. If the filter entry ID indicates the entry is Inactive, the filter entry is incomplete, no action was specified.
	Drop drop packets matching the filter entry
	Forward the explicit action to perform is forwarding of the packet. If the action is Forward, then if configured the nexthop information should be displayed, including Nexthop: <IP address>, Indirect: <IP address> or Interface: <IP interface name>.
Ing. Matches	the number of ingress filter matches/hits for the filter entry
Src. Port	the source TCP, UDP, or SCTP port number, port range, or port match list
Dest. Port	the destination TCP, UDP, or SCTP port number, port range, or port match list
Dscp	the DiffServ Code Point (DSCP) name
ICMP Code	the ICMP code field in the ICMP header of an IP packet
Option-present	Off specifies not to search for packets that contain the option field or have an option field of zero
	On matches packets that contain the option field or have an option field of zero be used as IP filter match criteria
Int. Sampling	Off Interface traffic sampling is disabled.
	On Interface traffic sampling is enabled.
Multiple Option	Off The option fields are not checked.
	On Packets containing one or more option fields in the IP header will be used as IP filter match criteria.

Table 59 Filter IPv6 Associations Output Fields (Continued)

Label	Description
TCP-ack	False configures a match on packets with the ACK flag set to false
	True configured a match on packets with the ACK flag set to true
	Off the state of the TCP ACK flag is not considered as part of the match criteria
Egr. Matches	the number of egress filter matches/hits for the filter entry

Show Filter Counters — The following output is an example of IPv6 filter information when the **counters** keyword is specified, and Table 60 describes the output fields.

Egress count the packets without Layer 2 encapsulation. Ingress counters count the packets with Layer 2 encapsulation.

Sample Output

```
A:ALA-48# show filter ipv6 8 counters
===============================================================================
IPv6 Filter
===============================================================================
Filter Id    : 8                                Applied        : Yes
Scope        : Template                         Def. Action    : Forward
Entries      : 4
Description  : Description for Ipv6 Filter Policy id # 8
-------------------------------------------------------------------------------
Filter Match Criteria : IPv6
-------------------------------------------------------------------------------
Entry        : 5
Ing. Matches : 0 pkts
Egr. Matches : 0 pkts

Entry        : 6
Ing. Matches : 0 pkts
Egr. Matches : 0 pkts

Entry        : 8
Ing. Matches : 160 pkts (14400 bytes)
Egr. Matches : 80 pkts (6880 bytes)

Entry        : 10
Ing. Matches : 80 pkts (7200 bytes)
Egr. Matches : 80 pkts (6880 bytes)

====================================================================================
A:ALA-48#
```

Table 60 Filter IPv6 Counters Output Fields

Label	Description
IP Filter Filter Id	the IP filter policy ID
Scope	Template the filter policy is of type template
	Exclusive the filter policy is of type exclusive
Applied	No the filter policy ID has not been applied
	Yes the filter policy ID is applied
Def. Action	Forward the default action for the filter ID for packets that do not match the filter entries is to forward
	Drop the default action for the filter ID for packets that do not match the filter entries is to drop
Filter Match Criteria	IP indicates the filter is an IP filter policy
Entry	The filter ID filter entry ID. If the filter entry ID indicates the entry is (Inactive), then the filter entry is incomplete as no action has been specified.
Ing. Matches	the number of ingress filter matches/hits for the filter entry
Egr. Matches	the number of egress filter matches/hits for the filter entry

Egress count the packets without Layer 2 encapsulation. Ingress counters count the packets with Layer 2 encapsulation.

log

Syntax **log** *log-id* [**match** *string*]
log [**bindings**]

Context show>filter

Description This command shows the contents of a memory-based or a file-based filter log.

If the optional keyword **match** and *string* parameter are given, the command displays the given filter log from the first occurrence of the given string.

Parameters *log-id* — The filter log ID destination expressed as a decimal integer.

Values 101 to 199

match *string* **—** Specifies to start displaying the filter log entries from the first occurrence of *string*.

bindings — Displays the number of filter logs currently instantiated.

Output The following output is an example of filter log entry information, and Table 61 describes the fields. If log summary is active, the filter log mini-tables contain the information described in Table 62.

Sample Output

```
2007/04/13 16:23:09  Filter: 100:100  Desc: Entry-100
Interface: to-ser1  Action: Forward
Src MAC: 04-5b-01-01-00-02  Dst MAC: 04-5d-01-01-00-02  EtherType: 0800
Src IP: 10.10.0.1:646  Dst IP: 10.10.0.4:49509  Flags:   TOS: c0
Protocol: TCP  Flags: ACK

2007/04/13 16:23:10  Filter: 100:100  Desc: Entry-100
Interface: to-ser1  Action: Forward
Src MAC: 04-5b-01-01-00-02  Dst MAC: 04-5d-01-01-00-02  EtherType: 0800
Src IP: 10.10.0.1:646  Dst IP: 10.10.0.3:646  Flags:   TOS: c0
Protocol: UDP

2007/04/13 16:23:12  Filter: 100:100  Desc: Entry-100
Interface: to-ser1  Action: Forward
Src MAC: 04-5b-01-01-00-02  Dst MAC: 01-00-5e-00-00-05  EtherType: 0800
Src IP: 10.10.13.1  Dst IP: 224.0.0.5  Flags:   TOS: c0
Protocol: 89
Hex: 02 01 00 30 0a 0a 00 01 00 00 00 00 ba 90 00 00
     00 00 00 00 00 00 00 00 ff ff ff 00 00 03 02 01

A:ALA-A>config# show filter log bindings
===============================================================================
Filter Log Bindings
===============================================================================
Total Log Instances (Allowed)          : 2046
Total Log Instances (In Use)           : 0
Total Log Bindings                     : 0
-------------------------------------------------------------------------------
Type  FilterId EntryId   Log    Instantiated
-------------------------------------------------------------------------------
No Instances found
===============================================================================
A:ALA-A>config#
```

A summary log will be printed only in case TotCnt is different from 0. Only the address types with at least 1 entry in the minitable will be printed.

```
A:ALA-A>config# show filter log 190
================================================================================
Summary Log[190] Crit1: SrcAddr TotCnt:       723 ArpCnt:     83
 Mac           8  06-06-06-06-06-06
 Mac           8  06-06-06-06-06-05
 Mac           8  06-06-06-06-06-04
 Mac           8  06-06-06-06-06-03
 Mac           8  06-06-06-06-06-02
  Ip          16  6.6.6.1
  Ip          16  6.6.6.2
  Ip          16  6.6.6.3
  Ip          16  6.6.6.4
  Ip           8  6.6.6.5
Ipv6           8  3FE:1616:1616:1616:1616:1616::
Ipv6           8  3FE:1616:1616:1616:1616:1616:FFFF:FFFF
Ipv6           8  3FE:1616:1616:1616:1616:1616:FFFF:FFFE
Ipv6           8  3FE:1616:1616:1616:1616:1616:FFFF:FFFD
Ipv6           8  3FE:1616:1616:1616:1616:1616:FFFF:FFFC
================================================================================
A:ALA-A
```

Log Message Formatting — Each filter log entry contains the following information in case summary log feature is not active (as appropriate).

Table 61 **Filter Log Output Fields**

Label	Description
yyyy/*mm*/*dd* *hh*:*mm*:*ss*	The date and timestamp for the log filter entry where *yyyy* is the year, *mm* is the month, *dd* is the day, *hh* is the hour, *mm* is the minute and *ss* is the second.
Filter	The filter ID and the entry ID which generated the filter log entry in the form *Filter_ID*:*Entry_ID*.
Desc	The description of the filter entry ID which generated the filter log entry.
Interface	The IP interface on which the filter ID and entry ID was associated which generated the filter log entry.
Action	The action of the filter entry on the logged packet.
Src MAC	The source MAC address of the logged packet.
Dst MAC	The destination MAC of the logged packet.
EtherType	The Ethernet type of the logged Ethernet type II packet.
Src IP	The source IP address of the logged packet. The source port will be displayed after the IP address as appropriate separated with a colon.

Table 61 Filter Log Output Fields (Continued)

Label	Description
Dst IP	The destination IP address of the logged packet. The source port will be displayed after the IP address as appropriate separated with a colon.
Flags (IP flags)	M — The more fragments IP flag is set in the logged packet. DF — The do not fragment IP flag is set in the logged packet.
TOS	The TOS byte value in the logged packet.
Protocol	The IP protocol of the logged packet (TCP, UDP, ICMP or a protocol number in hex).
Flags (TCP flags)	URG — Urgent bit set. ACK — Acknowledgment bit set. RST — Reset bit set. SYN — Synchronize bit set. FIN — Finish bit set.
HEX	If an IP protocol does not have a supported decode, the first 32 bytes following the IP header are printed in a hex dump. Log entries for non-IP packets include the Ethernet frame information and a hex dump of the first 40 bytes of the frame after the Ethernet header.
Total Log Instances (Allowed)	Specifies the maximum allowed instances of filter logs allowed on the system.
Total Log Instances (In Use)	Specifies the instances of filter logs presently existing on the system.
Total Log Bindings	Specifies the count of the filter log bindings presently existing on the system.
Type	The type of service of the service ID.
Filter ID	Uniquely identifies an IP filter as configured on the system.
Entry ID	The identifier which uniquely identifies an entry in a filter table.
Log	Specifies an entry in the filter log table.
Instantiated	Specifies if the filter log for this filter entry has or has not been instantiated.

If the packet being logged does not have a source or destination MAC address (that is, POS) then the MAC information output line is omitted from the log entry.

If log summary is active, the filter log mini-tables contain the information described in Table 62.

Table 62 **Filter Log Summary Mini-Table Fields**

Label	Description
Summary Log LogID	Displays the log ID.
Crit1	Summary criterion that is used as index into the mini-tables of the log.
TotCnt	The total count of logs.
ArpCnt	Displays the total number of ARP messages logged for this log ID.
Src... Dst...	The address type indication of the key in the mini-table.
count	The number of messages logged with the specified source/ destination address.
address	The address for which count messages where received.

mac

Syntax **mac** *mac-filter-id*
mac *mac-filter-id* **associations**
mac *mac-filter-id* **associations** [**type** *entry-type*] **counters** [**detail**]
mac [*mac-filter-id*] **embedded** [**inactive**]
mac *mac-filter-id* **entry** *entry-id* [**counters**] [**detail**]
mac [**filter-type** *filter-type*]
mac *mac-filter-id* **type** *entry-type*]

Context show>filter

Description This command displays MAC filter information.

Parameters *mac-filter-id* — Displays detailed information for the specified filter ID and its filter entries.

Values 1 to 65535

associations — Appends information as to where the filter policy ID is applied to the detailed filter policy ID output.

counters — Displays counter information for the specified filter ID.

entry *entry-id* **—** Displays information on the specified filter entry ID for the specified filter ID only.

Values 1 to 65535

type *entry-type* **—** Specify the type of filter entries as “fixed” or “embedded”.

filter-type *filter-type* **—** Specify the type of filter entries as “config” or “vsd”.

Output **No Parameters Specified —** A brief listing of MAC filters is produced when no parameters are specified; Table 63 describes the output fields.

Sample Output

Table 63 **Filter MAC Output Fields**

Label	Description
Filter Id	The MAC filter ID
Scope	Template The filter policy is of type Template.
	Exclusive The filter policy is of type Exclusive.
Applied	No The filter policy ID has not been applied.
	Yes The filter policy ID is applied.
Description	The MAC filter policy description.

Filter ID Specified — The following output is an example of MAC filter information when the filter ID is specified, and Table 64 describes the fields. Detailed filter information for the filter ID and its entries is produced when the filter ID is specified.

Sample Output

```
===============================================================================
Mac Filter : 200
===============================================================================
Filter Id       : 200                Applied       : No
Scope       : Exclusive                D. Action       : Drop
Description : Forward SERVER sourced packets
-------------------------------------------------------------------------------
Filter Match Criteria : Mac
-------------------------------------------------------------------------------
Entry       : 200                FrameType       : 802.2SNAP
Description       : Not Available
Src Mac       : 00:00:5a:00:00:00 ff:ff:ff:00:00:00
Dest Mac       : 00:00:00:00:00:00 00:00:00:00:00:00
Dot1p       : Undefined                Ethertype       : 802.2SNAP
DSAP       : Undefined                SSAP       : Undefined
Snap-pid       : Undefined                ESnap-oui-zero : Undefined
Match action       : Forward
```

```
Ing. Matches      : 0              Egr. Matches       : 0
Entry       : 300 (Inactive)              FrameType       : Ethernet
Description       : Not Available
Src Mac       : 00:00:00:00:00:00 00:00:00:00:00:00
Dest Mac       : 00:00:00:00:00:00 00:00:00:00:00:00
Dot1p       : Undefined              Ethertype       : Ethernet
DSAP       : Undefined              SSAP       : Undefined
Snap-pid       : Undefined              ESnap-oui-zero : Undefined
Match action      : Default
Ing. Matches      : 0              Egr. Matches       : 0
===============================================================================
```

Table 64 **Filter MAC with Filter-ID Specified Output Fields**

Label	Description
MAC Filter Filter Id	The MAC filter policy ID.
Scope	Template The filter policy is of type Template.
	Exclusive The filter policy is of type Exclusive.
Description	The MAC filter policy description.
Applied	No The filter policy ID has not been applied.
	Yes The filter policy ID is applied.
Def. Action	Forward The default action for the filter ID for packets that do not match the filter entries is to forward.
	Drop The default action for the filter ID for packets that do not match the filter entries is to drop.
Filter Match Criteria	MAC Indicates the filter is an MAC filter policy.
Entry	The filter ID filter entry ID. If the filter entry ID indicates the entry is (Inactive), then the filter entry is incomplete as no action has been specified.
Description	The filter entry description.

Table 64 Filter MAC with Filter-ID Specified Output Fields (Continued)

Label	Description
FrameType	Ethernet The entry ID match frame type is Ethernet IEEE 802.3.
	Ethernet II The entry ID match frame type is Ethernet Type II.
Src MAC	The source MAC address and mask match criterion. When both the MAC address and mask are all zeros, no criterion specified for the filter entry.
Dest MAC	The destination MAC address and mask match criterion. When both the MAC address and mask are all zeros, no criterion specified for the filter entry.
Dot1p	The IEEE 802.1p value for the match criteria. Undefined indicates no value is specified.
Ethertype	The Ethertype value match criterion.
DSAP	The DSAP value match criterion. Undefined indicates no value specified.
SSAP	SSAP value match criterion. Undefined indicates no value specified.
Snap-pid	The Ethernet SNAP PID value match criterion. Undefined indicates no value specified.
Esnap-oui-zero	Non-Zero Filter entry matches a non-zero value for the Ethernet SNAP OUI.
	Zero Filter entry matches a zero value for the Ethernet SNAP OUI.
	Undefined No Ethernet SNAP OUI value specified.
Match action	Default The filter does not have an explicit forward or drop match action specified. If the filter entry ID indicates the entry is Inactive, the filter entry is incomplete, no action was specified.
	Drop Packets matching the filter entry criteria will be dropped.
	Forward Packets matching the filter entry criteria is forwarded.
Ing. Matches	The number of ingress filter matches/hits for the filter entry.

Table 64 Filter MAC with Filter-ID Specified Output Fields (Continued)

Label	Description
Egr. Matches	The number of egress filter matches/hits for the filter entry.

Filter Associations — The associations for a filter ID will be displayed if the **associations** keyword is specified. The association information is appended to the filter information.

The following output is an example of MAC filter information when the associations keyword is specified, and Table 65 describes the fields.

Sample Output

```
A:ALA-49# show filter mac 3 associations
===============================================================================
Mac Filter
===============================================================================
Filter ID    : 3               Applied      : Yes
Scope    : Template              Def. Action      : Drop
Entries    : 1
-------------------------------------------------------------------------------
Filter Association : Mac
-------------------------------------------------------------------------------
Service Id  : 1001                Type      : VPLS
- SAP   1/1/1:1001      (Egress)
===============================================================================
```

Table 65 Filter MAC Associations Output Fields

Label	Description
Filter Association	Mac The filter associations displayed are for a MAC filter policy ID.
Service Id	The service ID on which the filter policy ID is applied.
SAP	The Service Access Point or spoke/mesh SDP on which the filter policy ID is applied.
Type	The type of service of the Service ID.
(Ingress)	The filter policy ID is applied as an ingress filter policy on the interface.
(Egress)	The filter policy ID is applied as an egress filter policy on the interface.

Filter Entry Counters Output — When the **counters** keyword is specified, the filter entry output displays the filter matches/hit information. The following table describes the command output for the command.

```
A:ALA-49# show filter mac 8 counters
===============================================================================
Mac Filter
===============================================================================
Filter Id   : 8                               Applied        : Yes
Scope       : Template                        Def. Action    : Forward
Entries     : 2
Description : Description for Mac Filter Policy id # 8
-------------------------------------------------------------------------------
Filter Match Criteria : Mac
-------------------------------------------------------------------------------
Entry       : 8                               FrameType      : Ethernet
Ing. Matches: 80 pkts (5440 bytes)
Egr. Matches: 62 pkts (3968 bytes)

Entry       : 10                              FrameType      : Ethernet
Ing. Matches: 80 pkts (5440 bytes)
Egr. Matches: 80 pkts (5120 bytes)
```

Table 66 **Filter MAC Counters Output Field Descriptions**

Label	Description
Mac Filter Filter Id	The MAC filter policy ID.
Scope	Template The filter policy is of type Template.
	Exclusive The filter policy is of type Exclusive.
Description	The MAC filter policy description.
Applied	No The filter policy ID has not been applied.
	Yes The filter policy ID is applied.
Def. Action	Forward The default action for the filter ID for packets that do not match the filter entries is to forward.
	Drop The default action for the filter ID for packets that do not match the filter entries is to drop.
Filter Match Criteria	Mac Indicates the filter is an MAC filter policy.

Table 66 **Filter MAC Counters Output Field Descriptions (Continued)**

Label	Description
Entry	The filter ID filter entry ID. If the filter entry ID indicates the entry is (Inactive), then the filter entry is incomplete as no action has been specified.
FrameType	Ethernet The entry ID match frame type is Ethernet IEEE 802.3.
	802.2LLC The entry ID match frame type is Ethernet IEEE 802.2 LLC.
	802.2SNAP The entry ID match frame type is Ethernet IEEE 802.2 SNAP.
	Ethernet II The entry ID match frame type is Ethernet Type II.
Ing. Matches	The number of ingress filter matches/hits for the filter entry.
Egr. Matches	The number of egress filter matches/hits for the filter entry.

redirect-policy

Syntax **redirect-policy** [*redirect-policy-name* {**dest** *ip-address*] [**associations**}]

Context show>filter

Description This command shows redirect filter information.

Parameters *redirect-policy-name* — Displays information for the specified redirect policy.

dest *ip-address* **—** Directs the router to use a specified IP address for communication.

associations — Appends association information.

Output **Redirect Policy Output —** The following output is an example of redirect policy information, and Table 67 describes the fields.

Sample Output

```
A:ALA-A>config>filter# show filter redirect-policy
===============================================================================
Redirect Policies
===============================================================================
Redirect Policy                 Applied Description
-------------------------------------------------------------------------------
wccp                            Yes
redirect1                       Yes     New redirect info
redirect2                       Yes     Test test test test
```

```
===============================================================================
ALA-A>config>filter#


ALA-A>config>filter# show filter redirect-policy redirect1
===============================================================================
Redirect Policy
===============================================================================
Redirect Policy: redirect1                          Applied      : Yes
Description    : New redirect info
Active Dest    : 10.10.10.104
-------------------------------------------------------------------------------
Destination    : 10.10.10.104
-------------------------------------------------------------------------------
Description    : SNMP_to_104
Admin Priority : 105                                Oper Priority: 105
Admin State    : Up                                 Oper State   : Up

SNMP Test      : SNMP-1
Interval       : 30                                 Timeout      : 1
Drop Count     : 30
Hold Down      : 120                                Hold Remain  : 0
Last Action at : None Taken
-------------------------------------------------------------------------------
Destination    : 10.10.10.105
-------------------------------------------------------------------------------
Description    : another test
Admin Priority : 95                                 Oper Priority: 105
Admin State    : Up                                 Oper State   : Down

Ping Test
Interval       : 1                                  Timeout      : 30
Drop Count     : 5
Hold Down      : 0                                  Hold Remain  : 0
Last Action at : 03/19/2007 00:46:55                Action Taken : Disable
-------------------------------------------------------------------------------
Destination    : 10.10.10.106
-------------------------------------------------------------------------------
Description    : (Not Specified)
Admin Priority : 90                                 Oper Priority: 90
Admin State    : Up                                 Oper State   : Down

URL Test       : URL_to_Proxy
Interval       : 10                                 Timeout      : 10
Drop Count     : 3
Hold Down      : 0                                  Hold Remain  : 0
Last Action at : 03/19/2007 05:04:15                Action Taken : Disable
Priority Change: 0                                  Return Code  : 0
===============================================================================
A:ALA-A>config>filter#


A:ALA-A>show filter redirect-policy redirect1 dest 10.10.10.106
===============================================================================
Redirect Policy
===============================================================================
Redirect Policy: redirect1                          Applied      : Yes
Description    : New redirect info
Active Dest    : 10.10.10.104
```

```
-------------------------------------------------------------------------------
Destination    : 10.10.10.106
-------------------------------------------------------------------------------
Description    : (Not Specified)
Admin Priority : 90                              Oper Priority: 90
Admin State    : Up                              Oper State   : Down

URL Test       : URL_to_Proxy
Interval       : 10                              Timeout      : 10
Drop Count     : 3
Hold Down      : 0                               Hold Remain  : 0
Last Action at : 03/19/2007 05:04:15             Action Taken : Disable
Priority Change: 0                               Return Code  : 0
===============================================================================
ALA-A#
```

Table 67 **Filter Redirect-Policy Output Fields**

Label	Description
Redirect Policy	Specifies a specific redirect policy.
Applied	Specifies whether the redirect policy is applied to a filter policy entry.
Description	Displays the user-provided description for this redirect policy.
Active Destination	ip address Specifies the IP address of the active destination.
	none Indicates that there is currently no active destination.
Destination	Specifies the destination IP address.
Oper Priority	Specifies the operational value of the priority for this destination. The highest operational priority across multiple destinations is used as the preferred destination.
Admin Priority	Specifies the configured base priority for the destination.
Admin State	Specifies the configured state of the destination.
	Out of Service Tests for this destination will not be conducted.
Oper State	Specifies the operational state of the destination.
Ping Test	Specifies the name of the ping test.
Timeout	Specifies the amount of time in seconds that is allowed for receiving a response from the far-end host. If a reply is not received within this time the far-end host is considered unresponsive.

Table 67 Filter Redirect-Policy Output Fields (Continued)

Label	Description
Interval	Specifies the amount of time in seconds between consecutive requests sent to the far end host.
Drop Count	Specifies the number of consecutive requests that must fail for the destination to declared unreachable.
Hold Down	Specifies the amount of time in seconds that the system should be held down if any of the test has marked it unreachable.
Hold Remain	Specifies the amount of time in seconds that the system will remain in a hold down state before being used again.
Last Action at	Displays a time stamp of when this test received a response for a probe that was sent out.
SNMP Test	Specifies the name of the SNMP test.
URL Test	Specifies the name of the URL test.

system-filter

Syntax **system-filter** [**chained-to**]

Context show>filter

Description This command shows system filter information.

Parameters **chained-to —** This option displays filters that chain to a given system filter.

Output **No Parameters Specified —** When no parameters are specified, the output is grouped for IPv4 and IPv6, and displays information about the active system filter and all filters with scope **system**.

The following output is an example of system filter information when no parameters are specified.

Sample Output

```
*A:Dut-C>show>filter# system-filter

===============================================================================
IP system filters
===============================================================================
Filter-Id                     Active
-------------------------------------------------------------------------------
100                           Yes
65535                         No
-------------------------------------------------------------------------------
No. of IP system filters (total / active): 2 / 1
```

```
===============================================================================

===============================================================================
IPv6 system filters
===============================================================================
Filter-Id                     Active
-------------------------------------------------------------------------------
No Matching Entries
-------------------------------------------------------------------------------
No. of IPv6 system filters (total / active): 0 / 0
===============================================================================
```

With chained-to Option Specified — The following output is an example of system filter information when the **chained-to** option is specified, .

```
*A:Dut-C>show>filter# system-filter chained-to

============================================================================
IP filters that chain to the active IP system filter
============================================================================
3                   4                   5                   6
5:23                6:24
----------------------------------------------------------------------------
No. of IP filters that chain to the active IP system filter: 6
============================================================================

============================================================================
IPv6 filters that chain to the active IPv6 system filter
============================================================================
No Matching Entries
----------------------------------------------------------------------------
No. of IPv6 filters that chain to the active IPv6 system filter: 0
============================================================================
```

match-list

Syntax **match-list**

Context show>filter

Description This command enables the context to display information for match lists used in filter policies (IOM/FP and CPM).

ip-prefix-list

Syntax **ip-prefix-list** [*prefix-list-name*]
ip-prefix-list *prefix-list-name* **references**

Context show>filter>match-list

Description This command displays IPv4 prefixes information for match criteria in IPv4 ACL and CPM filter policies.

Parameters *prefix-list-name* — A string of up to 32 characters of printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

ipv6-prefix-list

Syntax **ipv6-prefix-list** [*prefix-list-name*]
ipv6-prefix-list *prefix-list-name* **references**

Context show>filter>match-list

Description This command displays IPv6 prefixes information for match criteria in IPv6 ACL and CPM filter policies.

Parameters *prefix-list-name* — A string of up to 32 characters of printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

port-list

Syntax **port-list** [*port-list-name*]
port-list *port-list-name* **references**

Context show>filter>match-list

Description This command displays TCP/UDP/SCTP port values or ranges for match criteria in IPv4 and IPv6 ACL and CPM filter policies.

Parameters *port-list-name* — A string of up to 32 characters of printable ASCII characters. If special characters are used, the string must be enclosed within double quotes.

4.7.2.2 Clear Commands

ip

Syntax **ip** *filter-id* [**entry** *entry-id*] [**ingress | egress**]

Context clear>filter

Description Clears the counters associated with the entries of the specified IPv4 filter policy.

By default, the counters associated with each entry of the specified filter policy are all cleared. The scope of which counters are cleared can be narrowed using the command line parameters.

Default Clears all counters associated with each entry of the specified IPv4 filter policy.

Parameters *filter-id* — The IPv4 filter policy ID for which to clear the entry counters. Values can be expressed in different formats. The following shows decimal integer format.

Values 1 to 65535

entry *entry-id* — Specifies that only the counters associated with the specified filter policy entry will be cleared.

Values 1 to 65535

ingress — Specifies to only clear the ingress counters.

egress — Specifies to only clear the egress counters.

ipv6

Syntax **ipv6** *ipv6-filter-id* [**entry** *entry-id*] [**ingress | egress**]

Context clear>filter

Description Clears the counters associated with the entries of the specified IPv6 filter policy.

By default, the counters associated with each entry of the specified filter policy are all cleared. The scope of which counters are cleared can be narrowed using the command line parameters.

Default Clears all counters associated with each entry of the specified IPv6 filter policy.

Parameters *ipv6-filter-id* — The IPv6 filter policy ID for which to clear the entry counters. Values can be expressed in different formats. The following only shows decimal integer format.

Values 1 to 65535

entry *entry-id* — Specifies that only the counters associated with the specified filter policy entry will be cleared.

Values 1 to 65535

ingress — Specifies to only clear the ingress counters.

egress — Specifies to only clear the egress counters.

log

Syntax **log** *log-id*

Context clear>filter

Description Clears the contents of a memory or file based filter log.

This command has no effect on a syslog based filter log.

Parameters *log-id* — The filter log ID expressed as a decimal integer.

Values 101 to 199

mac

Syntax **mac** *mac-filter-id* [**entry** *entry-id*] [**ingress | egress**]

Context clear>filter

Description Clears the counters associated with the entries of the specified MAC filter policy.

By default, the counters associated with each entry of the specified filter policy are all cleared. The scope of which counters are cleared can be narrowed using the command line parameters.

Default Clears all counters associated with each entry of the specified MAC filter policy.

Parameters *mac-filter-id* — The MAC filter policy ID for which to clear the entry counters. Values can either be expressed as a decimal integer or as an ASCII string of up to 64 characters. The following values only shows decimal integer.

Values 1 to 65535

entry *entry-id* — Specifies that only the counters associated with the specified filter policy entry will be cleared. The values are expressed as a decimal integer.

Values 1 to 65535

ingress — Specifies to only clear the ingress counters.

egress — Specifies to only clear the egress counters.

4.7.2.3 Monitor Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

ip

Syntax **ip** *ip-filter-id* **entry** *entry-id* [**interval** *seconds*] [**repeat** *repeat*] [**absolute | rate**]

Context monitor>filter

Description This command monitors the counters associated with the specified entry of the specified IP filter policy.

Parameters *filter-id* — The IPv4 filter policy ID. Values can be expressed in different formats. The following only shows decimal integer format values.

Values 1 to 65535

entry *entry-id* — Specifies the filter policy entry to monitor, as a decimal integer. .

Values 1 to 65535

interval *seconds* **—** Configures the interval for each display in seconds.

Default 10 seconds

Values 3 to 60

repeat *repeat* — Configures how many times the command is repeated.

Default 10

Values 1 to 999

absolute — When the **absolute** keyword is specified, the raw statistics are displayed, without processing. No calculations are performed on the delta or rate statistics.

rate — When the **rate** keyword is specified, the rate-per-second for each statistic is displayed instead of the delta.

Default **absolute**

ipv6

Syntax **ipv6** *ipv6-filter-id* **entry** *entry-id* [**interval** *seconds*] [**repeat** *repeat*] [**absolute | rate**]

Context monitor>filter

Description This command monitors the counters associated with the IPv6 filter policy.

Parameters *ipv6-filter-id* — The IPv6 filter policy ID. Values can be expressed in different formats. The following only shows decimal integer format values.

Values 1 to 65535

entry *entry-id* — Specifies the filter policy entry to monitor, as a decimal integer. .

Values 1 to 65535

interval *seconds* **—** Configures the interval for each display in seconds.

Default 10 seconds

Values 3 to 60

repeat *repeat* — Configures how many times the command is repeated.

Default 10

Values 1 to 999

absolute — When the **absolute** keyword is specified, the raw statistics are displayed, without processing. No calculations are performed on the delta or rate statistics.

rate — When the **rate** keyword is specified, the rate-per-second for each statistic is displayed instead of the delta.

Default **absolute**

mac

Syntax **mac** *mac-filter-id* **entry** *entry-id* [**interval** *seconds*] [**repeat** *repeat*] [**absolute** | **rate**]

Context monitor>filter

Description This command monitors the counters associated with the specified entry of the specified MAC filter policy.

Parameters *mac-filter-id* — The MAC filter policy ID. Values can be expressed in different formats. The following only shows decimal integer format values.

Values 1 to 65535

entry *entry-id* — Specifies the filter policy entry to monitor, as a decimal integer. .

Values 1 to 65535

interval *seconds* **—** Configures the interval for each display in seconds.

Default 10 seconds

Values 3 to 60

repeat *repeat* — Configures how many times the command is repeated.

Default 10

Values 1 to 999

absolute — When the **absolute** keyword is specified, the raw statistics are displayed, without processing. No calculations are performed on the delta or rate statistics.

rate — When the **rate** keyword is specified, the rate-per-second for each statistic is displayed instead of the delta.

Default **absolute**

4.7.2.4 Debug Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

cpm

Syntax **cpm**

Context tools>dump>filter>resources

Description This command displays information about filter resource utilization on the CPM, consumption by filter-using services like TMS, OpenFlow, and the filters that use the most resources.

Output The following output is an example of filter resource utilization information.

Sample Output

```
*A:Dut-C>tools>dump>filter>resources># cpm

===========================================================================
Number of ACL filters defined on CPM
===========================================================================
Owner                     MAC             IP           IPv6          Total
---------------------------------------------------------------------------
Configuration               0              7              0              7
Host Common                 0              2              0              2
Tms                         0              1              1              2
Openflow                    0              2              1              3
---------------------------------------------------------------------------
Total                       0             14              4             18
===========================================================================
Available filters (except openflow): 16369
Available openflow filters:          16381

=============================================================================
Number of ACL filter entries / subentries defined on CPM
=============================================================================
Inserted by                               MAC        IP     IPv6         Total
-----------------------------------------------------------------------------
User configuration                          0        21        1            22
                                            0        21        1            22
Radius                                      0         0        0             0
                                            0         0        0             0
Credit Control                              0         0        0             0
                                            0         0        0             0
Embedded                                    0         0        0             0
                                            0         0        0             0
Radius shared host                          0         2        0             2
                                            0         2        0             2
Openflow                                    0         0        0             0
                                            0         0        0             0
PCC-Rule                                    0         0        0             0
                                            0         0        0             0
Other                                       0         0        0             0
                                            0         0        0             0
-----------------------------------------------------------------------------
Total                                       0        23        1            24
                                            0        23        1            24
=============================================================================
Available subentries (except openflow): 262120
Available openflow subentries:          262144
```

```
===============================================================================
Filters utilizing most resources (ordered by CPM entries)
===============================================================================
Type Id                                       Entries     Subentries   TCAM entries
                                                                       (per FlexPath)
-------------------------------------------------------------------------------
No Mac filters found
-------------------------------------------------------------------------------
Ip   100                                            5              5              5
Ip   65535                                          5              5              5
Ip   1                                              4              4              4
Ip   5:23                                           2              2              2
Ip   6:24                                           2              2              2
-------------------------------------------------------------------------------
Ipv6 _tmnx_tms-ing-5/1-F                            1              1              1
Ipv6 fSpec-0                                        0              0              0
Ipv6 fSpec-2345                                     0              0              0
Ipv6 _tmnx_ofs_system:1                             0              0              0
No more Ipv6 filters
===============================================================================

===============================================================================
Filters utilizing most resources (ordered by CPM subentries)
===============================================================================
Type Id                                       Entries     Subentries   TCAM entries
                                                                       (per FlexPath)
-------------------------------------------------------------------------------
No Mac filters found
-------------------------------------------------------------------------------
Ip   100                                            5              5              5
Ip   65535                                          5              5              5
Ip   1                                              4              4              4
Ip   5:23                                           2              2              2
Ip   6:24                                           2              2              2
-------------------------------------------------------------------------------
Ipv6 _tmnx_tms-ing-5/1-F                            1              1              1
Ipv6 fSpec-0                                        0              0              0
Ipv6 fSpec-2345                                     0              0              0
Ipv6 _tmnx_ofs_system:1                             0              0              0
No more Ipv6 filters
===============================================================================
```

dest-tracking

Syntax **dest-tracking** {**sap** | **sdp** | **ip** | **ipv6**} [**detail**]

Context tools>dump>filter>resources

Description This command displays information about resources pertaining to tracked targets.

Parameters **sap | sdp| ip | ipv6 —** displays information about SAP, SDP, IPv4, or IPv6 targets

detail — displays detailed information

Output The following output is an example of filter resource SAP destination tracking information.

Sample Output

```
dest-tracking sap
===============================================================================
Unique SAPs with tracked forwarding states ====================================
Used  : 1
Free  : 4095
Total : 4096
===============================================================================
```

The following output is an example of filter resource SAP destination tracking detailed information.

```
dest-tracking# sap detail
===============================================================================
Unique SAPs with tracked forwarding states ====================================
Num  Destination                                      Ref. count
-------------------------------------------------------------------------------
    1 sap 1/2/2                                         1
===============================================================================
Unique SAPs with tracked forwarding states ====================================
Used  : 1
Free  : 4095
Total : 4096
===============================================================================
```

egress-pbr

Syntax **egress-pbr** [**detail**]

Context tools>dump>filter>resources

Description This command displays the number of allocated unique egress PBR destinations.

Parameters **detail —** Displays number of allocated unique egress PBR destinations together with a list of destinations and their ref counts.

Output The following output is an example of filter resource egress PBR destination information.

Sample Output

```
*A:Dut-C>tools dump filter resources egress-pbr

===============================
Egress PBR destinations
===============================
Name                       Count
-------------------------------
All destinations               8
Unique destinations            4
===============================
```

```
*A:Dut-C# tools dump filter resources egress-pbr detail

===============================================================================
Unique egress PBR destinations
===============================================================================
Num Action       Ref. count Parameters
-------------------------------------------------------------------------------
  1 Esi L3       1          esi  00:00:00:00:00:00:00:00:00:01
                            ip   5.5.1.5
                            if   VasToFromAccess
                            rtr  123
-------------------------------------------------------------------------------
  2 Esi L3       2          esi  00:00:00:00:00:00:00:00:00:02
                            ip   5.5.0.5
                            if   VasToFromNetwork
                            rtr  123
-------------------------------------------------------------------------------
  3 Red-pol      3          name egress-pbr
-------------------------------------------------------------------------------
  4 Red-pol      2          name ingress-pbr
===============================================================================
```

iom

Syntax **iom** [*slot-number*]

Context tools>dump>filter>resources

Description This command shows information about filter resource utilization on all IOMs or a specified IOM. Resource utilization per filter type is available, as well as filters using most resources on a given line card.

Parameters *slot-number* — specifies that only the filter resource utilization associated with the IOM card in this slot will be displayed

Values 1 to 10

Output The following output is an example of filter resource utilization information for all IOMs.

Sample Output

```
*A:Dut-C>tools>dump>filter>resources># iom

=======================================================
Number of ACL filter entries used / available on IOMs
=======================================================
Slot                          Used          Available
-------------------------------------------------------
1                               11              65524
2                                5              65530
3                                5              65530
=======================================================
```

```
===========================================================================
Number of ACL filters and filter entries used / available on FlexPaths
===========================================================================
Slot FlexPath    Dir  Filters  Filters   MAC/IP   MAC/IP     IPv6     IPv6
                         used    avail  entries  entries  entries  entries
                                           used    avail     used    avail
---------------------------------------------------------------------------
1    1          Ingr        2     2045       10    65526        2    28670
                 Egr        2     2045        5    32763        2    16382
2    1          Ingr        4     2043        7    65529        2    28670
                 Egr        0     2047        2    32766        2    16382
3    1          Ingr        0     2047        7    65529        2    28670
                 Egr        0     2047        2    32766        2    16382
===========================================================================

===============================================================================
Filters utilizing most resources (ordered by TCAM entries per FlexPath)
Only filters present on any IOM are displayed
===============================================================================
Type Id                                     Entries     Subentries   TCAM entries
                                                                   (per FlexPath)
-------------------------------------------------------------------------------
No Mac filters found
-------------------------------------------------------------------------------
Ip   100                                          5              5              5
Ip   5:23                                         2              2              2
Ip   6:24                                         2              2              2
Ip   3                                            1              1              1
Ip   4                                            1              1              1
-------------------------------------------------------------------------------
Ipv6 _tmnx_tms-ing-5/1-F                          1              1              1
Ipv6 fSpec-0                                      0              0              0
Ipv6 fSpec-2345                                   0              0              0
No more Ipv6 filters
===============================================================================
```

ip

Syntax **ip <filter-id>**

Context tools>dump>filter>resources

Description This command displays information about the specified IP filter including resource utilization on CPM and IOM, the IOMs on which the filter is used, and the entries using the most resources.

Parameters **filter-id —** specifies that only the filter resource utilization associated with this IP filter will be displayed.

Values 1 to 65535

Output The following output is an example of IP filter resource utilization information.

Sample Output

```
*A:Dut-C>tools>dump>filter>resources># ip 100

===============================================================================
Resource utilization details for Ip filter 100
===============================================================================
CPM entries used                      : 5
CPM subentries used                   : 5
TCAM entries used (per FlexPath)      : 5
Associated with IOMs                  : 1,2,3,4,5,6,7,8,9,10

---------------------------------------------------------------------------
Largest 5 entries
---------------------------------------------------------------------------
Entry ID                                        Active        TCAM entries
                                                            (per FlexPath)
---------------------------------------------------------------------------
3                                                  Yes                   1
4                                                  Yes                   1
5                                                  Yes                   1
6                                                  Yes                   1
100                                                Yes                   1
---------------------------------------------------------------------------
===============================================================================
```

ipv6

Syntax **ipv6 <filter-id>**

Context tools>dump>filter>resources

Description This command displays information about the specified IPv6 filter including resource utilization on CPM and IOM, the IOMs on which the filter is used, and the entries using the most resources.

Parameters **filter-id —** specifies that only the filter resource utilization associated with this IPv6 filter will be displayed.

Values 1 to 65535

Output The following output is an example of IPv6 filter resource utilization information.

Sample Output

```
*A:Dut-C>tools>dump>filter>resources># ipv6 "fSpec-0"

===============================================================================
Resource utilization details for Ipv6 filter fSpec-0
===============================================================================
CPM entries used                      : 0
CPM subentries used                   : 0
TCAM entries used (per FlexPath)      : 0
Associated with IOMs                  : 2
```

```
---------------------------------------------------------------------------
Largest 5 entries
---------------------------------------------------------------------------
Entry ID                                        Active        TCAM entries
                                                            (per FlexPath)
---------------------------------------------------------------------------
No Matching Entries
---------------------------------------------------------------------------
===============================================================================
```

mac

Syntax **mac <filter-id>**

Context tools>dump>filter>resources

Description This command displays information about the specified MAC filter including resource utilization on CPM and IOM, the IOMs on which the filter is used, and the entries using the most resources.

Parameters **filter-id —** specifies that only the filter resource utilization associated with this IPv6 filter will be displayed

Values 1 to 65535

Output The following output is an example of MAC filter resource utilization information.

Sample Output

```
*A:Dut-C>tools>dump>filter>resources># mac 1

===============================================================================
Resource utilization details for Mac filter 1
===============================================================================
CPM entries used                       : 1
CPM subentries used                    : 1
TCAM entries used (per FlexPath)       : 1
Associated with IOMs                   : 1

---------------------------------------------------------------------------
Largest 5 entries
---------------------------------------------------------------------------
Entry ID                                        Active        TCAM entries
                                                            (per FlexPath)
---------------------------------------------------------------------------
1                                                  Yes                   1
No more entries defined
---------------------------------------------------------------------------
===============================================================================
```

sticky-dest

Syntax **sticky-dest**

Context tools>dump>filter>resources

Description This command displays information about resources pertaining to sticky destinations timers.

Output The following output is an example of sticky destination filter action information.

Sample Output

```
===============================================================================
Filter action - Sticky-dest resources
===============================================================================
Used  : 1
Free  : 2047
Total : 2048
===============================================================================
```

activate-best-dest

Syntax **activate-best-dest**

Context tools>perform>filter>redirect-policy

Description This command allows the operator to force a PBR switch to the best destination selected by the redirect policy when that destination is not currently active as result of sticky destination functionality being enabled for the specified redirect policy. If **hold-time-up** is running, the timer is also expired.

activate-primary-action

Syntax **activate-primary-action**

Context tools>perform>filter>ip-filter>entry
tools>perform>filter>ipv6-filter>entry
tools>perform>filter>mac-filter>entry

Description This command allows an operator to activate the primary action for the given filter policy entry. If the primary action is already active, the command has no effect. If a secondary action is active, the primary action will be activated unless the primary target is down. If the sticky destination timer is running for the primary action entry, it will expire.

5 Hybrid OpenFlow Switch

5.1 In This Chapter

Nokia supports Hybrid OpenFlow Switch (H-OFS) functionality. The hybrid model allows operators to deploy Software Defined Network (SDN) traffic steering using OpenFlow (OF) atop of the existing routing/switching infrastructure.

Topics in this chapter include:

- Hybrid OpenFlow Switching
- Configuration Notes

5.2 Hybrid OpenFlow Switching

The hybrid OpenFlow model allows operators to deploy Software Defined Network (SDN) traffic steering using OpenFlow atop of the existing routing/switching infrastructure. Some of the main benefits of the hybrid model include:

- Increased flexibility and speed for new service deployment—H-OFS implements flexible, policy-driven, standard-based Hybrid OpenFlow Switch traffic steering that allows deployment of new services and on-demand services through policy updates rather than service and infrastructure programming.
- Evolutionary capex/opex-optimized SDN deployment—The H-OFS functionality can be deployed on the existing hardware through software upgrade, realizing benefits of FlexPath programmability. The OpenFlow traffic placement is focused access only (i.e. flexible, fast, on-demand service deployment) while network infrastructure provides robustness, resiliency, scale and security.

In a basic mode of operation, a single OpenFlow Switch instance is configured on the router and controlled by a single OpenFlow controller.

The OF controller(s) and router exchange OpenFlow messages using the OpenFlow protocol (version 1.3.1) over the TCP/IPv4 control channel. Both out-of-band (default) and in-band management is supported for connectivity to the controller. An OpenFlow message is processed by the OpenFlow switch instance on the router that installs all supported H-OFS traffic steering rules in a flow table for the H-OFS instance. A single table per H-OFS instance is supported initially.

The H-OFS allows operators to:

- Steer IPv4/IPv6 unicast traffic arriving on a Layer 3 interface by programming the 7450 ESS, 7750 SR, and 7950 XRS L3 PBR ACL actions.
- Steer IPv4/IPv6 unicast traffic arriving on a Layer 2 interface by programing the 7450 ESS, 7750 SR, and 7950 XRS L2 PBF ACL actions.
- Drop traffic by programming ACL action drop.
- Forward traffic using regular processing by programming ACL action forward.

Steering actions programmed using OpenFlow are functionally equivalent to ACL actions. Please see later sections for more details on how OpenFlow standard messages are translated by the SR OS OpenFlow switch into SR OS ACL filter actions.

The router allows operators to control traffic using OF, as follows:

- An operator can select a subset of interfaces on the router to have OF rules enabled, by embedding a given instance of H-OFS in filter policies used only by those interfaces.
- For the interfaces with a given H-OFS instance enabled, an operator can:
  - Steer all traffic arriving on an interface by programming the flow table with a “match all” entry.
  - Steer a subset of traffic arriving on an interface with this H-OFS instance enabled by programming the flow table with match rules that select a subset of traffic (OpenFlow match criteria are translated to ACL filter match criteria). Unless explicitly listed as a limitation, the SR OS H-OFS supports any OpenFlow match criteria that can be translated to ACL IPv4/IPv6 filter policy match criteria. A default rule can be assigned for packets that do not match specific rules. These packets can be dropped, forwarded, or sent to the OpenFlow controller.

To enable rules in a given H-OFS on an existing service router interface, an operator must:

1. Create one or more ingress line card policy
2. Assign those line card ingress filter policies to the 7450 ESS, 7750 SR, and 7950 XRS service/router interfaces
3. Embed H-OFS instance into those line card policies
4. Program OF rules as required

OpenFlow can be embedded in IPv4/IPv6 ACL filter policies deployed on:

- L3 IES service interfaces
- L3 Network interfaces in base router context

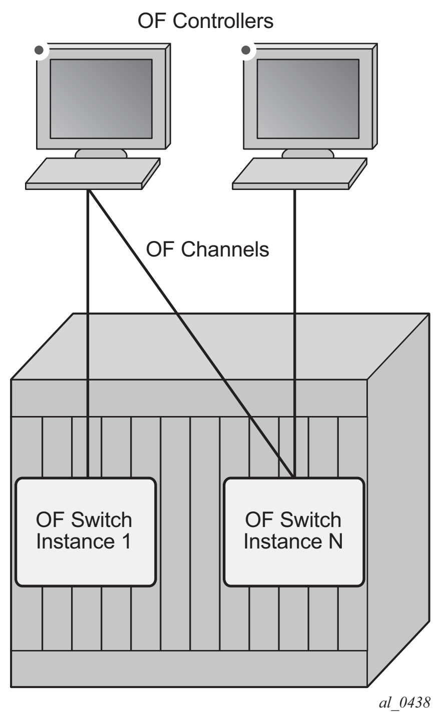
- L3 VPRN service interfaces, including those with NAT
- L2 VPLS service interfaces
- IES/VPRN r-VPLS service interfaces, including those with NAT
- System ACL filters

OpenFlow functionality is supported in addition to all existing functionality on a given interface and can be enabled with no impact on forwarding performance. Operators can move from CLI/SNMP programmed steering rules to OpenFlow operational model in service without service disruption.

5.2.1 Redundant Controllers and Multiple Switch Instances

The operator can configure one or more instances of an H-OFS (using SNMP/CLI interfaces) with each instance controlled by an OF-controller over a unique OF channel (using openflow protocol). One OF controller can control multiple H-OFS instances (using dedicated channels), or a dedicated OF controller per switch can be deployed. For each switch, up to two OF controllers can be deployed for redundancy. If two controllers are programmed, they can operate in either OFPCR_ROLE_EQUAL roles or in OFPCR_ROLE_MASTER and OFPCR_ROLE_SLAVE roles. Figure 28 depicts this architecture:

Figure 28 **SR OS/Switch OF Controller/Switch Architecture Overview**



5.2.2 GRT-only and Multi-Service H-OFS Mode of Operations

SR OS supports two modes of operations for an H-OFS instance: GRT-only and multi-service. The mode of operations is operator-controlled per H-OFS instance by enabling or disabling the **switch-defined-cookie** option (**configure**>**open-flow**>**of-switch**>**flowtable 0**). For backward compatibility, GRT-only mode of operation is default but, since multi-service mode is a functional superset, it is recommended to operate in multi-service mode whenever possible. The operator can change the mode in which an H-OFS instance operates but a shutdown is required first. This will purge all the rules forcing the OF controller to reprogram the switch instance once re-enabled in a new mode. An SR OS supports both H-OFS operational modes concurrently for different switch instances.

Multi-service operational mode uses part of the FlowTable cookie field (higher order 32 bits) to provide the enhanced functionality; the lower order FlowTable cookie bits are fully controlled by the OF controller. Table 68 depicts higher order bit Flow Table cookie encoding used when operating in the multi-service mode.

Table 68 Multi-Service Mode — Higher Order Bit Flow Table Cookie Encoding

sros-cookie Name	sros-cookie Type (Bits 63...60)	sros-cookie Value (Bits 59...32)	FlowTable Entry Interpretation Based on the sros-cookie
grt	0000	0	FlowTable rule is applicable to GRT instance (IES and router interfaces)
system	1000	0	FlowTable rule is applicable to system filters
service	1100	service-id for existing VPLS or VPRN service	FlowTable rule is applicable to an existing VPRN or VPLS service specified by the sros-cookie value

To enable multi-service mode of operation, an operator must embed the OF switch in an ACL filter policy, and, since multi-service H-OFS supports a mix of VPRN/VPLS/GRT/System rules, an additional scope of embedding must be selected (embed open-flow service, embed open-flow system - grt scope used by default). Since after embedding H-OFS instance, an ACL policy contains rules specific to a particular VPRN or VPLS service instance or to a GRT or to a System Filter Policy, the ACL filter policy can only be used in the scope defined by H-OFS embedding.

Rules programmed by an OF controller with grt, system, and service cookies specified are accepted even if the H-OFS instance is not embedded by a filter activated in a given context. Rules programmed by an OF controller with a service cookie specified, when the service ID is not one of the supported service types, or when the service with the specified id does not exist, are rejected with an error returned back to the controller. If an H-OFS is embedded into a line card policy with a specific service context, the embedding must be removed before that service is deleted.

Table 69 summarizes the main differences between the two modes of operation.

Table 69 Differences Between GRT Mode and Multi-service Mode

Function	GRT Mode (no switch-defined-cookie)	Multi-service Mode (switch-defined-cookie)
Support OF on IES access interfaces	Yes	Yes
Support OF on router interfaces in GRT instance	Yes	Yes
Support OF on VPRN access and network interfaces	No (lack of native OF service virtualization)	Yes

Table 69 Differences Between GRT Mode and Multi-service Mode (Continued)

Function	GRT Mode (no switch-defined-cookie)	Multi-service Mode (switch-defined-cookie)
Support OF on VPLS access and network interfaces	No (lack of native OF service virtualization)	Yes
Support port and VLAN in flowtable match (see the following section)	No	Yes
Support OF control of System ACL policies	No	Yes
Traffic steering actions	Forward, drop, redirect to LSP, Layer 3 PBR actions only	All
Scale	Up to ingress ACL filter policy entry scale	Up to OF system scale limit per H-OFS instance, and up to 64534 entries per unique sros-cookie value

Caveats:

- Please refer to the Release Notes for a full list of GRT/IES/VPRN/VPLS interfaces that support OF control for multi-service mode.
- The 7450 ESS, 7750 SR, and 7950 XRS H-OFS always requires sros-cookie to be provided for FlowTable operations and will fail any operation without the cookie when the **switch-defined-cookie** command is enabled.
- OF no-match-action is not programmed in hardware for system filters, since system filters are chained to other filter policies and no-match-action would break the chaining.
- An H-OFS instance does not support overlapping of priorities (flow_priority value) within a single sros-cookie (type+value). The supported values for priority differ based on a value for switch-define-cookie:
  - H-OFS with the **switch-defined-cookie** command disabled
    - Valid flow_priority_range 1 to max-size – 1
    - flow_priority_value 0 is reserved (no match action)
  - H-OFS with the **switch-defined-cookie** command enabled
    - Valid flow_priority_range 1 to 65534
    - flow_priority_value 0 is reserved (no match action)
- flow_priority must map to a valid filter ID. The following items show how flow_priority is mapped to a filter policy entry ID:
  - H-OFS with **switch-define-cookie** disabled

    - filter entry ID = max-size – flow_priority + embedding offset
  - H-OFS with **switch-define-cookie** enabled
    - filter entry ID = 65535 – flow_priority + embedding offset
- When multiple H-OFS instances are embedded into a single ACL filter, no two H-OFS instances can program the same filter entry ID.

5.2.2.1 Port and VLAN ID Match in Flow Table Entries

When operating in multi-service mode, SR OS H-OFS supports matching on port and VLAN IDs as part of Flow Table match criteria. When an OF controller specifies incoming port and VLAN values other than "ANY", the H-OFS instance translates them to an SR OS VPLS SAP (sros-cookie must be set to a valid VPLS service ID). If the translation does not result in an existing VPLS SAP, the rule is rejected and an error is returned to the controller.

A flow table rule with a port/VLAN ID match is programmed only if the matching SAP has this H-OFS instance embedded in its ACL ingress filter policy using SAP scope of embedding (**embed open-flow sap**). Please see SR OS H-OFS Port and VLAN Encoding for required encoding of port and VLAN IDs.

The SR OS H-OFS supports a mix of rules with service scope and with SAP scope. For VPLS SAPs, an H-OFS instance must be embedded twice: once for the VPLS service and once for the SAP if both service-level and SAP-level rules are to be activated.

An example of activating both service-level and SAP-level rules inside a single ACL policy 1 used on VPS SAP 1/1/1:100:

```
configure filter ip-filter 1
     scope exclusive
     embed open-flow "ofs1" service vpls100 offset 100
     embed open-flow "ofs1" sap 1/1/1:100 offset 200
```

Caveats:

- Since an H-OFS instance does not support overlapping priorities within a single sros-cookie (type+value), the priority for rules applicable to different SAPs within the same VPLS service must not overlap.
- Masking is not supported when adding a new flow table rule with a port and VLAN ID match.

5.2.3 Hybrid OpenFlow Switch Steering using Filter Policies

A router H-OFS instance is embedded into line card IPv4 and IPv6 filter policies to achieve OF-controlled Policy Based Routing (PBR). When H-OFS instance is created, embedded filters (IP and IPv6) required for that instance are automatically created. The filters are created with names, as follows:

“_tmnx_ofs_<ofs_name>”, with the same name for IPv4 and IPv6 filters used.

If embedded filters cannot be allocated due to the lack of filter policy instances, the creation of an H-OFS instance will fail. When the H-OFS instance is deleted, the corresponding embedded filters are freed.

The H-OFS can be embedded only in ingress filter policies on line cards/platforms supporting embedded filters (FP2-based or newer) and for services supporting H-OFS. Embedding of an H-OFS in filter policies on unsupported services is blocked, embedding of an H-OFS in filter policies in unsupported direction or on unsupported hardware follows the general filter policy misconfiguration behavior and is not recommended. Unsupported match fields are ignored. Other match criteria may cause a packet to match an entry.

As soon as an H-OFS instance is created, the controller can program OF rules for that instance. For instance, the rules can be created prior to the H-OFS instance embedding into a filter policy or prior to a filter policy with H-OFS instance embedded being assign to an interface. This allows operator to either preprogram H-OFS steering rules, or to disable the rules without removing them from a flow table by removing the embedding. An error is returned to controller if it attempts to program rules not supported by the system. The following lists examples of the errors returned:

- unsupported instr: [OFPET_BAD_INSTRUCTION, OFPBIC_UNSUP_INST]
- unsupported action: [OFPET_BAD_ACTION, OFPBAC_BAD_TYPE]?
- unsupported output port: [OFPET_BAD_ACTION, OFPBAC_BAD_OUT_PORT]?
- unsupported match field: [OFPET_BAD_MATCH, OFPBMC_BAD_FIELD]?
- unsupported match value: [OFPET_BAD_MATCH, OFPBMC_BAD_VALUE]?
- output port invalid/deleted after flow_mod is sent to filter: OFPET_BAD_ACTION, OFPBAC_BAD_OUT_PORT]?

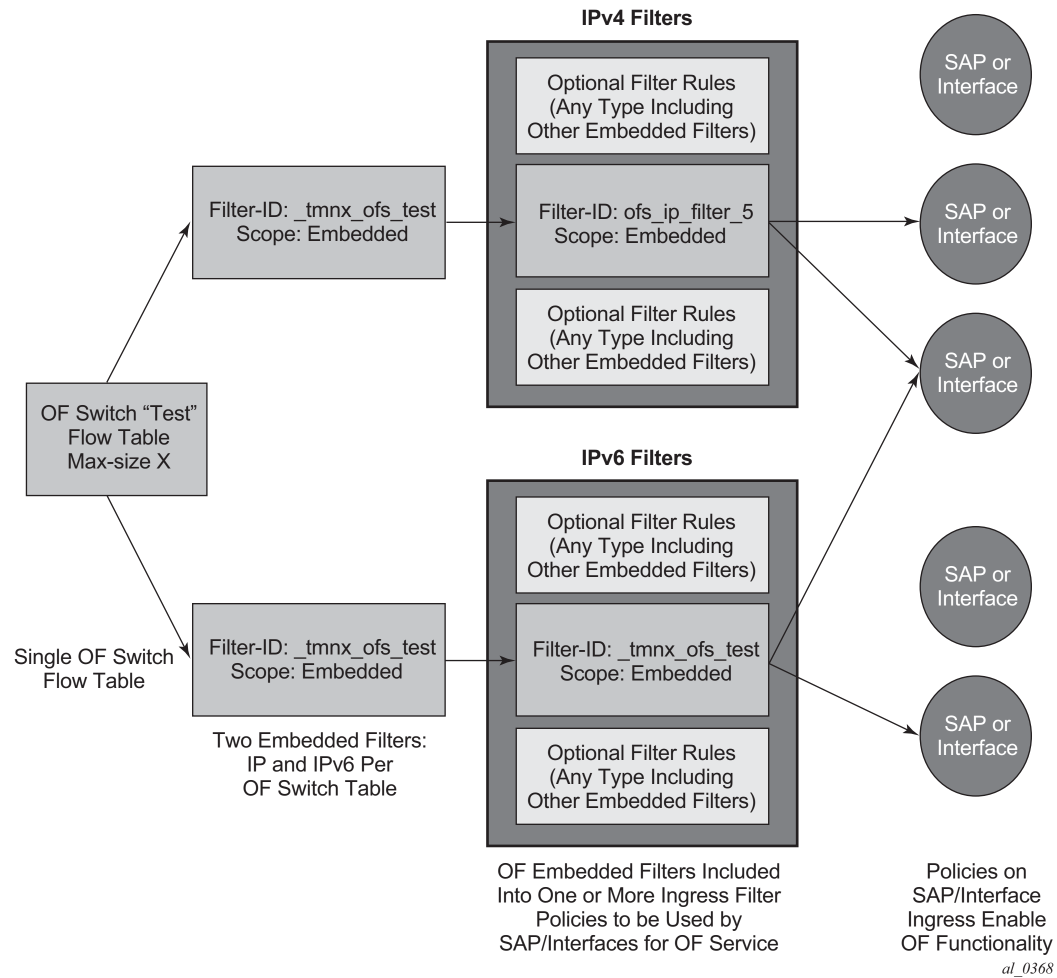
As the OF controller updates traffic steering rules, the Hybrid OpenFlow Switch updates the flow table rules. This automatically triggers programming of the embedded filter, which consequently causes instantiation of the rules for all services/ interfaces that have a filter policy embedding this H-OFS instance. Embedding filter policy configuration/operational rules apply also to embedded filters auto-created for an H-OFS instance (see Embedded Filter Support for ACL Filter Policies section of this guide). MPLS cannot be deleted if OFS rules are created that redirect to an LSP.

The auto-created embedded filters can be viewed through CLI but cannot be modified and/or deleted through filter policy CLI/SNMP. Operator can see the above embedded filters under show filter context, including the details on the filters themselves, entries programmed, interface association, statistics, etc.

The following picture depicts the H-OFS to service operator-configurable mapping example.

For an H-OFS with the **switch-defined-cookie** command enabled, embedded filters are created for each unique context in the H-OFS instead.

Figure 29 **OF Flow Table Mapping to Router/Switch Service Infrastructure Example — switch-defined-cookie Disabled**



The router allows mixing H-OFS rules from one or more H-OFS instances in a single filter policy. Co-existence of H-OFS rules in a single policy with CLI/SNMP programmed rules and/or BGP flowspec programmed rules in a single line card filter policy is also supported. When a management interface and an OF controller flow entry have the same filter policy entry, the management interface-created entry overrides the OF controller-created entry; see the embedded filter functional description. For mixing of the rules from multiple management entities, the controller should not program an entry in its Flow Table that would match all traffic, as this would stop evaluation of the filter policy.

The router supports HA for the OF Flow Table content and statistics. On an activity switch the channel goes down and is re-established by the newly active CPM. “Fail secure mode” operation takes place during channel re-establishment (OpenFlow rules continue to be applied to the arriving traffic). OF controller is expected to re-synchronize the OF table when the channel is re-established.On a router reboot, H-OFS Flow Table rules and statistics are purged. The same takes place when H-OFS instance is shutdown. The H-OFS instance cannot be deleted unless the H-OFS instance is removed first from all embedding filter policies.

5.2.4 Hybrid OpenFlow Switch Statistics

SR OS Hybrid OpenFlow switch supports statistics retrieval using the OpenFlow protocol. There are two types of statistics that can be collected:

1. **Statistics for SR OS H-OFS logical ports**

   Logical port statistics are available for RSVP-TE and MPLS-TP LSP logical ports. The non-zero statistics will be returned as long as a given LSP has its statistics enabled through an MPLS configuration. The statistics can be retrieved irrespective of whether a given OF switch uses the specified LSP or not. The statistics account for an aggregate of all packets/bytes forwarded over a given LSP. High availability follows MPLS statistics support.

   Statistics are not available for any other logical ports encodings.

2. **Statistics for SR OS H-OFS flow table**

   Flow table statistics can be retrieved for one or more flow table entries of a given H-OFS. The returned packet/bytes values are based on ACL statistics collected in hardware. An OpenFlow controller can retrieve statistics either directly from hardware or from the ACL CPM-based bulk request cache. The ACL cache is used when processing an OpenFlow statistics multi-part aggregate request message (OFPMP_AGGREGATE), or when an OpenFlow statistics multi-part flow message request (OFPM_FLOW) is translated to multiple flow table entries (a bulk request). When an OpenFlow multi-part flow statistics request message (OFPM_FLOW) is translated to a single flow table entries requests (a single entry request), the counters are read from hardware in real-time.

   A mix of the two methods can be used to retrieve some flow table statistics from hardware in real-time while retrieving other statistics from the cache. See the Filter Policy Statistics section of this guide for more details on ACL cache and ACL statistics.

   When the auxiliary channel is enabled, the switch will set up a dedicated auxiliary channel for statistics. See OpenFlow Switch Auxiliary Channels for more information.

Operational Notes:

- Flow table statistics displayed through the CLI debugging tools (tools>dump>open-flow>of-switch) are read in real-time from hardware. However, to protect the system, executing CLI debugging tool commands within 5 seconds will return the same statistics for any flow that had its statistics read from hardware within the last 5 seconds.
- When retrieving flow table statistics at scale, it is recommended to either use bulk requests, or to pace single entry requests in order to obtain the desired balance between stats real-time accuracy and CPM activity.

5.2.5 OpenFlow Switch Auxiliary Channels

The H-OFS supports auxiliary channels, as defined in OpenFlow version 1.3.1. The packet-in and statistics functions are supported on the auxiliary channels as well as on the main channel.

When the auxiliary channel is enabled on a switch (using the **aux-channel-enable** command), the switch will set up a dedicated auxiliary channel for statistics (Auxiliary ID 1) and a dedicated auxiliary channel for packet-in (Auxiliary ID 2) if a packet-in action is configured, to every controller for a given H-OFS switch instance. Auxiliary connections use the same transport as the main connection. The switch will handle any requests over any established channel and respond on the same channel even if a specific requested auxiliary channel is available.

The H-OFS instance uses the packet-in connection for packet-in functionality by default and expects (but does not require) the controller to use the statistics channel for statistics processing by default.

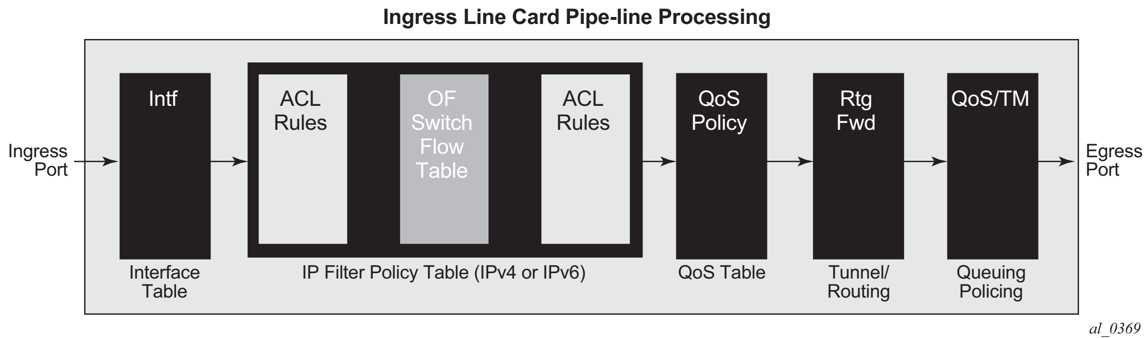
The switch uses the auxiliary channels (packet-in for packet-in-specific requests and statistics for statistics-specific requests) as long as they are available. If they are not available, the switch will use the next available auxiliary channel. If none of the auxiliary channels are available, the main channel will be used.

Auxiliary connections can be enabled or disabled without shutting down the switch.

5.2.6 Hybrid OpenFlow Switch Traffic Steering Details

As described in the previous section, an update to an OpenFlow Switch’s flow table, results in the embedded filter update(s), which triggers update to all filter policies embedding those filters. The router automatically downloads the new set of rules to the line cards as defined through service configuration. The rules became part of ingress line card pipeline as depicted in Figure 30.

Figure 30 **OpenFlow Switch Embedding in Ingress Pipeline Processing**



5.2.6.1 SR OS H-OFS Logical Port

Logical ports are used in OpenFlow to encode switch-specific ports. SR OS H-OFS uses logical ports in steering actions by encoding PBR targets. The following encoding shows logical port types supported by SR OS H-OFS:

Table 70 **Encoding and Supported Logical Port Types**

Bits 31..28	Bits 27..24	Bits 24..0
Logical port type (LPT)	Logical port type sub-type (LPT-S)	Logical port type value (LPT-V) — always padded with leading zeros

Encodings:

```
RSVP LSP: LPT: 0100, LPT-S: 0000 (tunnel), LPT-V: RSVP TE Tunnel ID
MPLS-TP LSP: LPT: 0100, LPT-S: 0000 (tunnel), LTP-V: MPLS-TP Tunnel Number
GRT instance: LPT: 0100, LPT-S: 0001 (L3 routing instance), LPT-V: 0
VPRN Id: LPT: 0100, LPT-S: 0001 (L3 routing instance), LPT-V: VPRN Service ID for a
VPRN instance configured on the system, NAT: LPT 0100, LPT-S: 0020 (NAT), LPT-V: 0
```

The supported range in OF is limited to a 24-bit service ID value range (a subset of VPRN IDs supported by the SR OS system).

Logical port values other than RSVP-TE LSP and MPLS-TP LSP require H-OFS with the **switch-defined-cookie** command enabled. Only tunnel-encoded ports are stored in the H-OFS logical port table, therefore functionality such as retrieving statistics per port is not available for logical ports that are not stored in the H-OFS logical port table.

5.2.6.2 SR OS H-OFS Port and VLAN Encoding

The OF controller can use port and VLAN values other than ANY for VPLS SAP match and for VPLS steering to SAP for H-OFS instances with the **switch-defined-cookie** command enabled.

To specify a port in an OF message, SR OS TmnxPortId encoding must be used. The allowed values are those for Ethernet physical ports and LAG.

To encode VLAN tags, OXM_OF_VLAN_ID and new experimenter OFL_OUT_VLAN_ID fields are used as per Table 71.

Table 71 **VLAN Tag Encoding**

NULL tag, dot1Q tag, inner QinQ tag VlanId	Outer QinQ tag VlanId
OXM_OF_VLAN_VID	OFL_OUT_VLAN_ID (Experimenter field uses same encoding as OXM_OF_VLAN_VID)

Table 72 shows how OF programmed values are translated to SR OS SAPs.

Table 72 **Translation of OF Programmed Values to SR OS SAPs**

OXM_OF_IN_PORT	OXM_OF_VLAN_VID	OFL_OUT_VLAN_ID	Matching SAP SR OS Encoding	Supported in flow_add	Supported in flow_mod flow_del mp_req	Comment
TmnxPortId for port or LAG	Value: 0x0000 Mask: Absent	Must be absent	port-id lag-id	Yes	Yes	Mask must be absent
TmnxPortId for port or LAG	Value: 0x1yyy, yyy encodes qtag1 Mask: Absent	Must be absent	port-id:qtag1 lag-id:qtag1	Yes	Yes	Mask must be absent
TmnxPortId for port or LAG	Value: 0x1FFF Mask: Absent	Must be absent	port-id:* lag-id:*	Yes	Yes	Mask must be absent

Table 72 **Translation of OF Programmed Values to SR OS SAPs (Continued)**

OXM_OF_IN_PORT	OXM_OF_VLAN_VID	OFL_OUT_VLAN_ID	Matching SAP SR OS Encoding	Supported in flow_add	Supported in flow_mod flow_del mp_req	Comment
TmnxPortId for port or LAG	Value: 0x1000 Mask: 0x1000	Must be absent	port-id: any lag-id: any where "any" is either * or a valid VLAN-ID (but not NULL)	No	Yes	Mask must be 0x1000
TmnxPortId for port or LAG	Value: 0x1yyy, yyy encodes qtag2 Mask: Absent	Value: 0x1zzz, zzz encodes qtag1 Mask: Absent	port-id:qtag1.qtag2 lag-id:qtag1.qtag2	Yes	Yes	Mask must be absent
TmnxPortId for port or LAG	Value: 0x1FFF Mask: Absent	Value: 0x1zzz, zzz encodes qtag1 Mask: Absent	port-id: qtag1.* lag-id: qtag1.*	Yes	Yes	Mask must be absent
TmnxPortId for port or LAG	Value: 0x1FFF Mask: Absent	Value: 0x1FFF Mask: Absent	port-id: *.* lag-id: *.*	Yes	Yes	Mask must be absent
TmnxPortId for port or LAG	Value: 0x1000 Mask: 0x1000	Value: 0x1zzz, zzz encodes qtag1 Mask: Absent	port-id: qtag1.any lag-id: qtag1.any where any is either * or a valid VLAN-ID (but not NULL)	No	Yes	Mask must be absent for OFL_OUT_VLAN_VID

Table 72 **Translation of OF Programmed Values to SR OS SAPs (Continued)**

OXM_OF_IN_PORT	OXM_OF_VLAN_VID	OFL_OUT_VLAN_ID	Matching SAP SR OS Encoding	Supported in flow_add	Supported in flow_mod flow_del mp_req	Comment
TmnxPortId for port or LAG	Value: 0x1000 Mask: 0x1000	Value: 0x1FFF Mask: Absent	port-id: *.any lag-id: *.any where "any" is either * or a valid VLAN-ID (but not NULL)	No	Yes	Mask must be absent for OFL_OUT_VLAN_VID
TmnxPortId for port or LAG	Value: 0x1000 Mask: 0x1000	Value: 0x1000 Mask: 0x1000	port-id: any.any lag-id: any.any where "any" is either * or a valid VLAN-ID (but not NULL)	No	Yes	Masks must be 0x1000
TmnxPortId for port or LAG	Value: 0x0000 Mask: Absent	Value: 0x1FFF Mask: Absent	port-id: *.null	Yes	Yes	Mask must be absent

5.2.6.3 Redirect to IP next-hop

A router supports redirection of IPv4 or IPv6 next-hop for traffic arriving on a Layer 3 interface. An OF controller can rely on this functionality and program PBR next-hop steering actions for H-OFS instances with the **switch-defined-cookie** command enabled using the following OF encoding:

```
ALU_IPD_EXPERIMENTER_ID: 0x000025BA
ALU_AXN_REDIRECT_TO_NEXTHOP: 2
flow_mod:
instruction= OFPIT_WRITE_ACTION/OFPIT_APPLY_ACTION,
action= OFPAT_EXPERIMENTER(ALU_AXN_REDIRECT_TO_NEXTHOP),
encoding:
struct alu_axn_redirect_to_nhopv4{
uint16_t type;                    /* OFPAT_EXPERIMENTER. */
uint16_t len;                     /* Total Length is a multiple of 8. */
```

```
uint32_t experimenter;           /* Experimenter ID vendor unique*/
uint8_t    redirect_type;        /* Type = 1 for Nhop*/
uint8_t    flags;                /* flags is 0-7 bits:
     Bit 0 = Ipv4,
     Bit 1 = Ipv6,
     Bit 2   = indirect
     */
uint8_t     pad[2];
uint32_t   ipaddr;                /* ipv4 addr */
unit8_t     pad[0];               /* Not needed */
}; ASSERT(sizeof(alu_axn_redirect_to_nhopv4) == 16)
struct alu_axn_redirect_to_nhopv6{
uint16_t type;                   /* OFPAT_EXPERIMENTER. */
uint16_t len;                    /* Total Length is a multiple of 8. */
uint32_t experimenter;           /* Experimenter ID vendor unique*/
uint8_t    redirect_type;        /*  Type = 1 for Nhop*/
uint8_t    flags;                /* flags is 0-7 bits:
     Bit 0 = Ipv4,
     Bit 1 = Ipv6,
     Bit 2   = indirect
     */
uint8_t       pad[2];
uint128_t   ip6addr;              /* ipv6 addr */
unit8_t     pad[4];               /* Make total len multiple of 8 */
}; ASSERT(sizeof(alu_axn_redirect_to_nhopv6) == 32)
```

In case of erroneous programming, the following experimenter-specific errors are returned to the controller:

```
enum alu_err_exp_class{
ALU_ERR_CLASS_RD_TO_SDP       = 0,
ALU_ERR_CLASS_RD_TO_NHOP      = 1,
}
enum alu_err_subtype_redirect_to_nhop
{
ALU_ERR_RN_INVALID_FLAGS      = 0
ALU_ERR_RN_INVALID_ARGS       = 1
ALU_ERR_RN_INVALID_ADDR       = 2
}
```

5.2.6.4 Redirect to GRT Instance or VRF Instance

A router supports redirection of IPv4 or IPv6 traffic arriving on a Layer 3 interface to a different routing instance (GRT or VRF). An OF controller can rely on this functionality and program PBR actions for GRT/VRF steering for H-OFS instances with the **switch-defined-cookie** command enabled using the following OF encoding:

```
flow_mod:
instruction type: OFPIT_WRITE_ACTIONS/OFPIT_APPLY_ACTION,
action type: OFPAT_OUTPUT,
```

port= SR OS LOGICAL port encoding GRT or VPRN Service ID as outlined in the SR OS H-OFS Logical Port section.

Since a 24-bit value is used to encode the VPRN service ID in the logical port, redirection to a VPRN service with a service ID above that range is not supported.

5.2.6.5 Redirect to Next-hop and VRF/GRT Instance

A router supports redirection of IPv4 or IPv6 traffic arriving on a Layer 3 interface to a different routing instance (GRT or VRF) and next-hop IP at the same time. An OF controller can rely on this functionality and program PBR steering action for H-OFS instances with the **switch-defined-cookie** command enabled using the following OF encoding:

```
ALU_IPD_EXPERIMENT_ID:0X000025BA
ALU_AXN_REDIRECT_TO_NEXTHOP:2
flow_mod:
Instruction 1:
instruction=OFPIT_WRITE_ACTION/OFPIT_APPLY_ACTION
action=OFPAT_EXPERIMENTER(ALU_AXN_REDIRECT_TO_NEXTHOP),
```

Encoding as outlined in the Redirect to IP next-hop section (indirect flag must be set).

```
Instruction 2:
instruction type: OFPIT_WRITE_ACTIONS/OFPIT_APPLY_ACTION,
action type: OFPAT_OUTPUT,
```

port= SR OS LOGICAL port encoding GRT or VPRN Service ID as outlined in the SR OS H-OFS Logical Port section.

5.2.6.6 Redirect to ESI (L2)

The router supports redirection of IPv4/IPv6 traffic arriving on a Layer 2 interface to an Ethernet Segment Identifier (ESI) with an EVPN control plane. An OF controller can program L2 ESI steering with the **switch-defined-cookie** command enabled using the following OF encoding:

```
flow_mod:
    instruction type: OFPIT_WRITE_ACTIONS/OFPIT_APPLY_ACTION,
    action type: OFPAT_EXPERIMENTER(ALU_AXN_REDIRECT_TO_ESI_L2)
    encoding:

struct alu_axn_redirect_to_ESI_L2{
    uint16_t  type;              /* OFPAT_EXPERIMENTER. */
    uint16_t  len;               /* Total  Length is a multiple of 8. */
    uint32_t  experimenter;      /* Experimenter ID vendor unique*/
```

```
    uint8_t   redirect_type ;      /*  Type = 3 for ESI*/
    uint8_t   flags;               /*  flags is 0-7 bits:
                                       Value   0 = L2,
                                   */
    uint8_t    esi[10];            /* 10 byte ESI */
    uint32_t   svcId;              /* Svc-Name Using the OF Encoding */
}; ASSERT(sizeof(alu_axn_redirect_to_ESI_L2) == 24)
```

5.2.6.7 Redirect to ESI (L3)

The router supports redirection of IPv4/IPv6 traffic arriving on a Layer 3 interface to an ESI with an EVPN control plane. An OF controller can program L3 ESI steering with the **switch-defined-cookie** command enabled using the following OF encoding:

```
flow_mod:
    instruction type: OFPIT_WRITE_ACTIONS/OFPIT_APPLY_ACTION,
    action type: OFPAT_EXPERIMENTER(ALU_AXN_REDIRECT_TO_ESI_L3)
    encoding:

struct alu_axn_redirect_to_ESI_L3_V4{
    uint16_t  type;                /* OFPAT_EXPERIMENTER. */
    uint16_t  len;                 /* Total  Length is a multiple of 8. */
    uint32_t  experimenter;        /* Experimenter ID vendor unique*/
    uint8_t   redirect_type ;      /*  Type = 3 for ESI*/
    uint8_t   flags;               /*  flags is 0-7 bits:
                                       Value   1 = L3 (ipv4)
                                   */
    uint8_t    esi[10];            /* 10 byte ESI */
    uint32_t   svcId;              /* Svc-Name Using the OF Encoding */
    uint32_t   sf-ip;              /* v4 address of sf-ip */
    uint32_t   ifIndex;            /* interface id*/
}; ASSERT(sizeof(alu_axn_redirect_to_ESI_L3_V42) == 32)

struct alu_axn_redirect_to_ESI_L3_V6{
    uint16_t  type;                /* OFPAT_EXPERIMENTER. */
    uint16_t  len;                 /* Total  Length is a multiple of 8. */
    uint32_t  experimenter;        /* Experimenter ID vendor unique*/
    uint8_t   redirect_type ;      /*  Type = 1 for Nhop*/
    uint8_t   flags;               /*  flags is 0-7 bits:
                                       Value = 2 = L3 (ipv6)
                                   */
    uint8_t    esi[10];            /* 10 byte ESI */
    uint32_t   svcId;              /* Svc-Name Using the OF Encoding */
    uint128_t  sf-ip;              /* v6 address of sf-ip */
    uint32_t   ifIndex;            /* interface id*/
    uint8_t    pad[4];
}; ASSERT(sizeof(alu_axn_redirect_to_ESI_L3_V6) == 48)
```

5.2.6.8 Redirect to ESI IP VAS-Interface Router

The router supports redirection of IPv4/IPv6 traffic arriving on a Layer 3 interface to a VAS interface bound to an ESI with an EVPN control plane. An OF controller can program L3 steering with the **switch-defined-cookie** command enabled using the following OF encoding:

```
flow_mod:
    instruction type: OFPIT_WRITE_ACTIONS/OFPIT_APPLY_ACTION,
    action type: OFPAT_EXPERIMENTER(ALU_AXN_REDIRECT_TO_ESI_VAS_INTERFACE_L3)
    encoding:

struct alu_axn_redirect_to_ESI_VAS_INTERFACE_L3_V4{
    uint16_t  type;                /* OFPAT_EXPERIMENTER. */
    uint16_t  len;                 /* Total Length is a multiple of 8. */
    uint32_t  experimenter;        /* Experimenter ID vendor unique*/
    uint8_t   redirect_type ;      /*  Type = 2 for ESI*/
    uint8_t   flags;               /*  flags is 0-7 bits:
                                       Value 2 = L3 (ipv4)
                                   */
    uint8_t    pad[2];
    uint32_t   svcId;              /* Svc-Name Using the OF Encoding */
    uint32_t   vas-ip;             /* v4 address of sf-ip */
    uint32_t   ifIndex;            /* vas interface id*/
}; ASSERT(sizeof(alu_axn_redirect_to_ESI_VAS_INTERFACE_L3_V4) == 24)

struct alu_axn_redirect_to_ESI_VAS_INTERFACE_L3_V6{
    uint16_t  type;                /* OFPAT_EXPERIMENTER. */
    uint16_t  len;                 /* Total Length is a multiple of 8. */
    uint32_t  experimenter;        /* Experimenter ID vendor unique*/
    uint8_t   redirect_type ;      /*  Type = 2 for ESI*/
    uint8_t   flags;               /*  flags is 0-7 bits:
                                       Value 2 = L3 (ipv6)
                                   */
    uint8_t    pad[6];             /* 10 byte ESI */
    uint32_t   svcId;              /* Svc-Name Using the OF Encoding */
    uint128_t  vas-ip;             /* v6 address of sf-ip */
    uint32_t   ifIndex;            /* vas interface id*/
}; ASSERT(sizeof(alu_axn_redirect_to_ESI_VAS_INTERFACE_L3_V6) == 40)
```

5.2.6.9 Redirect to LSP

The router supports traffic steering to an LSP. The following details the OF encoding to be used by an OF controller:

```
flow_mod:
instruction type: OFPIT_WRITE_ACTIONS or OFPIT_APPLY_ACTION,
action type: OFPAT_OUTPUT,
```

port= SR OS LOGICAL port encoding RSVP-TE or MPLS-TP LSP as outlined in SR OS H-OFS Logical Port section

A received LSP in a flow rule is compared against those in the H-OFS logical port table, if the table does not contain the LSP the rule programming fails. Otherwise, the rule is installed in an ACL filter. As long as any path within the LSP is UP, the redirect rule will forward unicast IP(v6) traffic on the currently used best LSP path by adding LSP transport label and, in case of IPv6 traffic, additionally adding explicit NULL label.

When an LSP in the H-OFS logical port table goes down, the OF Switch removes the LSP from its logical port table and may notify the controller of that fact if the logical port status reporting is enabled. It is up to the OF controller to decide whether to remove rules using this LSP or not. If the rules are left in the flow table, the traffic that was to be redirected to this LSP will instead be subject to a forward action for this flow rule. If the controller does not remove the entries and the system re-uses the LSP identified for another LSP, the rules left in the flow table will start redirecting traffic onto this new LSP.

In some deployments, an SDN controller may need to learn from the router H-OFS logical ports status. To support that function, the OF switch supports optional status reporting using asynchronous OF protocol messages for ports status change.

5.2.6.10 Redirect to NAT

The router supports redirection of IPv4 traffic arriving on a Layer 3 interface for ISA NAT processing. An OF controller can program NAT steering for H-OFS instances with the **switch-defined-cookie** command enabled using the following OF encoding:

```
flow_mod:
    instruction type: OFPIT_WRITE_ACTIONS/OFPIT_APPLY_ACTION,
    action type: OFPAT_OUTPUT,
```

port = SR-OS LOGICAL port encoding as outlined in the SR OS H-OFS Logical Port section.

5.2.6.11 Redirect to SAP

For traffic arriving on a VPLS interface, a router supports PBF to steer traffic over another VPLS SAP in the same service. An OF controller can rely on this functionality and program PBF steering action for H-OFS instances with the **switch-defined-cookie** command enabled using the following OF encoding:

```
flow_mod:
instruction type: OFPIT_WRITE_ACTIONS or OFPIT_APPLY_ACTION,
```

```
Action 1:
action type: OFPAT_OUTPUT,
```

port: = Encoding as outlined in SR OS H-OFS Port and VLAN Encoding section

```
Action 2:
action type=OFPAT_SET_FIELD
```

OXM TLVs encode SAP VLANs as outlined in SR OS H-OFS Port and VLAN Encoding section:

```
- OXM_OF_VLAN_VID
- OFL_OUT_VLAN_ID (optional)
```

5.2.6.12 Redirect to SDP

For traffic arriving on a VPLS interface, a router supports PBF to steer traffic over a VPLS SDP in the same service. An OF controller can rely on this functionality and program PBF steering action for H-OFS instances with switched-defined-cookie enabled using the following OF encoding:

```
ALU_IPD_EXPERIMENTER_ID:  0x000025BA
ALU_AXN_REDIRECT_TO_SDP: 1
flow_mod:
instruction= OFPIT_WRITE_ACTIONS/OFPIT_APPLY_ACTIONS,
action= OFPAT_EXPERIMENTER(ALU_AXN_REDIRECT_TO_SDP),
encoding:
struct alu_axn_redirect_to_sdp{
uint16_t type;                   /* OFPAT_EXPERIMENTER. */
uint16_t len;                    /* Total Length is a multiple of 8. */
uint32_t experimenter;           /* Experimenter ID vendor unique*/
uint8_t    redirect_type;        /* Type = 0 for SDP*/
uint8_t    flags;               /
* Flags that can be used to denote    info(reserved)*/
uint16_t sdp-id;                 /* Sdp-id*/
uint32_t vcId;                   /* Vc-id*/
unit8_t    pad[0];                /* Not needed */
}; ASSERT(sizeof(alu_axn_redirect_to_sdp) == 16)
```

In case of erroneous programming, the following experimenter-specific errors are returned to the controller:

```
enum alu_err_exp_class
{
ALU_ERR_CLASS_RD_TO_SDP      = 0,
ALU_ERR_CLASS_RD_TO_NHOP     = 1,
}
enum alu_err_redirect_to_sdp
{
ALU_ERR_RS_INVALID_FLAGS     = 0
ALU_ERR_RS_INVALID_ARGS      = 1
```

```
ALU_ERR_RS_INVALID_SDP_ID    = 2
ALU_ERR_RS_INVALID_VC_ID     = 3
}
```

5.2.6.13 Forward action

An OF controller can program forward action, when a specific flow is to be forwarded using regular router forwarding. This would be a default behavior if the filter-policy embedding this OF switch instance has a default-action forward and no filter policy rule matches the flow. To implement forward action, the following OF encoding is used:

```
flow_mod:
instruction type: OFPIT_WRITE_ACTIONS or OFPIT_APPLY_ACTION,
action type: OFPAT_OUTPUT,
port= NORMAL
```

where NORMAL is a OF reserved value.

5.2.6.14 Drop action

An OF controller can program a drop action, when packets of a specific flow are to be dropped. To implement drop action, the following OF encoding is used:

- A wildcard rule with empty action-set

5.2.6.15 Default no-match Action

Packets that do not match any of the flow table entries programmed by the controller are subject to a default action. The default action is configurable in the CLI using the **no-match-action** command. Three possible no-match actions are supported: **drop**, **fall-through** (packets are forwarded with regular processing by the router), and **packet-in**.

The **packet-in** action causes packets that do not match entries in the flow table as programmed by the OpenFlow controller to be extracted and sent to the controller in a flow-controlled manner. Because EQUAL is supported, packet-in messages are sent to all controllers in the UP state. Only the first packet of a given 5-tuple flow (source IP address, destination IP address, source port, destination port, protocol) to which the no-match action is applied is sent to the controller in order to protect the controller. This 5-tuple flow context ages out after 10 s. Each switch instance maintains contexts for up to 8192 outstanding packet-in messages to the controller. If the **packet-in** action is used, an auxiliary channel should be enabled for packet-in processing (using the **aux-channel-enable** command). A count of packets to which packet-in is applied is also available through the OpenFlow channel statistics.

5.2.6.16 Programming of DSCP Remark Action

The router supports DSCP remarking of IPv4/IPv6 packets arriving on VPLS, VPRN, GRT, and system interfaces for OFS instances with the **switch-defined-cookie** command enabled using the following OF encoding:

```
flow_mod:
    instruction type: OFPIT_METER
    action type:  with the meterId.
```

The meters are configured using meter modification messages, and are configured before the flow messages are sent with meter instruction:

```
typedef struct tOfpMeterModMsg
{
    tOfpMsgHeader       msgHdr;
    uint16_t            mtrCommand;    /* One of OFP_MTR_CMD_*. */
    uint16_t            mtrConfig;     /* bitmap of OFP_MTR_CFG_*. */
    uint32_t            mtrId;         /* Meter instance. */
    tOfpMeterBandHeader bands[0];      /* The band list length is inferred from
                                       the length field in the msgHdr. */
} tOfpMeterModMsg;

typedef struct tOfpMeterBandHeader
{
    uint16_t            bandType;      /* One of OFP_MTR_BAND_*. */
    uint16_t            length;        /* Length in bytes of this band. */
    uint32_t            rate;          /* Rate for this band. */
    uint32_t            burstSize;     /* Size of bursts. */
} tOfpMeterBandHeader;

typedef enum eOfpMeterBandType
{
    OFP_MTR_BAND_DROP         = 1,             /* Drop packet. */
    OFP_MTR_BAND_DSCP_REMARK  = 2,             /* Remark DSCP in the IP header. */
    OFP_MTR_BAND_EXPERIMENTER = 0xFFFF         /* Experimenter meter band. */
} eOfpMeterBandType;

typedef struct tOfpMeterBandDscpRemark
{
    tOfpMeterBandHeader  bandHdr;      /* OFP_MTR_BAND_DSCP_REMARK */
    uint8_t              precLevel;    /* Number of drop precedence level to add */
    uint8_t              pad[3];
} tOfpMeterBandDscpRemark;
```

5.3 Configuration Notes

The following information describes OF implementation caveats:

- The SR OS Hybrid OpenFlow Switch requires a software upgrade only and can be enabled on any SR OS or switch running IOM-2 (with restrictions) or newer line cards. For full functionality, performance, and future scale IOM3-XP or newer line cards and CPM4 or newer control cards are recommended.
- Some platforms may not support all OF functionality based on the underlying hardware. For example, if the underlying hardware does not support IPv6, then OF IPv6 functionality will not be supported, if the underlying hardware does not support redirect to LSP, redirect action will be ignored.
- Each flow in an OF flow table must have unique priority. Overlap is not supported
- Timed expiry of the flow entries is not supported
- The implementation is compliant by design with OpenFlow specification as applicable to supported router functionality only.

5.4 OpenFlow Command Reference

5.4.1 Command Hierarchies

- OpenFlow Commands
- Show Commands
- Tools Commands

5.4.1.1 OpenFlow Commands

config
- — **open-flow** *filter-id* [**create**]
  - — [**no**] **of-switch** *ofs-name*
    - — [**no**] **aux-channel-enable**
    - — [**no**] **controller** *ip-address:port*
    - — **description** *description-string*
    - — **no description**
    - — **echo-interval** *seconds*
    - — **no echo-interval**
    - — **echo-multiple** *value*
    - — **no echo-multiple**
    - — [**no**] **flowtable** *of-table-id*
      - — **max-size** *size*
      - — **no max-size**
      - — **no-match-action** {**drop** | **fall-through** | **packet-in**}
      - — **no no-match-action**
      - — [**no**] **switch-defined-cookie**
    - — [**no**] **logical-port-status** [**rsvp-te** | **mpls-tp**]
    - — [**no**] **logical-port-status** {**rsvp-te** | **mpls-tp**}
    - — [**no**] **shutdown**

5.4.1.2 Show Commands

show
- — **open-flow**
  - — **of-switch**
  - — **of-switch** *ofs-name* **controller** *ip-address:port* **detail**
  - — **of-switch** *ofs-name* **status controller** [*ip-address:port*]
  - — **of-switch** *ofs-name* **controller**
  - — **of-switch** *ofs-name* **flowtable**
  - — **of-switch** *ofs-name* **status**
  - — **of-switch** *ofs-name* **port**

5.4.1.3 Tools Commands

tools
— **dump**
— **open-flow**
— **of-switch** *ofs-name* [**flowtable** *of-table-id*] [{**grt** | **system** | **service-id** *service-id*}] [**cookie** *hex-string*] [**priority** *priority*]
— **of-switch** *ofs-name* [**flowtable** *of-table-id*] **service-id** *service-id* **sap-id** *sap-id* [**cookie** *hex-string*] [**priority** *priority*]
— **of-switch** *ofs-name* [**flowtable** *of-table-id*] **summary**

5.4.2 Command Descriptions

5.4.2.1 Generic Commands

open-flow

Syntax **open-flow**

Context config

Description This command enables configuration content for OpenFlow Hybrid Switch compatibility.

The **no** form of the command removes the OpenFlow configuration from the context.

Default n/a

of-switch

Syntax [**no**] **of-switch** *ofs-name*

Context config>open-flow

Description This command creates an OpenFlow switch instance.

The **no** form of the command deletes the OpenFlow switch instance from the context.

Default no of-switch

Parameters *string* — specifies the name of the OpenFlow switch instance, a string up to 32 characters

aux-channel-enable

Syntax [**no**] **aux-channel-enable**

Context config>open-flow>of-switch

Description This command enables auxiliary connections for the given H-OFS instance. If enabled, the H-OFS switch sets up a statistics auxiliary channel (Auxiliary ID 1) and a packet-in auxiliary channel (Auxiliary ID 2) for the main connection to every configured OpenFlow controller.

The **no** form of this command disables auxiliary connections.

Default no aux-channel-enable

controller

Syntax [**no**] **controller** *ip-address:port*

Context config>open-flow>of-switch

Description This command configures the OpenFlow controller for this OpenFlow switch. Up to two controllers can be configured per OpenFlow switch instance.

The **no** form of this command deletes the controller for this OpenFlow switch instance.

Default no controller

Parameters *ip-address:port* — specifies the IP address and TCP port for the OpenFlow channel to the the controller

description

Syntax **description** *string*
no description

Context config>open-flow>of-switch

Description This command allows the user to configure a description string for the specified OpenFlow controller instance.

The **no** form of this command deletes the description of the specified OpenFlow controller instance.

Default no description

Parameters *string* — specifies a description of the OpenFlow switch instance, a string up to 256 characters

echo-interval

Syntax **echo-interval** *seconds*
no echo-interval

Context config>open-flow>of-switch

Description This command configures the Echo Request interval for monitoring the OpenFlow control channels to the controller(s) for this OpenFlow switch instance.

The **no** form of this command restores default value.

Default echo-interval 10

Parameters *seconds* — specifies an interval, in seconds

Values 1 to 3600

echo-multiple

Syntax **echo-multiple** *value*
no echo-multiple

Context config>open-flow>of-switch

Description This command configures the number of consecutive Echo Reply messages that must be lost to declare OF control channel down.

The **no** form of this command restores default value.

Default echo-multiple 3

Parameters *value* — specifies the threshold value for the number of consecutive Echo Rely messages lost

Values 3 to 100

logical-port-status

Syntax [**no**] **logical-port-status** [**rsvp-te** | **mpls-tp**]

Context config>open-flow>of-switch

Description This command enables status change reporting to the OpenFlow controller for the specified logical port type. To report on multiple logical port types, the command needs to be executed multiple times with different logical port specified as required.

The **no** form of this command disables status reporting for specified or all (no argument) logical ports.

Default no logical-port-status

Parameters **rsvp-te —** enables reporting on RSVP-TE LSP logical ports

mpls-te — enables reporting on MPLS-TE logical ports

shutdown

Syntax [**no**] **shutdown**

Context config>open-flow>of-switch

Description This command administratively enables or disables the OpenFlow switch instance. Disabling the switch purges all flowtable entries.

Default shutdown

flowtable

Syntax [**no**] **flowtable** *of-table-id*

Context config>open-flow>of-switch

Description This command configures the flow table parameters for this OpenFlow switch instance.

The **no** form of this command restores flow table configuration default settings.

Default no flowtable

Parameters *of-table-id* — specifies an identifier of the OpenFlow table, a string up to 256 characters

max-size

Syntax **max-size** *size*
no max-size

Context config>open-flow>of-switch>flowtable

Description This command configures the size for the specified flow table. The OpenFlow switch instance must be shutdown to modify this parameter.

The **no** form of this command restores the default size.

Default max-size 1000

Parameters *size* — specifies the maximum size limit for the flow table. The size limit is a total for both IPv4 and IPv6.

Values 1 to 262144

Default 1000

no-match-action

Syntax **no-match-action** {**drop** | **fall-through** | **packet-in**}
no no-match-action

Context config>open-flow>of-switch>flowtable

Description This command configures the action for the flow table when a packet does not match any entry for the controller.

The **no** form of this command restores the default action.

Default no-match-action fall-through

Parameters **drop —** specifies that packets that do not match entries in the flow table as programmed by the OpenFlow switch will be dropped

fall-through — specifies that packets that do not match entries in the flow table as programmed by the OpenFlow switch will be forwarded using regular processing by the router. Fall-through applies if an error occurs that prevents a flow table from being installed in a filter policy.

packet-in — specifies that packets that do not match entries in the flow table as programmed by the OpenFlow switch will be extracted and sent to the controller in a flow-controlled manner. If this action is used, an auxiliary channel should be enabled for packet-in processing (using the **aux-channel-enable** command).

switch-defined-cookie

Syntax **switch-defined-cookie**
[**no**] **switch-defined-cookie**

Context config>open-flow>of-switch>flowtable

Description This command enables OpenFlow switch-defined Flow Table cookie encoding for flowtable 0 that allows multi-service operation.

The **no** form of the command disables the above function.

Default **no switch-defined-cookie**

5.4.2.2 Show Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

open-flow

Syntax **open-flow**

Context show

Description Displays OpenFlow switch hybrid information.

Default n/a

of-switch

Syntax
of-switch
of-switch *ofs-name* **controller** *ip-address:port* **detail**
of-switch *ofs-name* **status controller** [*ip-address:port*]
of-switch *ofs-name* **controller**
of-switch *ofs-name* **flowtable**
of-switch *ofs-name* **status**
of-switch *ofs-name* **port**

Context show>open-flow

Description This command displays information related to H-OFS configuration and operations as per the parameters specified.

If no parameter is specified, this command displays a summary for H-OFS instances configured.

Default n/a

Parameters *ofs-name* — specifies the name of the configured H-OFS instance, up to 32 characters

controller *ip-address:port* **—** displays information on the controller for the specified H-OFS instance

Values ip-address: a.b.c.d
port: 1 to 65535

detail — displays detailed information

status — displays status information for the specified H-OFS switch or its controller

flowtable — displays information about flowtables for the specified H-OFS instance

port — displays information about the logical OpenFlow ports registered with the specified H-OFS instance

Output

Sample Output

```
*A:Dut-A# show open-flow of-switch "s1" status
```

```
===============================================================================
Open Flow Switch Information
===============================================================================
Switch Name        : s1
Data Path ID       : 0                    Admin Status       : Up
Echo Interval      : 10 seconds           Echo Multiple      : 3
Logical Port Type  : all
Buffer Size        : 256                  Num. of Tables     : 1
Description        : test-sw1
Capabilities Supp. : flow-stats table-stats port-stats
===============================================================================

*A:Dut-A# show open-flow of-switch "s1" controller

===============================================================================
Open Flow Controller Summary
===============================================================================
IP Address                                       Port
-------------------------------------------------------------------------------
10.20.1.2                                        6633
10.20.1.3                                        6633
-------------------------------------------------------------------------------
Number of Controllers : 2
-------------------------------------------------------------------------------
===============================================================================

*A:Dut-A# show open-flow of-switch "s1" controller 10.20.1.2:6633 detail

===============================================================================
Open Flow Controller Information
===============================================================================
IP Address        : 10.20.1.2         Port               : 6633
Role              : equal             Generation ID      : 0

-------------------------------------------------------------------------------
Open Flow Channel Information
-------------------------------------------------------------------------------
Channel ID            : 1                 Version          : 4
Connection Type       : primary           Operational Status: Up
Operational Flags     : socketStateEstablished helloReceived helloTransmitted
                        handshake
Async Fltr Packet In
 (Master or Equal)    : tableMiss applyAction
 (Slave)              : (Not Specified)
Async Fltr Port Status
 (Master or Equal)    : portAdd portDelete portModify
 (Slave)              : portAdd portDelete portModify
Async Fltr Flow Rem
 (Master or Equal)    : idleTimeOut hardTimeOut flowModDelete groupDelete
 (Slave)              : (Not Specified)

Echo Time Expiry      : 0d 00:00:10       Hold Time Expiry  : 0d 00:00:30
Conn. Uptime          : 0d 00:00:00       Conn. Retry           : 0d 00:00:00

-------------------------------------------------------------------------------
Open Flow Channel Stats - Channel ID(1)
-------------------------------------------------------------------------------
Packet Type      Transmitted Packets  Received Packets     Error Packets
```

```
-------------------------------------------------------------------------------
Hello             1                    1                    0
Error             0                    0                    0
Echo Request      0                    70                   0
Echo Reply        70                   0                    0
Experimenter      0                    0                    0
Feat. Request     0                    1                    0
Feat. Reply       1                    0                    0
Get Cfg Request   0                    1                    0
Get Cfg Reply     1                    0                    0
Set Config        0                    1                    0
Packet In         0                    0                    0
Flow Removed      0                    0                    0
Port Status       0                    0                    6
Packet Out        0                    0                    0
Flow Modify       0                    0                    0
Group Modify      0                    0                    0
Port Modify       0                    0                    0
Table Modify      0                    0                    0
Multipart Req     0                    0                    0
Multipart Reply   0                    0                    0
Barrier Request   0                    0                    0
Barrier Reply     0                    0                    0
Get Q Cfg Req     0                    0                    0
Get Q Cfg Reply   0                    0                    0
Role Request      0                    0                    0
Role Reply        0                    0                    0
Get Async Req     0                    0                    0
Get Async Reply   0                    0                    0
Set Async         0                    0                    0
Meter Modify      0                    0                    0
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
===============================================================================

*A:Dut-A# show open-flow of-switch "s1" flowtable

===============================================================================
Flow Table Information
===============================================================================
Flow Table ID      : 0                  Max-Size                 : 1000
No-Match Action    : fall-through       Curr Num. of Entries     : 1
                                        Max. Num. of Entries     : 54
===============================================================================

*A:Dut-A# show open-flow of-switch "s1" port

===============================================================================
Open Flow Port Stats
===============================================================================
Port ID     Port Name                Transmitted Packets  Transmitted Bytes
-------------------------------------------------------------------------------
1073741825  to_B                     0                    0
1073741826  to_C                     0                    0
1073741827  to_D                     0                    0
1073741828  to_E                     0                    0
1073741829  to_F                     0                    0
1073742824  1                        0                    0
===============================================================================
```

```
*A:Dut-C# show open-flow of-switch "ofs" controller 1.3.8.8:6633 detail
===============================================================================
Open Flow Controller Information
===============================================================================
IP Address            : 1.3.8.8          Port              : 6633
Role                  : equal
Generation ID         : 0
-------------------------------------------------------------------------------
Open Flow Channel Information - Channel ID(2)
-------------------------------------------------------------------------------
Channel ID         : 2                 Version           : 4
Connection Type    : primary           Operational Status: Up
Auxiliary ID       : 0
Source Address     : 10.20.1.3         Source Port       : 49722
Operational Flags : socket-state-established hello-received hello-transmitted
                    handshake
Async Fltr Packet In
 (Master or Equal): table-miss apply-action
 (Slave)          : (Not Specified)
Async Fltr Port Status
 (Master or Equal): port-add port-delete port-modify
 (Slave)          : port-add port-delete port-modify
Async Fltr Flow Rem
 (Master or Equal): idle-time-out hard-time-out flow-mod-delete group-delete
 (Slave)          : (Not Specified)
Echo Time Expiry  : 0d 00:00:04       Hold Time Expiry  : 0d 00:00:24
Conn. Uptime      : 0d 01:27:53       Conn. Retry       : 0d 00:00:00
-------------------------------------------------------------------------------
Open Flow Channel Stats - Channel ID(2)
-------------------------------------------------------------------------------
Packet Type      Transmitted Packets  Received Packets     Error Packets
-------------------------------------------------------------------------------
Hello            0                    0                    0
Error            0                    0                    0
Echo Request     348                  174                  0
Echo Reply       174                  348                  0
Experimenter     0                    0                    0
Feat. Request    0                    0                    0
Feat. Reply      0                    0                    0
Get Cfg Request  0                    0                    0
Get Cfg Reply    0                    0                    0
Set Config       0                    0                    0
Packet In        0                    0                    0
Flow Removed     0                    0                    0
Port Status      0                    0                    0
Packet Out       0                    0                    0
Flow Modify      0                    0                    0
Group Modify     0                    0                    0
Port Modify      0                    0                    0
Table Modify     0                    0                    0
Multipart Req    0                    0                    0
Multipart Reply  0                    0                    0
Barrier Request  0                    0                    0
Barrier Reply    0                    0                    0
Get Q Cfg Req    0                    0                    0
Get Q Cfg Reply  0                    0                    0
Role Request     0                    0                    0
Role Reply       0                    0                    0
```

```
Get Async Req    0                    0                    0
Get Async Reply  0                    0                    0
Set Async        0                    0                    0
Meter Modify     0                    0                    0
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Open Flow Channel Information - Channel ID(3)
-------------------------------------------------------------------------------
Channel ID        : 3                 Version           : 4
Connection Type   : auxiliary         Operational Status: Up
Auxiliary ID      : 1
Source Address    : 10.20.1.3         Source Port       : 49748
Operational Flags : socket-state-established hello-received hello-transmitted
                    handshake
Async Fltr Packet In
 (Master or Equal): table-miss apply-action
 (Slave)          : (Not Specified)
Async Fltr Port Status
 (Master or Equal): port-add port-delete port-modify
 (Slave)          : port-add port-delete port-modify
Async Fltr Flow Rem
 (Master or Equal): idle-time-out hard-time-out flow-mod-delete group-delete
 (Slave)          : (Not Specified)
Echo Time Expiry  : 0d 00:00:02       Hold Time Expiry  : 0d 00:00:22
Conn. Uptime      : 0d 01:27:47       Conn. Retry       : 0d 00:00:00
-------------------------------------------------------------------------------
Open Flow Channel Stats - Channel ID(3)
-------------------------------------------------------------------------------
Packet Type      Transmitted Packets  Received Packets     Error Packets
-------------------------------------------------------------------------------
Hello            0                    0                    0
Error            0                    0                    0
Echo Request     348                  174                  0
Echo Reply       174                  348                  0
Experimenter     0                    0                    0
Feat. Request    0                    0                    0
Feat. Reply      0                    0                    0
Get Cfg Request  0                    0                    0
Get Cfg Reply    0                    0                    0
Set Config       0                    0                    0
Packet In        0                    0                    0
Flow Removed     0                    0                    0
Port Status      0                    0                    0
Packet Out       0                    0                    0
Flow Modify      0                    0                    0
Group Modify     0                    0                    0
Port Modify      0                    0                    0
Table Modify     0                    0                    0
Multipart Req    0                    0                    0
Multipart Reply  0                    0                    0
Barrier Request  0                    0                    0
Barrier Reply    0                    0                    0
Get Q Cfg Req    0                    0                    0
Get Q Cfg Reply  0                    0                    0
Role Request     0                    0                    0
Role Reply       0                    0                    0
Get Async Req    0                    0                    0
Get Async Reply  0                    0                    0
```

```
Set Async        0                    0                    0
Meter Modify     0                    0                    0
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Open Flow Channel Information - Channel ID(4)
-------------------------------------------------------------------------------
Channel ID         : 4                Version            : 4
Connection Type    : auxiliary        Operational Status: Up
Auxiliary ID       : 2
Source Address     : 10.20.1.3        Source Port        : 49749
Operational Flags : socket-state-established hello-received hello-transmitted
                    handshake
Async Fltr Packet In
 (Master or Equal): table-miss apply-action
 (Slave)           : (Not Specified)
Async Fltr Port Status
 (Master or Equal): port-add port-delete port-modify
 (Slave)           : port-add port-delete port-modify
Async Fltr Flow Rem
 (Master or Equal): idle-time-out hard-time-out flow-mod-delete group-delete
 (Slave)           : (Not Specified)
Echo Time Expiry  : 0d 00:00:01       Hold Time Expiry  : 0d 00:00:21
Conn. Uptime      : 0d 01:27:49       Conn. Retry       : 0d 00:00:00
-------------------------------------------------------------------------------
Open Flow Channel Stats - Channel ID(4)
-------------------------------------------------------------------------------
Packet Type      Transmitted Packets  Received Packets     Error Packets
-------------------------------------------------------------------------------
Hello            0                    0                    0
Error            0                    0                    0
Echo Request     348                  174                  0
Echo Reply       174                  348                  0
Experimenter     0                    0                    0
Feat. Request    0                    0                    0
Feat. Reply      0                    0                    0
Get Cfg Request  0                    0                    0
Get Cfg Reply    0                    0                    0
Set Config       0                    0                    0
Packet In        104420               0                    0
Flow Removed     0                    0                    0
Port Status      0                    0                    0
Packet Out       0                    0                    0
Flow Modify      0                    0                    0
Group Modify     0                    0                    0
Port Modify      0                    0                    0
Table Modify     0                    0                    0
Multipart Req    0                    0                    0
Multipart Reply  0                    0                    0
Barrier Request  0                    0                    0
Barrier Reply    0                    0                    0
Get Q Cfg Req    0                    0                    0
Get Q Cfg Reply  0                    0                    0
Role Request     0                    0                    0
Role Reply       0                    0                    0
Get Async Req    0                    0                    0
Get Async Reply  0                    0                    0
Set Async        0                    0                    0
Meter Modify     0                    0                    0
```

```
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
===============================================================================
*A:Dut-C#
```

5.4.2.3 Debug Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

open-flow

Syntax **open-flow**

Context tools>dump

Description This command enables dumping of the open-flow information.

Default n/a

of-switch

Syntax **of-switch** *ofs-name* [**flowtable** *of-table-id*] [{**grt | system | service-id** ***service-id***}] [**cookie** *hex-string*] [**priority** *priority*]
of-switch *ofs-name* [**flowtable** *of-table-id*] **service-id** ***service-id*** **sap** ***sap-id*** [**cookie** *hex-string*] [**priority** *priority*]
of-switch *ofs-name* [**flowtable** *of-table-id*] **summary**

Context tools>dump>open-flow

Description This command can be used to dump information for a given open-flow switch or its flowtable. Priority and cookie filters are provided no focus on part of a flow table.

Usage examples:

a. **tools**>**dump**>**open-flow**>**of-switch ofs-test** — This command displays detailed flow information for a given OpenFlow switch. If the switch has **switch-defined-cookie** enabled, the flows with all cookie-types are displayed.

b. **tools**>**dump**>**open-flow**>**of-switch ofs summary** — This command displays a summary of each cookie context and the number of flows in it for the switch that has **switch-defined-cookie** enabled. If **switch-defined-cookie** is disabled, then the total number of entries is displayed (single context).

c. Options like **grt**, **system**, **service-id**, **sap-id**, **cookie**, and **priority** can be used to limit display entries to the specified options.

Default n/a

Parameters *ofs-name* — specifies the name of the OFS instance, up to 32 characters

of-table-id — specifies the identifier for the OpenFlow table

Values 0

hex-string — specifies the identifier for the OpenFlow cookies

Values 0x0 to 0xFFFFFFFFFFFFFFFF

priority — specifies the priority for the OpenFlow switch

Values 0 to 65535

service-id — specifies the identifier for the service

Values 1 to 2148007978 **|** *svc-name*: 64 characters max

sap-id — specifies the identifier for the Ethernet SAP

Values

sap-id	null	port-id | bundle-id | bpgrp-id | lag-id | aps-id>	
	dot1q	port-id | bundle-id | bpgrp-id | lag-id | aps-id | pw-id>:qtag1	
	qinq	port-id | bundle-id | bpgrp-id | lag-id | pw-id>:qtag1.qtag2	
	atm	<port-id | aps-id>[:vpi/vci | vpi | vpi1.vpi2 | cp.conn-prof-id]	
		cp	keyword
		conn-prof-id	1..8000
	frame	port-id | aps-id:dlci	
	cisco-hdlc	slot/mda/port.channel	
	cem	slot/mda/port.channel	
	ima-grp	bundle-id>[:vpi/vci | vpi | vpi1.vpi2 | cp.conn-prof-id]	
		cp	keyword
		conn-prof-id	1..8000
	port-id	slot/mda/port[.channel]	
	bundle-id	bundle-<type>-slot/mda.*bundle-num*	
		bundle	keyword
		type	ima, fr, ppp
		bundle-num	1..336
	bpgrp-id	bpgrp-<type>-<bpgrp-num>	
		bpgrp	keyword
		type	ima, ppp
		bpgrp-num	1..2000

aps-id	aps-<group-id>[.channel]	
	aps	keyword
	group-id	1..64
ccag-id	*ccag-id*.*path-id*[*cc-type*]<*cc-id*	
	ccag	keyword
	id	1..8
	path-id	a, b
	cc-type	.sap-net, .net-sap
	cc-id	0..4094
eth-tunnel	eth-tunnel-*id*[:eth-tun-sap-id]	
	id	1..1024
	eth-tun-sap-id	0..4094
lag-id	lag-id	
	lag	keyword
	id	1..800
pw-id	pw-*id*	
	pw	keyword
	id	1..10239
qtag1	*, 0..4094	
qtag2	* | 0..4094	
vpi	0..4095 (NNI)	
	0..255 (UNI)	
vci	1, 2, 5..65535	
dlci	16..1022	
tunnel-id	tunnel-*id*.private | public:*tag*	
	tunnel	keyword
	id	1..16
	tag	0..4094

summary — Keyword to summarize output.

ip-address:*port* — *ip-address*: a.b.c.d

port: 1 to 65535

Output

Sample Output

```
===============================================================================
Switch: ofs
```

```
===============================================================================
Table     : 0                        Flow Pri  : 0
Cookie    : 0x0000000000000000       CookieType: grt
Controller: :::0
Filter Hnd: 0xC30000010000FFFF
Filter    : _tmnx_ofs_ofs:1 entry 65535

In Port   : *
VID       : *                        Outer VID : *
EthType   : *
Src IP    : *
Dst IP    : *
IP Proto  : *                        DSCP      : *
Src Port  : *                        Dst Port  : *
ICMP Type : *                        ICMP Code : *
Label     : *
IPv6ExtHdr: (Not Specified)

Action    : Fall-through

Flow Flags: IPv4/6 [!E] [RO] [DEF]
Up Time   : 0d 00:03:51              Add TS    : 680828
Mod TS    : 0                        Stats TS  : 703820
#Packets  : 0                        #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                        Flow Pri  : 16
Cookie    : 0x0000000000000000       CookieType: grt
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000010000FFEF
Filter    : _tmnx_ofs_ofs:1 entry 65519

In Port   : *
VID       : *                        Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : 22.22.22.1/32
IP Proto  : *                        DSCP      : *
Src Port  : *                        Dst Port  : *
ICMP Type : *                        ICMP Code : *
Label     : *

Action    : Forward On Svc 99

Flow Flags: IPv4
Up Time   : 0d 00:01:15              Add TS    : 696581
Mod TS    : 0                        Stats TS  : 703820
#Packets  : 0                        #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                        Flow Pri  : 17
Cookie    : 0xC000006300000000       CookieType: service 99
Controller: 1.3.8.8:6633
Filter Hnd: 0x8300000D0000FFEE
Filter    : _tmnx_ofs_ofs:13 entry 65518

In Port   : *
VID       : *                        Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : 22.22.22.2/32
```

```
IP Proto  : *                       DSCP      : *
Src Port  : *                       Dst Port  : *
ICMP Type : *                       ICMP Code : *
Label     : *

Action    : Forward On GRT

Flow Flags: IPv4
Up Time   : 0d 00:01:10             Add TS    : 697095
Mod TS    : 0                       Stats TS  : 703820
#Packets  : 0                       #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                       Flow Pri  : 4
Cookie    : 0xC00007E200000000      CookieType: service 2018
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000050000FFFB
Filter    : _tmnx_ofs_ofs:5 entry 65531
SAP       : 1/1/3:0

In Port   : 0x2218000
VID       : 0x1000                  Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : *
IP Proto  : *                       DSCP      : *
Src Port  : *                       Dst Port  : *
ICMP Type : *                       ICMP Code : *
Label     : *

Action    : Forward On Sap
            Sap 1/1/3:0

Flow Flags: IPv4
Up Time   : 0d 00:02:13             Add TS    : 690788
Mod TS    : 0                       Stats TS  : 703820
#Packets  : 0                       #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                       Flow Pri  : 3
Cookie    : 0xC00007E200000000      CookieType: service 2018
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000040000FFFC
Filter    : _tmnx_ofs_ofs:4 entry 65532
SAP       : 1/1/3:4094

In Port   : 0x2218000
VID       : 0x1ffe                  Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : *
IP Proto  : *                       DSCP      : *
Src Port  : *                       Dst Port  : *
ICMP Type : *                       ICMP Code : *
Label     : *

Action    : Forward On Sap
            Sap 1/1/3:4094

Flow Flags: IPv4
Up Time   : 0d 00:02:18             Add TS    : 690274
```

```
Mod TS     : 0                        Stats TS   : 703820
#Packets   : 0                        #Bytes     : 0
-------------------------------------------------------------------------------
Table      : 0                        Flow Pri   : 5
Cookie     : 0xC00007E200000000       CookieType: service 2018
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000060000FFFA
Filter     : _tmnx_ofs_ofs:6 entry 65530
SAP        : lag-800:4094

In Port    : 0x50000320
VID        : 0x1ffe                   Outer VID : *
EthType    : 0x0800
Src IP     : *
Dst IP     : *
IP Proto   : *                        DSCP       : *
Src Port   : *                        Dst Port   : *
ICMP Type : *                         ICMP Code : *
Label      : *

Action     : Forward On Sap
             Sap lag-800:4094

Flow Flags: IPv4
Up Time    : 0d 00:02:09              Add TS     : 691201
Mod TS     : 0                        Stats TS   : 703821
#Packets   : 0                        #Bytes     : 0
-------------------------------------------------------------------------------
Table      : 0                        Flow Pri   : 8
Cookie     : 0xC00007E300000000       CookieType: service 2019
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000090000FFF7
Filter     : _tmnx_ofs_ofs:9 entry 65527
SAP        : 2/1/3:1.0

In Port    : 0x4218000
VID        : 0x1000                   Outer VID : 0x1001
EthType    : 0x0800
Src IP     : *
Dst IP     : *
IP Proto   : *                        DSCP       : *
Src Port   : *                        Dst Port   : *
ICMP Type : *                         ICMP Code : *
Label      : *

Action     : Forward On Sap
             Sap 2/1/3:1.0

Flow Flags: IPv4
Up Time    : 0d 00:01:56              Add TS     : 692448
Mod TS     : 0                        Stats TS   : 703821
#Packets   : 0                        #Bytes     : 0
-------------------------------------------------------------------------------
Table      : 0                        Flow Pri   : 7
Cookie     : 0xC00007E300000000       CookieType: service 2019
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000080000FFF8
Filter     : _tmnx_ofs_ofs:8 entry 65528
SAP        : 2/1/3:4094.4094
```

```
In Port   : 0x4218000
VID       : 0x1ffe                       Outer VID : 0x1ffe
EthType   : 0x0800
Src IP    : *
Dst IP    : *
IP Proto  : *                            DSCP      : *
Src Port  : *                            Dst Port  : *
ICMP Type : *                            ICMP Code : *
Label     : *

Action    : Forward On Sap
            Sap 2/1/3:4094.4094

Flow Flags: IPv4
Up Time   : 0d 00:02:01                  Add TS    : 692032
Mod TS    : 0                            Stats TS  : 703821
#Packets  : 0                            #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                            Flow Pri  : 10
Cookie    : 0xC00007E300000000           CookieType: service 2019
Controller: 1.3.8.8:6633
Filter Hnd: 0x8300000B0000FFF5
Filter    : _tmnx_ofs_ofs:11 entry 65525
SAP       : lag-799:4094.4094

In Port   : 0x5000031f
VID       : 0x1ffe                       Outer VID : 0x1ffe
EthType   : 0x0800
Src IP    : *
Dst IP    : *
IP Proto  : *                            DSCP      : *
Src Port  : *                            Dst Port  : *
ICMP Type : *                            ICMP Code : *
Label     : *

Action    : Forward On Sap
            Sap lag-799:4094.4094

Flow Flags: IPv4
Up Time   : 0d 00:01:46                  Add TS    : 693483
Mod TS    : 0                            Stats TS  : 703821
#Packets  : 0                            #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                            Flow Pri  : 1
Cookie    : 0xC00007E400000000           CookieType: service 2020
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000020000FFFE
Filter    : _tmnx_ofs_ofs:2 entry 65534
SAP       : 2/1/4

In Port   : 0x4220000
VID       : 0x0                          Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : *
IP Proto  : *                            DSCP      : *
Src Port  : *                            Dst Port  : *
ICMP Type : *                            ICMP Code : *
```

```
Label     : *

Action    : Forward On Sap
            Sap 2/1/4

Flow Flags: IPv4
Up Time   : 0d 00:02:27                Add TS    : 689443
Mod TS    : 0                          Stats TS  : 703821
#Packets  : 0                          #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                          Flow Pri  : 12
Cookie    : 0xC00007E400000000         CookieType: service 2020
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000020000FFF3
Filter    : _tmnx_ofs_ofs:2 entry 65523
SAP       : 2/1/4

In Port   : 0x4220000
VID       : 0x0                        Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : *
IP Proto  : *                          DSCP      : *
Src Port  : *                          Dst Port  : *
ICMP Type : *                          ICMP Code : *
Label     : *

Action    : Forward Sdp 12:4294967295

Flow Flags: IPv4
Up Time   : 0d 00:01:36                Add TS    : 694524
Mod TS    : 0                          Stats TS  : 703821
#Packets  : 0                          #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                          Flow Pri  : 13
Cookie    : 0xC00007E400000000         CookieType: service 2020
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000020000FFF2
Filter    : _tmnx_ofs_ofs:2 entry 65522
SAP       : 2/1/4

In Port   : 0x4220000
VID       : 0x0                        Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : *
IP Proto  : *                          DSCP      : *
Src Port  : *                          Dst Port  : *
ICMP Type : *                          ICMP Code : *
Label     : *

Action    : Forward On Nhop(Indirect)
            Nhop: 200.180.200.180

Flow Flags: IPv4
Up Time   : 0d 00:01:31                Add TS    : 695037
Mod TS    : 0                          Stats TS  : 703821
#Packets  : 0                          #Bytes    : 0
-------------------------------------------------------------------------------
```

```
Table     : 0                        Flow Pri  : 15
Cookie    : 0xC00007E400000000       CookieType: service 2020
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000020000FFF0
Filter    : _tmnx_ofs_ofs:2 entry 65520
SAP       : 2/1/4

In Port   : 0x4220000
VID       : 0x0                      Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : *
IP Proto  : *                        DSCP      : *
Src Port  : *                        Dst Port  : *
ICMP Type : *                        ICMP Code : *
Label     : *

Action    : Forward LspId 1
            Lsp lsp1

Flow Flags: IPv4
Up Time   : 0d 00:01:21              Add TS    : 696067
Mod TS    : 0                        Stats TS  : 703822
#Packets  : 0                        #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                        Flow Pri  : 14
Cookie    : 0xC00007E400000000       CookieType: service 2020
Controller: 1.3.8.8:6633
Filter Hnd: 0x430000020000FFF1
Filter    : _tmnx_ofs_ofs:2 entry 65521
SAP       : 2/1/4

In Port   : 0x4220000
VID       : 0x0                      Outer VID : *
EthType   : 0x86dd
Src IP    : *
Dst IP    : *
IP Proto  : *                        DSCP      : *
Src Port  : *                        Dst Port  : *
ICMP Type : *                        ICMP Code : *
Label     : *
IPv6ExtHdr: (Not Specified)

Action    : Forward On Nhop(Indirect)
            Nhop: 3ffe:1111:1111:2222:2222:3333:3333:4444

Flow Flags: IPv6
Up Time   : 0d 00:01:26              Add TS    : 695551
Mod TS    : 0                        Stats TS  : 703822
#Packets  : 0                        #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                        Flow Pri  : 2
Cookie    : 0xC00007E400000000       CookieType: service 2020
Controller: 1.3.8.8:6633
Filter Hnd: 0x830000030000FFFD
Filter    : _tmnx_ofs_ofs:3 entry 65533
SAP       : lag-798

In Port   : 0x5000031e
```

```
VID       : 0x0                        Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : *
IP Proto  : *                          DSCP      : *
Src Port  : *                          Dst Port  : *
ICMP Type : *                          ICMP Code : *
Label     : *

Action    : Forward On Sap
            Sap lag-798

Flow Flags: IPv4
Up Time   : 0d 00:02:23                Add TS    : 689857
Mod TS    : 0                          Stats TS  : 703822
#Packets  : 0                          #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                          Flow Pri  : 19
Cookie    : 0x8000000000000000         CookieType: system
Controller: 1.3.8.8:6633
Filter Hnd: 0x4300000E0000FFEC
Filter    : _tmnx_ofs_ofs:14 entry 65516

In Port   : *
VID       : *                          Outer VID : *
EthType   : 0x86dd
Src IP    : *
Dst IP    : 3ffe::1616:1601/128
IP Proto  : *                          DSCP      : *
Src Port  : *                          Dst Port  : *
ICMP Type : *                          ICMP Code : *
Label     : *
IPv6ExtHdr: (Not Specified)

Action    : Forward On Nhop(Indirect)
            Nhop: 3ffe:1111:1111:2222:2222:3333:3333:4444

Flow Flags: IPv6
Up Time   : 0d 00:01:01                Add TS    : 698121
Mod TS    : 0                          Stats TS  : 703822
#Packets  : 0                          #Bytes    : 0
-------------------------------------------------------------------------------
Table     : 0                          Flow Pri  : 18
Cookie    : 0x8000000000000000         CookieType: system
Controller: 1.3.8.8:6633
Filter Hnd: 0x8300000E0000FFED
Filter    : _tmnx_ofs_ofs:14 entry 65517

In Port   : *
VID       : *                          Outer VID : *
EthType   : 0x0800
Src IP    : *
Dst IP    : 22.22.22.1/32
IP Proto  : *                          DSCP      : *
Src Port  : *                          Dst Port  : *
ICMP Type : *                          ICMP Code : *
Label     : *

Action    : Forward On Nhop(Indirect)
```

```
            Nhop: 200.180.200.180

Flow Flags: IPv4
Up Time    : 0d 00:01:06                Add TS    : 697608
Mod TS     : 0                          Stats TS  : 703822
#Packets   : 0                          #Bytes    : 0
-------------------------------------------------------------------------------
Number of flows: 17
===============================================================================
*A:Dut-C#
```

6 Cflowd

6.1 In This Chapter

This chapter provides information to configure Cflowd.

Topics in this chapter include:

6.2 Cflowd Overview

Cflowd is a tool used to sample IPv4, IPv6, MPLS, and Ethernet traffic data flows through a router. Cflowd enables traffic sampling and analysis by ISPs and network engineers to support capacity planning, trends analysis, and characterization of workloads in a network service provider environment.

Cflowd is also useful for traffic engineering, network planning and analysis, network monitoring, developing user profiles, data warehousing and mining, as well as security-related investigations. Collected information can be viewed several ways such as in port, AS, or network matrices, and pure flow structures. The amount of data stored depends on the cflowd configurations.

Cflowd maintains a list of data flows through a router. A flow is a unidirectional traffic stream defined by several characteristics such as source and destination IP addresses, source and destination ports, inbound interface, IP protocol and TOS bits.

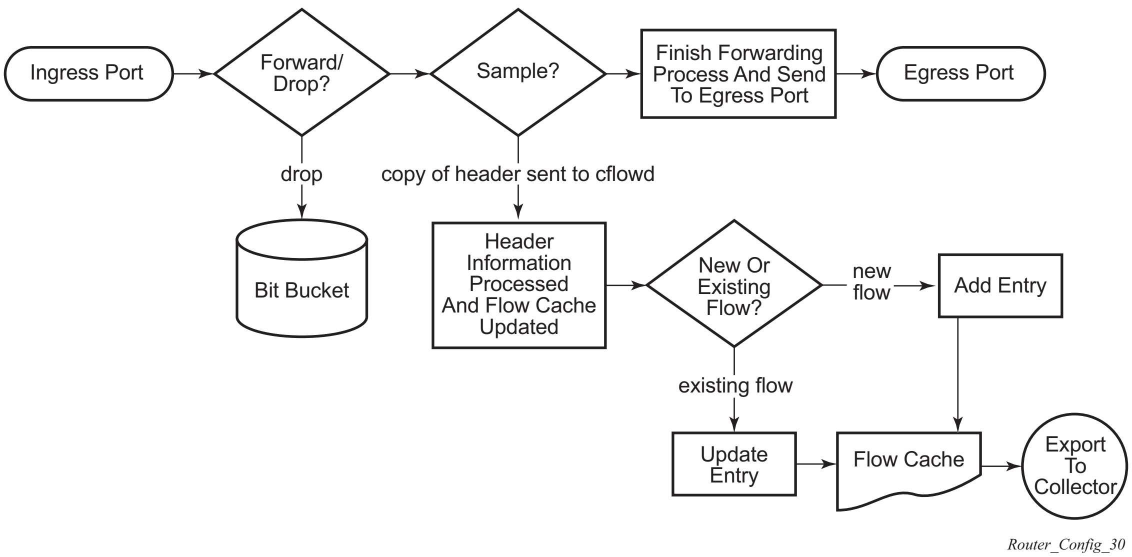
When a router receives a packet for which it currently does not have a flow entry, a flow structure is initialized to maintain state information regarding that flow, such as the number of bytes exchanged, IP addresses, port numbers, AS numbers, etc. Each subsequent packet matching the same parameters of the flow contributes to the byte and packet count of the flow until the flow is terminated and exported to a collector for storage.

For the 7450 ESS-7 and 7450 ESS-12, Cflowd is only supported if mixed mode is enabled.

6.2.1 Operation

Figure 31 depicts the basic operation of the cflowd feature. This sample flow is only used to describe the basic steps that are performed. It is not intended to specify implementation.

Figure 31 **Basic Cflowd Steps**



1. As a packet ingresses a port, a decision is made to forward or drop the packet.
2. If the packet is forwarded, it is then decided if the packet should be sampled for cflowd.
3. If a new flow is found, a new entry is added to the cache. If the flow already exists in the cache, the flow statistics are updated.
4. If a new flow is detected and the maximum number of entries are already in the flow cache, the earliest expiry entry is removed. The earliest expiry entry/flow is the next flow that will expire due to the active or inactive timer expiration.
5. If a flow has been inactive for a period of time equal to or greater then the inactive timer (default 15 seconds), then the entry is removed from the flow cache.
6. If a flow has been active for a period of time equal to or greater than the active timer (default 30 minutes), then the entry is removed from the flow cache.

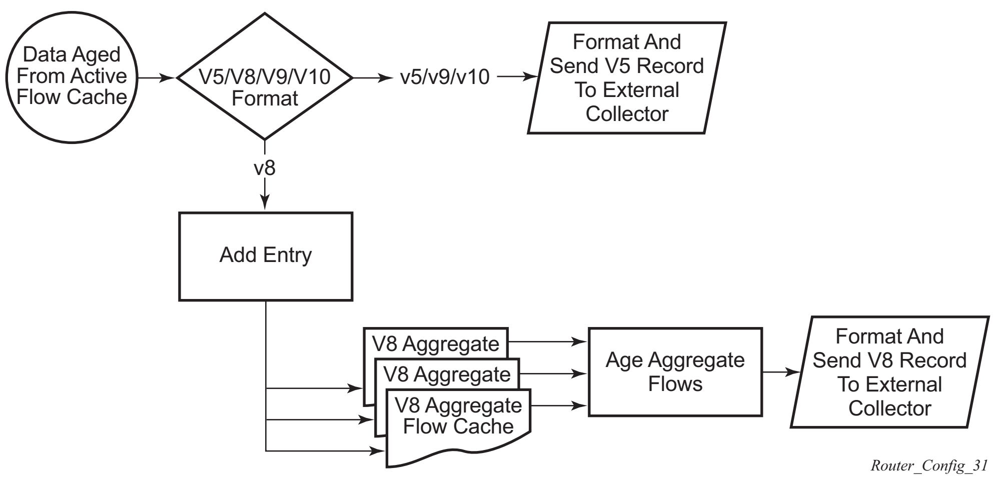
When a flow is exported from the cache, the collected data is sent to an external collector which maintains an accumulation of historical data flows that network operators can use to analyze traffic patterns.

Data is exported in one of the following formats:

- Version 5 — Generates a fixed export record for each individual flow captured.
- Version 8 — Aggregates multiple individual flows into a fixed aggregate record.
- Version 9 — Generates a variable export record, depending on user configuration and sampled traffic type (IPv4, IPv6, or MPLS), for each individual flow captured.
- Version 10 (IPFIX) — Generates a variable export record, depending on user configuration and sampled traffic type (IPv4, IPv6, or MPLS), for each individual flow captured.

Figure 32 depicts Version 5, Version 8, Version 9, and Version 10 flow processing.

Figure 32 **V5, V8, V9, V10, and Flow Processing**



1. As flows are expired from the active flow cache, the export format must be determined, either Version 5, Version 8, Version 9, and Version 10.
   - If the export format is Version 5 or Version 9 and Version 10, no further processing is performed and the flow data is accumulated to be sent to the external collector.
   - If the export format is Version 8, then the flow entry is added to one or more of the configured aggregation matrices.
   - As the entries within the aggregate matrices are aged out, they are accumulated to be sent to the external flow collector in Version 8 format.

The sample rate and cache size are configurable values. The cache size default is 64K flow entries.

A flow terminates when one of the following conditions is met:

- When the inactive timeout period expires (default: 15 seconds). A flow is considered terminated when no packets are seen for the flow for N seconds.
- When an active timeout expires (default: 30 seconds). Default active timeout is 30 minutes. A flow terminates according to the time duration regardless of whether or not there are packets coming in for the flow.
- When the user executes a **clear cflowd** command.
- When other measures are met that apply to aggressively age flows as the cache becomes too full (such as overflow percent).

6.2.1.1 Version 8

There are several different aggregate flow types including:

- AS matrix
- Destination prefix matrix
- Source prefix matrix
- Prefix matrix
- Protocol/port matrix.

Version 8 is an aggregated export format. As individual flows are aged out of the raw flow cache, the data is added to the aggregate flow cache for each configured aggregate type. Each of these aggregate flows are also aged in a manner similar to the method the active flow cache entries are aged. When an aggregate flow is aged out, it is sent to the external collector in the Version 8 record format.

6.2.1.2 Version 9

The Version 9 format is a more flexible format and allows for different templates or sets of cflowd data to be sent based on the type of traffic being sampled and the template set configured.

Version 9 is interoperable with RFC 3954, *Cisco Systems NetFlow Services Export Version 9*.

6.2.1.3 Version 10

Version 10 is a new format and protocol that inter-operates with the specifications from the IETF as the IP Flow Information Export (IPFIX) standard. Like Version 9, the version 10 format uses templates to allow for different data elements regarding a flow that is to be exported and to handle different type of data flows such as IPv4, IPv6, and MPLS.

Version 10 is interoperable with RFC 5150 and 5102.

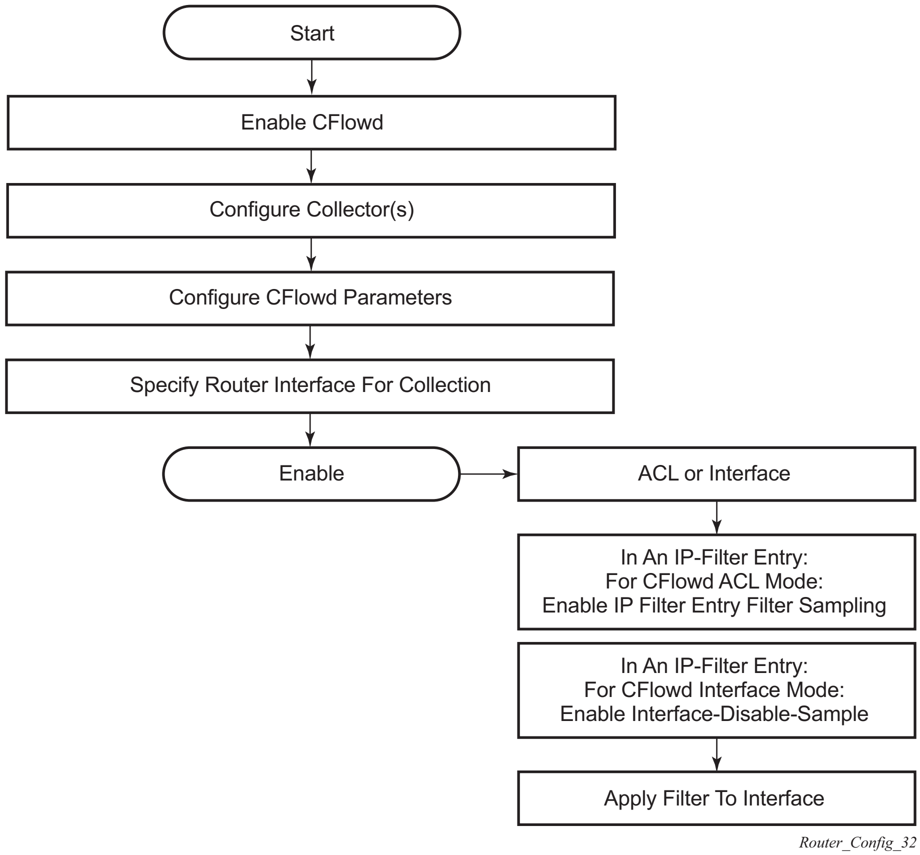
6.2.2 Cflowd Filter Matching

In the filter-matching process, normally, every packet is matched against filter (access list) criteria to determine acceptability. With cflowd, only the first packet of a flow is checked. If the first packet is forwarded, an entry is added to the cflowd cache. Subsequent packets in the same flow are then forwarded without needing to be matched against the complete set of filters. Specific performance varies depending on the number and complexity of the filters.

6.3 Cflowd Configuration Process Overview

Figure 33 displays the process to configure Cflowd parameters.

Figure 33 Cflowd Configuration and Implementation Flow



There are three modes in which cflowd can be enabled to sample traffic on a given interface:

- Cflowd interface, where all traffic entering a given port will be subjected to sampling as the configured sampling rate
- Cflowd interface plus the definition of IP filters which specify an action of interface-disable-sample, in which traffic that matches these filter entries will not be subject to cflowd sampling.
- Cflowd ACL, where IP filters must be created with entries containing the action filter-sampled. In this mode only traffic matching these filter entries will be subject to the cflowd sampling process.

6.4 Configuration Notes

The following cflowd components must be configured for cflowd to be operational:

- Cflowd is enabled globally.
- At least one collector must be configured and enabled.
- A cflowd option must be specified and enabled on a router interface.
- Sampling must be enabled on either:
  - An IP filter which is applied to a port or service.
  - An interface on a port or service.

For the 7450 ESS, Cflowd is only available when mixed-mode is enabled on the system.

6.5 Configuring Cflowd with CLI

This section provides information to configure cflowd using the command line interface.

Topics in this section include:

6.6 Cflowd Configuration Overview

The SR OS implementation of cflowd supports the option to analyze traffic flow. The implementation also supports the use of traffic/access list (ACL) filters to limit the type of traffic that is analyzed.

6.6.1 Traffic Sampling

Traffic sampling does not examine all packets received by a router. Command parameters allow the rate at which traffic is sampled and sent for flow analysis to be modified. The default sampling rate is every 1000th packet. Excessive sampling over an extended period of time, for example, more than every 1000th packet, can burden router processing resources.

The following data is maintained for each individual flow in the raw flow cache:

- Source IP address
- Destinations IP address
- Source port
- Destination port
- Forwarding status
- Input interface
- Output interface
- IP protocol
- TCP flags
- First timestamp (of the first packet in the flow)
- Last timestamp (timestamp of last packet in the flow prior to expiry of the flow)
- Source AS number for peer and origin (taken from BGP)
- Destination AS number for peer and origin (taken from BGP)
- IP next hop
- BGP next hop
- ICMP type and code
- IP version
- Source prefix (from routing)
- Destination prefix (from routing)
- MPLS label stack from label 1 to 6

Within the raw flow cache, the following characteristics are used to identify an individual flow:

- Ingress interface
- Source IP address
- Destination IP address
- Source transport port number

- Destination transport port number
- IP protocol type
- IP TOS byte
- Virtual router id
- ICMP type and code
- Direction
- MPLS labels

The SR OS implementation allows you to enable cflowd either at the interface level or as an action to a filter. By enabling cflowd at the interface level, all IP packets forwarded by the interface are subject to cflowd analysis. By setting cflowd as an action in a filter, only packets matching the specified filter are subject to cflowd analysis. This provides the network operator greater flexibility in the types of flows that are captured.

6.6.2 Collectors

A collector defines how data flows should be exported from the flow cache. A maximum of 5 collectors can be configured. Each collector is identified by a unique IP address and UDP port value. Each collector can only export traffic in one version type, either V5, V8, V9, or V10.

The parameters within a collector configuration can be modified or the defaults retained.

The autonomous-system-type command defines whether the autonomous system information to be included in the flow data is based on the originating AS or external peer AS of the flow.

6.6.2.1 Aggregation

V8 aggregation allows for flow data to be aggregated into larger, less granular flows. Use aggregation commands to specify the type of data to be collected. These aggregation types are only applicable to flows being exported to a v8 collector.

The following aggregation schemes are supported:

- AS matrix — Flows are aggregated based on source and destination AS and ingress and egress interface.

- Protocol-port — Flows are aggregated based on the IP protocol, source port number, and destination port number.
- Source prefix — Flows are aggregated based on source prefix and mask, source AS, and ingress interface.
- Destination prefix — Flows are aggregated based on destination prefix and mask, destination AS, and egress interface.
- Source-destination prefix — Flows are aggregated based on source prefix and mask, destination prefix and mask, source and destination AS, ingress interface and egress interface.
- Raw — Flows are not aggregated and are sent to the collector in a V5 record.

6.7 Basic Cflowd Configuration

This section provides information to configure cflowd and configuration examples of common configuration tasks. In order to sample traffic, the minimal cflowd parameters that need to be configured are:

- Cflowd must be enabled.
- At least one collector must be configured and enabled.
- Sampling must be enabled on either:
  - An IP filter entry and applied to a service or an port.
  - An interface applied to a port.

The following example displays a cflowd configuration.

```
A:ALA-1>config>cflowd# info detail
----------------------------------------------
     active-timeout 30
     cache-size 65536inactive-timeout 15
     overflow 1
     rate 1000
     collector 10.10.10.103:2055 version 9
          no aggregation
          autonomous-system-type origin
          description "V9 collector"
          no shutdown
     exit
     template-retransmit 330
     exit
     no shutdown
----------------------------------------------
A:ALA-1>config>cflowd#
```

6.8 Common Configuration Tasks

This section provides a brief overview of the tasks that must be performed to configure cflowd and provides the CLI commands. In order to begin traffic flow sampling, cflowd must be enabled and at least one collector must be configured.

6.8.1 Global Cflowd Components

The following common (global) attributes apply to all instances of cflowd:

- Active timeout - Controls the maximum amount of time a flow record can be active before it will be automatically exported to defined collectors.
- Inactive timeout - Controls the minimum amount of time before a flow is declared inactive. If no traffic is sampled for an existing flow for the inactive timeout duration, the flow is declared inactive and marked to be exported to the defined collectors.
- Cache size - Defines the maximum size of the flow cache.
- Overflow - Defines the percentage of flow records that are exported to all collectors if the flow cache size is exceeded.
- Rate - Defines the system wide sampling rate for cflowd.
- Template retransmit - Defines the interval (in seconds) at which the v9 and v10 template are retransmitted to all configured v9 or v10 collectors.

6.8.2 Configuring Cflowd

Use the CLI syntax displayed below to perform the following tasks:

- Enabling Cflowd
- Configuring Global Cflowd Parameters
- Configuring Cflowd Collectors
- Enabling Cflowd on Interfaces and Filters

CLI Syntax:

```
config>cflowd#
active-timeout minutes
cache-size num-entries
inactive-timeout seconds
template-retransmit seconds
overflow percent
```

```
rate sample-rate
collector ip-address[:port] {version [5 | 8 | 9 |10]}
     aggregation
          as-matrix
          destination-prefix
          protocol-port
          raw
          source-destination-prefix
          source-prefix
     template-set {basic | mpls-ip | l2-ip | mpls-
       transport}
     autonomous-system-type [origin | peer]
     description description-string
     no shutdown
no shutdown
```

6.8.3 Enabling Cflowd

Cflowd is disabled by default. Executing the command configure cflowd will enable cflowd, by default cflowd is not shutdown but must be configured including at least one collector to be active.

Use the following CLI syntax to enable cflowd:

CLI Syntax: `config# cflowd`
`no shutdown`

The following example displays the default values when cflowd is initially enabled. No collectors or collector options are configured.

```
A:ALA-1>config# info detail
...
#------------------------------------------
echo "Cflowd Configuration"
#------------------------------------------
    cflowd
        active-timeout 30
        cache-size 65536
        inactive-timeout 15
        overflow 1
        rate 1000
        template-retransmit 600
        no shutdown
    exit
#------------------------------------------
A:ALA-1>config#
```

6.8.4 Configuring Global Cflowd Parameters

The following cflowd parameters apply to all instances where cflowd (traffic sampling) is enabled.

Use the following CLI commands to configure cflowd parameters:

CLI Syntax:
```
config>cflowd#
active-timeout minutes
cache-size num-entries
inactive-timeout seconds
overflow percent
rate sample-rate
template-retransmit seconds
no shutdown
```

The following example displays a common cflowd component configuration:

```
A:ALA-1>config>cflowd# info
#------------------------------------------
        active-timeout 20
        inactive-timeout 10
        overflow 10
        rate 100
#------------------------------------------
A:ALA-1>config>cflowd#
```

6.8.5 Configuring Cflowd Collectors

To configure cflowd collector parameters, enter the following commands:

CLI Syntax:
```
config>cflowd#
collector ip-address[:port] [version version]
     aggregation
          as-matrix
          destination-prefix
          protocol-port
          raw
          source-destination-prefix
          source-prefix
     autonomous-system-type [origin | peer]
     description description-string
     no shutdown
     template-set {basic | mpls-ip  | l2-ip | mpls-
        transport}
```

The following example displays a basic cflowd configuration:

```
A:ALA-1>config>cflowd# info
-----------------------------------------
active-timeout 20
        inactive-timeout 10
        overflow 10
        rate 100
        collector 10.10.10.1:2000 version 8
            aggregation
                as-matrix
                raw
            exit
            description "AS info collector"
        exit
        collector 10.10.10.2:5000 version 8
            aggregation
                protocol-port
                source-destination-prefix
            exit
            autonomous-system-type peer
            description "Neighbor collector"
        exit
-----------------------------------------
A:ALA-1>config>cflowd#
```

Version 9 Collector example:

```
collector 10.10.10.9:2000 version 9
           description "v9collector"
           template-set mpls-ip
           no shutdown
exit
```

6.8.5.1 Version 9 and Version 10 Templates

If the collector is configured to use either version 9 or version 10 (IPFIX) formats, the flow data is sent to the designated collector using one of the predefined templates. The template used is based on the type of flow for which the data was collected (IPv4, IPv6, MPLS or Ethernet (Layer 2)), and the configuration of the **template-set** parameter. Table 73 indicates the relationship between these values and the corresponding template used to export the flow data.

Table 73 **Template-Set**

Traffic type	Basic	MPLS-IP
IPv4	Basic IPv4	MPLS-IPv4

Table 73 **Template-Set (Continued)**

Traffic type	Basic	MPLS-IP
IPv6	Basic IPv6	MPLS-IPv6
MPLS	Basic MPLS	MPLS-IP
Ethernet	L2-IP	L2-IP

Each flow exported, to a collector configured for either version 9 or version 10 formats, will be sent using one of the above flow template sets. As described above, which template is used is based on the flow type and how the collector's template-set parameter is configured.

The following tables specify the fields present in each template.

Table 74 **Basic IPv4 Template**

Field Name	Field ID
IPv4 Src Addr	8
IPv4 Dest Addr	12
IPv4 Nexthop	15
BGP Nexthop	18
Ingress Interface	10
Egress Interface	14
Packet Count	2
Byte Count	1
Start Time	22
End Time	21
Flow Start Milliseconds [1]	152
Flow End Milliseconds1	153
Src Port	7
Dest Port	11
Forwarding Status	89
TCP control Bits (Flags)	6
IPv4 Protocol	4

Table 74 **Basic IPv4 Template (Continued)**

Field Name	**Field ID**
IPv4 TOS	5
IP version	60
ICMP Type & Code	32
Direction	61
BGP Source ASN	16
BGP Dest ASN	17
Source IPv4 Prefix Length	9
Dest IPv4 Prefix Length	13
Minimum IP Total Length	25
Maximum IP Total Length	26
Minimum TTL	52
Maximum TTL	53

Note:

1. Only sent to collectors configured for v10 format

Table 75 **MPLS-IPv4 Template**

Field Name	**Field ID**
IPv4 Src Addr	8
IPv4 Dest Addr	12
IPv4 Nexthop	15
BGP Nexthop	18
Ingress Interface	10
Egress Interface	14
Packet Count	2
Byte Count	1
Start Time	22
End Time	21

Table 75 **MPLS-IPv4 Template (Continued)**

Field Name	Field ID
Flow Start Milliseconds [1]	152
Flow End Milliseconds	153
Src Port	7
Dest Port	11
Forwarding Status	89
TCP control Bits (Flags)	6
IPv4 Protocol	4
IPv4 TOS	5
IP version	60
ICMP Type & Code	32
Direction	61
BGP Source ASN	16
BGP Dest ASN	17
Source IPv4 Prefix Length	9
Dest IPv4 Prefix Length	13
MPLS Top Label Type	46
MPLS Top Label IPv4 Addr	47
MPLS Label 1	70
MPLS Label 2	71
MPLS Label 3	72
MPLS Label 4	73
MPLS Label 5	74
MPLS Label 6	75
Minimum IP Total Length	25
Maximum IP Total Length	26
Minimum TTL	52
Maximum TTL	53

Note:

1. Only sent to collectors configured for v10 format

Table 76 **Basic IPv6 Template**

Field Name	Field ID
IPv6 Src Addr	27
IPv6 Dest Addr	28
IPv6 Nexthop	62
IPv6 BGP Nexthop	63
IPv4 Nexthop	15
IPv4 BGP Nexthop	18
Ingress Interface	10
Egress Interface	14
Packet Count	2
Byte Count	1
Start Time	22
End Time	21
Flow Start Milliseconds [1]	152
Flow End Milliseconds1	153
Src Port	7
Dest Port	11
Forwarding Status	89
TCP control Bits (Flags)	6
Protocol	4
IPv6 Extension Hdr	64
IPv6 Next Header	193
IPv6 Flow Label	31
TOS	5
IP version	60
IPv6 ICMP Type & Code	139

Table 76 Basic IPv6 Template (Continued)

Field Name	Field ID
Direction	61
BGP Source ASN	16
BGP Dest ASN	17
IPv6 Src Mask	29
IPv6 Dest Mask	30
Minimum IP Total Length	25
Maximum IP Total Length	26
Minimum TTL	52
Maximum TTL	53

Note:

1. Only sent to collectors configured for v10 format

Table 77 MPLS-IPv6 Template

Field Name	Field ID
IPv6 Src Addr	27
IPv6 Dest Addr	28
IPv6 Nexthop	62
IPv6 BGP Nexthop	63
IPv4 Nexthop	15
IPv4 BGP Nexthop	18
Ingress Interface	10
Egress Interface	14
Packet Count	2
Byte Count	1
Start Time	22
End Time	21
Flow Start Milliseconds [1]	152

Table 77 **MPLS-IPv6 Template (Continued)**

Field Name	Field ID
Flow End Milliseconds1	153
Src Port	7
Dest Port	11
Forwarding Status	89
TCP control Bits (Flags)	6
Protocol	4
IPv6 Extension Hdr	64
IPv6 Next Header	193
IPv6 Flow Label	31
TOS	5
IP version	60
IPv6 ICMP Type & Code	139
Direction	61
BGP Source ASN	16
BGP Dest ASN	17
IPv6 Src Mask	29
IPv6 Dest Mask	30
MPLS_TOP_LABEL_TYPE	46
MPLS_TOP_LABEL_ADDR	47
MPLS Top Label Type	46
MPLS Top Label IPv6 Addr	47
MPLS Label 1	70
MPLS Label 2	71
MPLS Label 3	72
MPLS Label 4	73
MPLS Label 5	74

Table 77 **MPLS-IPv6 Template (Continued)**

Field Name	Field ID
MPLS Label 6	75
MPLS_TOP_LABEL_TYPE	46
MPLS_TOP_LABEL_ADDR	47
Minimum IP Total Length	25
Maximum IP Total Length	26
Minimum TTL	52
Maximum TTL	53

Note:

1. Only sent to collectors configured for v10 format

Table 78 **Basic MPLS Template**

Field Name	Field ID
Start Time	22
End Time	21
Flow Start Milliseconds [1]	152
Flow End Milliseconds1	153
Ingress Interface	10
Egress Interface	14
Packet Count	2
Byte Count	1
Direction	61
MPLS_TOP_LABEL_TYPE	46
MPLS_TOP_LABEL_ADDR	47
MPLS Label 1	70
MPLS Label 2	71

Table 78 Basic MPLS Template (Continued)

Field Name	Field ID
MPLS Label 3	72
MPLS Label 4	73
MPLS Label 5	74
MPLS Label 6	75

Note:

1. Only sent to collectors configured for v10 format

Table 79 MPLS-IP Template

Field Name	Field ID
IPv4 Src Addr	8
IPv4 Dest Addr	12
IPv4 Nexthop	15
IPv6 Src Addr	27
IPv6 Dest Addr	28
IPv6 Nexthop	62
Ingress Interface	10
Egress Interface	14
Packet Count	2
Byte Count	1
Start Time	22
End Time	21
Flow Start Milliseconds [1]	152
Flow End Milliseconds1	153
Src Port	7
Dest Port	11
TCP control Bits (Flags)	6
IPv4 Protocol	4

Table 79 **MPLS-IP Template (Continued)**

Field Name	Field ID
IPv4 TOS	5
IP version	60
ICMP Type & Code	32
Direction	61
MPLS_TOP_LABEL_TYPE	46
MPLS_TOP_LABEL_ADDR	47
MPLS Top Label Type	46
MPLS Top Label IPv4 Addr	47
MPLS Label 1	70
MPLS Label 2	71
MPLS Label 3	72
MPLS Label 4	73
MPLS Label 5	74
MPLS Label 6	75

Note:

1. Only sent to collectors configured for v10 format

Table 80 **Ethernet (L2-IP) Flow Template**

Field Name [1]	Field ID
MAC Src Addr	56
MAC Dest Addr	80
Ingress Physical Interface	252
Egress Physical Interface	253
Dot1q VLAN ID	243
Dot1q Customer VLAN ID	245
Post Dot1q VLAN ID	254
Post Dot1q Customer VLAN Id	255

Table 80 Ethernet (L2-IP) Flow Template (Continued)

Field Name [1]	Field ID
IPv4 Src Addr	8
IPv4 Dest Addr	12
IPv6 Src Addr	27
IPv6 Dest Addr	28
Packet Count	2
Byte Count	1
Flow Start Milliseconds	152
Flow End Milliseconds	153
Src Port	7
Dest Port	11
TCP control Bits (Flags)	6
Protocol	4
IPv6 Option Header	64
IPv6 Next Header	196
IPv6 Flow Label	31
TOS	5
IP Version	60
ICMP Type Code	32

Note:

1. Ohe Ethernet (L2-IP) flow template is only supported and exported to IPFIX (v10) collectors

Table 81 MPLS-Transport Template

Field Name	Field ID
Flow Start Milliseconds	152
Flow End Milliseconds	153
VRF ID	234
Ingress Interface	10

Table 81 **MPLS-Transport Template (Continued)**

Field Name	Field ID
Packet Count	2
Byte Count	1
Direction	61
MPLS_TOP_LABEL_TYPE	46
MPLS_TOP_LABEL_ADDR	47
MPLS Label-1	70

6.8.6 Enabling Cflowd on Interfaces and Filters

This section discusses the following cflowd configuration management tasks:

- Specifying Cflowd Options on an IP Interface
  - Interface Configurations
  - Service Interfaces
- Specifying Sampling Options in Filter Entries
  - Interface Configurations
- Dependencies

6.8.7 Specifying Cflowd Options on an IP Interface

When cflowd is enabled on an interface, all packets forwarded by the interface are subject to analysis according to the global cflowd configuration and sorted according to the collector configuration(s).

Refer to Cflowd Configuration Dependencies for configuration combinations.

When the cflowd interface option is configured in the **config>router>interface** context, the following requirements must be met to enable traffic sampling on the specific interface:

1. Cflowd must be enabled.
2. At least one cflowd collector must be configured and enabled.

3. The **interface>cflowd interface** option must be selected. For configuration information, refer to the Filter Policy Overview section of the Router Configuration Guide*.*
4. To omit certain types of traffic from being sampled when the interface sampling is enabled, the **config>filter>ip-filter>entry>interface-disable-sample** option may be enabled via an ip-filter or ipv6-filter. The filter must be applied to the service or network interface on which the traffic to be omitted is to ingress the system.

6.8.7.1 Interface Configurations

CLI Syntax:
```
config>router>if#
cflowd {acl | interface}
no cflowd
```

Depending on the option selected, either acl or interface, cflowd extracts traffic flow samples from an IP filter or an interface for analysis. All packets forwarded by the interface are analyzed according to the cflowd configuration.

The acl option must be selected in order to enable traffic sampling on an IP filter. Cflowd (filter-sample) must be enabled in at least one IP filter entry.

The interface option must be selected in order to enable traffic sampling on an interface. If cflowd is not enabled (no cflowd) then traffic sampling will not occur on the interface.

6.8.7.2 Service Interfaces

CLI Syntax:
```
config>service>vpls service-id# interface ip-int-name
cflowd {acl | interface}
```

When enabled on a service interface, cflowd collects routed traffic flow samples through a router for analysis. Cflowd is supported on IES and VPRN services interfaces only. Layer 2 traffic is excluded. All packets forwarded by the interface are analyzed according to the cflowd configuration. On the interface level, cflowd can be associated with a filter (ACL) or an IP interface.

6.8.8 Specifying Sampling Options in Filter Entries

Packets are matched against filter entries to determine acceptability. With cflowd, only the first packet of a flow is compared. If the first packet matches the filter criteria, then an entry is added to the cflowd cache. Subsequent packets in the same flow are also sampled based on the cache entry.

Since a filter can be applied to more than one interface (when configured with a **scope template**), the **interface-disable-sample** option is intended to enable or disable traffic sampling on an interface-by-interface basis. The command can be enabled or disabled as needed instead creating numerous filter versions.

To enable for filter traffic sampling, the following requirements must be met:

1. Cflowd must be enabled globally.
2. At least one cflowd collector must be configured and enabled.
3. On the IP interface being used, the **interface>cflowd acl** option must be selected. (See Interface Configuration) For configuration information, refer to the IP Router Configuration Overview section of the Router Configuration Guide*.*
4. On the IP filter being used, the **entry>filter-sample** option must be explicitly enabled for the entries matching the traffic that should be sampled. The default is **no filter-sample**. (See Filter Configuration for more information).
5. The filter must be applied to a service or a network interface. The service or port must be enabled and operational.

6.8.8.1 Filter Configurations

CLI Syntax:
```
config>filter>ip-filter>entry#
[no] filter-sample
[no] interface-disable-sample
```

When a filter policy is applied to a service or a network interface, sampling can be configured so that traffic matching the associated IP filter entry is sampled when the IP interface is set to cflowd ACL mode and the **filter-sample** command is enabled. If cflowd is either not enabled (**no filter-sample**) or set to the **cflowd interface** mode, then sampling does not occur.

When the **interface-disable-sample** command is enabled, then traffic matching the associated IP filter entry is not sampled if the IP interface is set to cflowd ACL mode.

6.8.8.2 Dependencies

In order for cflowd to be operational, the following requirements must be met:

- Cflowd must be enabled on a global level. If cflowd is disabled, any traffic sampling instances are also disabled.
- At least one collector must be configured and enabled in order for traffic sampling to occur on an enabled entity.
- If a specific collector UDP port is not identified then, by default, flows are sent to port 2055.

Cflowd can also be dependent on the following entity configurations:

- Interface Configurations
- Service Interfaces
- Filter Configurations

Depending on the combination of interface and filter entry configurations determine if and when flow sampling occurs. Table 82 displays the expected results when specific features are enabled and disabled.

Table 82 **Cflowd Configuration Dependencies**

Interface Setting	**router>interface cflowd [acl | interface] Setting**	**Command ip-filter entry**	**Expected Results**
IP-filter mode	ACL	filter-sampled	Traffic matching is sampled at specified rate.
IP-filter mode	ACL	no filter-sampled	No traffic is sampled on this interface.
IP-filter mode or cflowd not enabled on interface	ACL	interface-disable-sample	Command is ignored. No sampling occurs.
Interface mode	interface	interface-disable-sample	Traffic matching this IP filter entry is not sampled.
Interface mode	interface	none	All IP traffic ingressing the interface is subject to sampling.
Interface mode	interface	filter sampled	Filter level action is ignored. All traffic ingressing the interface is subject to sampling.

6.9 Cflowd Configuration Management Tasks

This section discusses the following cflowd configuration management tasks:

- Modifying Global Cflowd Components
- Modifying Cflowd Collector Parameters

6.9.1 Modifying Global Cflowd Components

Cflowd parameter modifications apply to all instances where cflowd or traffic sampling is enabled. Changes are applied immediately. Use the following cflowd commands to modify global cflowd parameters:

CLI Syntax:
```
config>cflowd#
active-timeout minutes
no active-timeout
cache-size num-entries
no cache-size
inactive-timeout seconds
no inactive-timeout
overflow percent
no overflow
rate sample-rate
no rate
[no] shutdown
template-retransmit seconds
no template-retransmit
```

The following example displays the cflowd command usage to modify configuration parameters:

Example:
```
config>cflowd# active-timeout 60
config>cflowd# no inactive-timeout
config>cflowd# overflow 2
config>cflowd# rate 10
```

The following example displays the common cflowd component configuration:

```
A:ALA-1>config>cflowd# info
#------------------------------------------
        active-timeout 60
        overflow 2
        rate 10
#------------------------------------------
A:ALA-1>config>cflowd#
```

6.9.2 Modifying Cflowd Collector Parameters

Use the following commands to modify cflowd collector and aggregation parameters:

CLI Syntax:

```
config>cflowd#
collector ip-address[:port] [version version]
no collector ip-address[:port]
     [no] aggregation
          [no] as-matrix
          [no] destination-prefix
          [no] protocol-port
          [no] raw
          [no] source-destination-prefix
          [no] source-prefix
     [no] autonomous-system-type [origin | peer]
     [no] description description-string
     [no] shutdown
     template-set {basic | mpls-ip | l2-ip | mpls-
       transport}
```

If a specific collector UDP port is not identified then, by default, flows are sent to port 2055.

The following displays basic cflowd modifications:

```
A:ALA-1>config>cflowd# info
----------------------------------------
     active-timeout 60
        overflow 2
        rate 10
        collector 10.10.10.1:2000 version 5
            description "AS info collector"
        exit
        collector 10.10.10.2:5000 version 8
            aggregation
                source-prefix
                raw
            exit
            description "Test collector"
        exit
----------------------------------------
A:ALA-1>config>cflowd#
```

6.10 Cflowd Configuration Command Reference

6.10.1 Command Hierarchies

config
- — [**no**] **cflowd**
  - — **active-timeout** *minutes*
  - — **no active-timeout**
  - — **cache-size** *num-entries*
  - — **no cache-size**
  - — **collector** *ip-address*[**:***port*] [**version** {**5** | **8** | **9** | **10**}]
  - — **no collector** *ip-address*[**:***port*]
    - — [**no**] **aggregation**
      - — [**no**] **as-matrix**
      - — [**no**] **destination-prefix**
      - — [**no**] **protocol-port**
      - — [**no**] **raw**
      - — [**no**] **source-destination-prefix**
      - — [**no**] **source-prefix**
    - — **autonomous-system-type** {**origin** | **peer**}
    - — **no autonomous-system-type**
    - — **description** *description-string*
    - — **no description**
    - — [**no**] **shutdown**
    - — **template-set** {**basic** | **mpls-ip** | **l2-ip** | **mpls-transport**}
  - — **export-mode** [**automatic** | **manual**]
  - — **inactive-timeout** *seconds*
  - — **no inactive-timeout**
  - — **overflow** *percent*
  - — **no overflow**
  - — **rate** *sample-rate*
  - — **no rate**
  - — [**no**] **shutdown**
  - — **template-retransmit seconds**
  - — **no template-retransmit**
  - — [**no**] **use-vrtr-if-index**

6.10.2 Command Descriptions

6.10.2.1 Global Commands

cflowd

Syntax [**no**] **cflowd**

Context config>cflowd

Description This command creates the context to configure cflowd.

The **no** form of this command removes all configuration under cflowd including the deletion of all configured collectors. This can only be executed if cflowd is in a shutdown state.

Default no cflowd

active-timeout

Syntax **active-timeout** *minutes*
no active-timeout

Context config>cflowd

Description This command configures the maximum amount of time before an active flow is aged out of the active cache. If an individual flow is active for this amount of time, the flow is aged out and a new flow will be created on the next packet sampled for that flow.

Existing flows do not inherit the new active-timeout value if this parameter is changed while cflowd is active. The active-timeout value for a flow is set when the flow is first created in the active cache table and does not change dynamically.

The **no** form of this command resets the inactive timeout back to the default value.

Default **active-timeout 30**

Parameters *minutes* — the value expressed in minutes before an active flow is exported

Values 1 — 600

cache-size

Syntax **cache-size** *num-entries*
no cache-size

Context config>cflowd

Description This command specifies the maximum number of active flows to maintain in the flow cache table.

The **no** form of this command resets the number of active entries back to the default value.

Default cache-size 65536

Parameters *num-entries* — the maximum number of entries maintained in the cflowd cache. It depends on the CPM version.

Values

For the 7450 ESS and 7750 SR:	1000 to 128 k (SF/CPM1, SF/CPM2) 1000 to 250000 (cfm-xp, SF/CPM3 or higher)
For the 7950 XRS:	1000 to 1500000

Default

For the 7450 ESS and 7750 SR:	65536 (64K)
For the 7950 XRS:	500000

collector

Syntax **collector** *ip-address*[:*port*] {**version** [**5** | **8** | **9** | **10**]}
no collector

Context config>cflowd

Description This command defines a flow data collector for cflowd data. The IP address of the flow collector must be specified. The UDP port number is an optional parameter. If it is not set, the default of 2055 is used for all collector versions. To connect to a IPFIX (version 10) collector using the IPFIX default port, specify port 4739 when configuring the collector. The version must be specified. A maximum of 5 collectors can be configured.

The **no** form of this command removes the flow collector definition from the config and stops the export of data to the collector. The collector needs to be shutdown to be deleted.

Default n/a

Parameters *ip-address* — specifies the address of a remote Cflowd collector host to receive the exported Cflowd data

Values

<ip-address[:port]>: ip-address - a.b.c.d[:port] (IPv4)
x:x:x:x:x:x:x:x (IPv6)
[x:x:x:x:x:x:x:x]:port (IPv6)

x - [0..FFFF]H

port — Specifies the UDP port number on the remote Cflowd collector host to receive the exported Cflowd data.

Values 1 to 65535

Default 2055

version — Specifies the version of the flow data collector.

Values Netflow v5, v8, v9, v10 (IPFIX) format

Default 5

aggregation

Syntax [**no**] **aggregation**

Context config>cflowd>collector

Description This command configures the type of aggregation scheme to be exported.

Specifies the type of data to be aggregated and to the collector.

To configure aggregation, you must decide which type of aggregation scheme to configure: autonomous system, destination prefix, protocol port, raw, source destination, or source prefix.

This can only be configured if the collector version is configured as V8.

The **no** form of this command removes all aggregation types from the collector configuration.

Default **no aggregation**

as-matrix

Syntax [**no**] **as-matrix**

Context config>cflowd>collector>aggregation

Description This command specifies that the aggregation data should be based on autonomous system (AS) information. An AS matrix contains packet and byte counters for traffic from either source-destination autonomous systems or last-peer to next-peer autonomous systems.

The **no** form of this command removes this type of aggregation from the collector configuration.

Default no as-matrix

destination-prefix

Syntax [**no**] **destination-prefix**

Context config>cflowd>collector>aggregation

Description This command specifies that the aggregation data is based on destination prefix information.

The **no** form removes this type of aggregation from the collector configuration.

Default none

protocol-port

Syntax [**no**] **protocol-port**

Context config>cflowd>collector>aggregation

Description This command specifies that flows be aggregated based on the IP protocol, source port number, and destination port number.

The **no** form of this command removes this type of aggregation from the collector configuration.

Default n/a

raw

Syntax [**no**] **raw**

Context config>cflowd>collector>aggregation

Description This command configures raw (unaggregated) flow data to be sent in Version 5.

The **no** form of this command removes this type of aggregation from the collector configuration.

Default n/a

source-destination-prefix

Syntax [**no**] **source-destination-prefix**

Context config>cflowd>collector>aggregation

Description This command configures cflowd aggregation based on source and destination prefixes.

The **no** form of this command removes this type of aggregation from the collector configuration.

Default n/a

source-prefix

Syntax [**no**] **source-prefix**

Context config>cflowd>collector>aggregation

Description This command configures cflowd aggregation based on source prefix information.

The **no** form of this command removes this type of aggregation from the collector configuration.

Default n/a

autonomous-system-type

Syntax **autonomous-system-type** {**origin** | **peer**}
no autonomous-system-type

Context config>cflowd>collector

Description This command defines whether the autonomous system (AS) information included in the flow data is based on the originating AS or external peer AS of the routes.

This option is only allowed if the collector is configured as Version 5 or Version 8.

The **no** form of this command resets the AS type to the default value.

Default **autonomous-system-type origin**

Parameters **origin —** specifies that the AS information included in the flow data is based on the originating AS

peer — specifies that the AS information included in the flow data is based on the peer AS

description

Syntax **description** *description-string*
no description

Context config>cflowd>collector

Description This command creates a text description stored in the configuration file for a configuration context.

The **no** form of this command removes the description string from the context.

Default No description is associated with the configuration context.

Parameters *description-string* — The description character string. Allowed values are any string up to 80 characters long composed of printable, 7-bit ASCII characters. If the string contains special characters (#, $, spaces, etc.), the entire string must be enclosed within double quotes.

shutdown

Syntax [**no**] **shutdown**

Context config>cflowd
config>cflowd>collector

Description This command administratively disables an entity. When disabled, an entity does not change, reset, or remove any configuration settings or statistics.

The operational state of the entity is disabled as well as the operational state of any entities contained within. Many objects must be shut down before they may be deleted.

The **no** form of this command administratively enables an entity.

Unlike other commands and parameters where the default state is not indicated in the configuration file. The **shutdown** and **no shutdown** states are always indicated in system generated configuration files.

Default no shutdown

template-set

Syntax **template-set** {**basic** | **mpls-ip** | **l2-ip** | **mpls-transport**}

Context config>cflowd>collector

Description This command specifies the set of templates sent to the collector when using cflowd Version 9 or Version 10.

Default **template-set basic**

Parameters **basic —** basic flow data is sent

mpls-ip — extended flow data is sent that includes IP and MPLS flow information

l2-ip — extended flow data is sent that includes Layer 2 (Ethernet) and IP flow information.This template is only applicable for v10(IPFIX) collectors.

mpls-transport — Allows cflowd to collect flow statistics for MPLS traffic using only the outer transport label, EXP bit value and ingress interface as the flow identifier. This template enables the collection of flows statistics on a core router to develop LSP usage statistics.

export-mode

Syntax **export-type** [**automatic** | **manual**]

Context config>cflowd

Description This command can be used to control how exports are generated by the cflowd process. The default behavior is for flow data to be exported automatically based on the active and inactive time-out values. The alternative mode is manual in which case flow data is only exported when the command “tools perform cflowd manual-export” is issued. The only exception is if the cflowd cache overflows, in which case the normal automatic export process is used.

Default export-mode automatic

Parameters **automatic —** Cflowd flow data is automatically generated.

manual — Cflowd flow data is exported only when manual triggered.

inactive-timeout

Syntax **inactive-timeout** *seconds*
no inactive-timeout

Context config>cflowd

Description This command specifies the amount of time, in seconds, that must elapse without a packet matching a flow in order for the flow to be considered inactive.

The **no** form of this command resets the inactive timeout back to the default of 15 seconds.

Existing flows will not inherit the new inactive-timeout value if this parameter is changed while cflowd is active. The inactive-timeout value for a flow is set when the flow is first created in the active cache table and does not change dynamically.

Default **inactive-timeout 15**

Parameters *seconds* — specifies the amount of time, in seconds, that must elapse without a packet matching a flow in order for the flow to be considered inactive

Values 10 to 600

overflow

Syntax **overflow** *percent*
no overflow

Context config>cflowd

Description This command specifies the percentage of the flow cache entries removed when the maximum number of entries is exceeded. The entries removed are the entries that have not been updated for the longest amount of time.

The **no** form of this command resets the number of entries cleared from the flow cache on overflow to the default value.

Default **overflow 1%**

Parameters *percent* — specifies the percentage of the flow cache entries removed when the maximum number of entries is exceeded

Values 1 to 50 percent

rate

Syntax **rate** *sample-rate*
no rate

Context config>cflowd

Description This command specifies the rate (N) at which traffic is sampled and sent for flow analysis. A packet is sampled every N packets; for example, when **sample-rate** is configured as 1, then all packets are sent to the cache. When **sample-rate** is configured as 100, then every 100th packet is sent to the cache.

The **no** form of this command resets the sample rate to the default value.

Default rate 1000

Parameters *sample-rate* — specifies the rate at which traffic is sampled

Values 1 to 10000

template-retransmit

Syntax **template-retransmit** *seconds*
no template-retransmit

Context config>cflowd

Description This command specifies the interval for sending template definitions.

Default template-retransmit 600

Parameters *seconds* — the value expressed in seconds before sending template definitions

Values 10 to 600

use-vrtr-if-index

Syntax [**no**] **use-vrtr-if-index**

Context config>cflowd

Description This command is used to export flow data using interface indexes (ifIndex values), which can be used directly as the index into the IF-MIB tables for retrieving interface statistics. Specifically, if the this command is enabled, then the ingressInterface (ID=10) and egressInterface (ID= 14) fields in IP flow templates used to export the flow data to Cflowd version 9 and version 10 collectors will be populated with the IF-MIB ifIndex of that interface. In addition, for version 10 templates, two fields are available in the IP flow templates to present the Virtual Router ID associated with the ingress and egress interfaces.

The **no** form of this command removes the command from the active configuration and causes cflowd to return to the default behavior of populating the ingress and egress interface ID with the global IF index IDs.

Default no use-vrtr-if-index

6.11 Show, Tools, and Clear Command Reference

- Command Hierarchies
- Command Descriptions

6.11.1 Command Hierarchies

- Show Commands
- Tools Commands
- Clear Commands

6.11.1.1 Show Commands

show
— **cflowd**
— **collector** [*ip-address*[**:***port*]] [**detail**]
— **interface** [*ip-int-name* | *ip-address*]
— **status**

6.11.1.2 Tools Commands

tools
— **dump**
— **cflowd**
— **cache** {**all** | **aggregate** {**src-dst-proto** | **src-dst-proto-port**}} **family** {**ipv4** | **ipv6**}
— **packet-size** [**ipv4** | **ipv6**] [**clear**]
— **top-flows** [**ipv4** | **ipv6** | **mpls**] [**clear**]
— **top-protocols** [**clear**]

6.11.1.3 Clear Commands

clear
— **cflowd**

6.11.2 Command Descriptions

6.11.2.1 Show Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

collector

Syntax **collector** [*ip-addr*[**:***port*]] [**detail**]

Context show>cflowd

Description This command displays administrative and operational status of data collector configuration.

Parameters *ip-addr* — Display only information about the specified collector IP address.

Default all collectors

:*port* **—** Display only information the collector on the specified UDP port.

Default all UDP ports

Values 1 to 65535

detail — Displays details about either all collectors or the specified collector.

Output **cflowd Collector Output —**The following output is an example of cflowd Collector information, and Table 83 describes the output fields.

```
A:R51-CfmA# show cflowd collector

===============================================================================
Cflowd Collectors
===============================================================================
Host Address     Port  Version    AS Type    Admin    Oper             Sent
-------------------------------------------------------------------------------
138.120.135.103  2055  v5         peer       up       up               1380 records
138.120.135.103  9555  v8         origin     up       up                 90 records
138.120.135.103  9996  v9           -        up       up                  0 packets
138.120.214.224  2055  v5         origin     up       up               1380 records
-------------------------------------------------------------------------------
Collectors : 4
===============================================================================
```

Table 83 Show Cflowd Collector Output Fields

Label	Description
Host Address	The IP address of a remote Cflowd collector host to receive the exported Cflowd data.
Port	The UDP port number on the remote Cflowd collector host to receive the exported Cflowd data.
AS Type	The style of AS reporting used in the exported flow data.
	origin Reflects the endpoints of the AS path which the flow is following.
	peer Reflects the AS of the previous and next hops for the flow.
Version	Specifies the configured version for the associated collector.
Admin	The desired administrative state for this Cflowd remote collector host.
Oper	The current operational status of this Cflowd remote collector host.
Recs Sent	The number of Cflowd records that have been transmitted to this remote collector host.
Collectors	The total number of collectors using this IP address.

cflowd Collector Detail Output —The following output is an example of cflowd Collector information, and Table 84 describes the output fields.

Sample Output

```
A:R51-CfmA# show cflowd collector detail
===============================================================================
Cflowd Collectors  (detail)
===============================================================================
Address                       : 138.120.135.103
Port                          : 2055
Description                   : Test v5 Collector
Version                       : 5
AS Type                       : peer
Admin State                   : up
Oper State                    : up
Records Sent                  : 1260
Last Changed                  : 09/03/2009 17:24:04
Last Pkt Sent                 : 09/03/2009 18:07:10
-------------------------------------------------------------------------------
                                              Sent          Open       Errors
```

```
-------------------------------------------------------------------------------
                                              42             0             0
===============================================================================
Address                      : 138.120.135.103
Port                         : 9555
Description                  : Test v8 Collector
Version                      : 8
AS Type                      : origin
Admin State                  : up
Oper State                   : up
Records Sent                 : 82
Last Changed                 : 09/03/2009 17:24:04
Last Pkt Sent                : 09/03/2009 18:06:41
-------------------------------------------------------------------------------
Aggregation Type              Status          Sent          Open       Errors
-------------------------------------------------------------------------------
as-matrix                    Disabled            0             0             0
protocol-port                Disabled            0             0             0
source-prefix                 Enabled           21             0             0
destination-prefix            Enabled           21             0             0
source-destination-prefix    Disabled            0             0             0
raw                          Disabled            0             0             0
===============================================================================
Address                      : 138.120.135.103
Port                         : 9996
Description                  : Test v9 Collector
Version                      : 9
Admin State                  : up
Oper State                   : up
Packets Sent                 : 51
Last Changed                 : 09/03/2009 17:24:04
Last Pkt Sent                : 09/03/2009 18:07:10
Template Set                 : Basic
-------------------------------------------------------------------------------
Traffic Type            Template Sent          Sent          Open       Errors
-------------------------------------------------------------------------------
IPv4              09/03/2009 18:07:29           51             1             0
MPLS                 No template sent            0             0             0
IPv6                 No template sent            0             0             0
===============================================================================
A:R51-CfmA#
```

Table 84 **Show Cflowd Collector Detailed Output Fields**

Label	Description
Address	The IP address of a remote Cflowd collector host to receive the exported Cflowd data.
Port	The UDP port number on the remote Cflowd collector host to receive the exported Cflowd data.
Description	A user-provided descriptive string for this Cflowd remote collector host.
Version	The version of the flow data sent to the collector.

Table 84 **Show Cflowd Collector Detailed Output Fields (Continued)**

Label	Description
AS Type	The style of AS reporting used in the exported flow data.
	origin Reflects the endpoints of the AS path which the flow is following.
	peer Reflects the AS of the previous and next hops for the flow.
Admin State	The desired administrative state for this Cflowd remote collector host.
Oper State	The current operational status of this Cflowd remote collector host.
Records Sent	The number of Cflowd records that have been transmitted to this remote collector host.
Last Changed	The time when this row entry was last changed.
Last Pkt Sent	The time when the last Cflowd packet was sent to this remote collector host.
Aggregation Type	The bit mask which specifies the aggregation scheme(s) used to aggregate multiple individual flows into an aggregated flow for export to this remote host collector.
	none No data will be exported for this remote collector host.
	raw Flow data is exported without aggregation in version 5 format.
	All other aggregation types use version 8 format to export the flow data to this remote host collector.
Collectors	The total number of collectors using this IP address.
Sent	The number of packets with flow date sent to the associated collector.
Open	This counter shows the number of partially filled packets which have some flow data but are not yet filled or have been timed out (60 seconds maximum).
Error	This counter increments when there was an error during exporting of the collector packet. The most common reason will be a UDP unreachable destination for the configured collector.

interface

Syntax **interface** [*ip-addr* | *ip-int-name*]

Context show>cflowd

Description Displays the administrative and operational status of the interfaces with cflowd enabled.

Parameters *ip-addr* — Display only information for the IP interface with the specified IP address.

Default all interfaces with Cflowd enabled.

ip-int-name — Display only information for the IP interface with the specified name.

Default all interfaces with Cflowd enabled.

Output The following output is an example of Cflowd interface information, and Table 85 describes the output fields.

Table 85 **Show Cflowd Interface Output Fields**

Label	Description
Interface	Displays the physical port identifier.
IPv4 Address	Displays the primary IPv4 address for the associated IP interface.
IPv6 Address	Displays the primary IPv6 address for the associated IP interface.
Router	Displays the virtual router index (Base = 0).
IF Index	Displays the Global IP interface index.
Mode	Displays the Cflowd sampling type and direction. intf — Interface based sampling acl — ACL based sampling ingr — Ingress sampling egr — Egress sampling both — Both ingress and egress sampling
Admin	Displays the administrative state of the interface.
Opr-IPv4	Displays the operational state for IPv4 sampling.
Opr-IPv6	Displays the operational state for IPv6 sampling.

Sample Output

```
B:sr-002# show cflowd interface [ip-addr | ip-int-name]
===============================================================================
Cflowd Interfaces
===============================================================================
Interface                          Router       IF Index   Mode      Admin
```

```
  IPv4 Address                                                      Oper IPv4
  IPv6 Address                                                      Oper IPv6
-------------------------------------------------------------------------------
ipv4ipv6NamedIf                  Base          381       intf/ing   Up
    5.5.5.5/24                                                       Up
    55::55/128                                                       Up
ipv4NamedIf                      5             254       acl-egr   Up
    10.10.10.10/24                                                   Up
    N/A                                                              Down
ipv6NamedIf                      Base          380       i/f-both  Up
    N/A                                                              Down
    1234:5678::9/128                                                 Up
-------------------------------------------------------------------------------
Interfaces : 3
===============================================================================


B:sr-002# show cflowd interface 11.10.1.2
===============================================================================
Cflowd Interfaces
===============================================================================
Interface:  To_Sr1
IP address: 11.10.1.2/24
Admin/Oper state:  Up/Up
Sampling Mode: (ingress | egress | both)
Total Flows seen: 1302000
Pkts sampled (ingress/egress) :  60103/70102
Bytes sampled (ingress/egress) :  6010300/7010200
Active flows (ingress/egress) :  6010/7010


B:sr-002# show cflowd interface
===============================================================================
Cflowd Interfaces
===============================================================================
Interface                        IP Address        Mode        Admin   Oper
-------------------------------------------------------------------------------
To_Sr1                           1.10.1.2/24       Interface   Up      Up
To_C2                            1.12.1.2/24       Interface   Up      Up
To_Cisco_7600                    1.13.1.2/24       Interface   Up      Up
To_E                             1.11.1.2/24       Interface   Up      Up
To_G2                            150.153.1.1/24    Interface   Up      Up
To_Sr1_Sonet                     150.140.1.2/24    Interface   Up      Down
Main                             120.1.1.1/24      Filter      Down    Down
New                              120.2.1.1/24      Filter      Up      Up
-------------------------------------------------------------------------------
Interfaces : 8
===============================================================================
B:sr12-002#
```

status

Syntax **status**

Context show>cflowd

Description This command displays basic information regarding the administrative and operational status of Cflowd.

Output The following output is an example of Cflowd status information, and Table 86 describes the output fields.

Sample Output

```
sr1# show cflowd status
===============================================================================
Cflowd Status
===============================================================================
Cflowd Admin Status : Enabled
Cflowd Oper Status : Enabled
Active Timeout : 1 minutes
Inactive Timeout : 30 seconds
Template Retransmit : 60 seconds
Cache Size : 65536 entries
Overflow : 1%
Sample Rate : 1
Active Flows : 34000
Overflow events 10
Dropped Flows: 0
Pkts Rcvd : 801600
Total Pkts Dropped : 0
                           Raw
Times flow created        160000
Times flow matched        224428382
Total flows flushed       150000
===============================================================================
Version Info
===============================================================================
Version       Status        Sent   Open   Errors
-------------------------------------------------------------------------------
5             Enabled       92     0      0
8             Enabled       46     0      0
9             Enabled       56     1      0
10            Enabled       39     1      0
===============================================================================

===============================================================================
Cflowd Status
===============================================================================
Cflowd Admin Status  : Enabled
Cflowd Oper Status   : Enabled
Active Timeout       : 1 minutes
Inactive Timeout     : 30 seconds
Template Retransmit  : 60 seconds
Cache Size           : 65536 entries
Overflow             : 1%
Sample Rate          : 1
Active Flows         : 34
Total Pkts Rcvd      : 801600
Total Pkts Dropped   : 0

===============================================================================
Version Info
```

```
===============================================================================
Version                    Status     Sent          Open          Errors
-------------------------------------------------------------------------------
     5                     Enabled    92            0             0
     8                     Enabled    46            0             0
     9                     Enabled    56            1             0
    10                     Enabled    39            1             0
===============================================================================
```

Table 86 **Show Cflowd Status Fields**

Label	Description
Cflowd Admin Status	The desired administrative state for this Cflowd remote collector host.
Cflowd Oper Status	The current operational status of this Cflowd remote collector host.
Active Timeout	The maximum amount of time, in minutes, before an active flow will be exported. If an individual flow is active for this amount of time, the flow is exported and a new flow is created.
Inactive Timeout	Inactive timeout in seconds.
Template Retransmit	The time in seconds before template definitions are sent.
Cache Size	The maximum number of active flows to be maintained in the flow cache table.
Overflow	The percentage number of flows to be flushed when the flow cache size has been exceeded.
Sample Rate	The rate at which traffic is sampled and forwarded for Cflowd analysis. one (1) All packets are analyzed. 1000 (default) Every 1000th packet is analyzed.
Active Flows	The current number of active flows being collected.
Total Pkts Rcvd	The total number of packets sampled and forwarded for Cflowd analysis.
Total Pkts Dropped	The total number of packets dropped.
Aggregation Info:	
Type	The type of data to be aggregated and to the collector.

Table 86 **Show Cflowd Status Fields (Continued)**

Label	Description
Status	enabled Specifies that the aggregation type is enabled.
	disabled Specifies that the aggregation type is disabled.
Sent	The number of packets with flow date sent to the associated collector.
Open	This counter shows the number of partially filled packets which have some flow data but are not yet filled or have been timed out (60 seconds maximum).
Error	This counter increments when there was an error during exporting of the collector packet. The most common reason will be a UDP unreachable destination for the configured collector.
Overflow events	The number of times the active cache overflowed.
Dropped Flows	Total number of flows dropped due to cache overflow events.

6.11.2.2 Tools Commands

The following command outputs are examples only; actual displays may differ depending on supported functionality and user configuration.

cache

Syntax **cache** {**all** | **aggregate** {**src-dst-proto** | **src-dst-proto-port**}} **family** {**ipv4** | **ipv6**}

Context tools>dump>cflowd

Description This command displays the contents of the Cflowd active cache. This information can be displayed either in raw form where every flow entry is displayed or in an aggregated form.

Table 87 describes the Cflowd cache output fields.

Table 87 **Tools Dump Cflowd Cache Output Fields**

Label	Description
Proto/Protocol	Displays the IPv4 or IPv6 protocol type.
Source Address/Src-IP	Displays the source IP address of the flow (IPv4 or IPv6).
Destination Address/ Dst-IP	Displays the destination IP address of the flow (IPv4 or IPv6).
Intf/Ingr	Displays the ingress interface associated with the sampled flow (only displayed with the raw (all) output).
Intf/Egr	Displays the egress interface associated with the sampled flow (only displayed with the raw (all) output).
S-Port	Displays the source protocol port number.
D-Port	Displays the destination protocol port number.
Pkt-Cnt	Displays the total number of packets sampled for the associated flow.
Byte-Cnt	Displays the total number of bytes of traffic sampled for the associated flow.
Start-Time	Displays the system time when the first packet was sampled for the associated flow.
Flags	Displays the IP flag value from the sampled IP flow header (only displayed with the raw (all) output).

Table 87 **Tools Dump Cflowd Cache Output Fields (Continued)**

Label	Description
ToS	Displays the ToS byte values from the sampled IP flow header (only displayed with the raw (all) output).
(Src) Mask	Displays the IP route mask for the route to the flow source IP address associated with the flow (only displayed with the raw (all) output).
(Dst) Mask	Displays the IP route mask for the route to the flow destination IP address associated with the flow (only displayed with the raw (all) output).
(Src) AS	Displays the ASN associated with the route to the flow source IP address associated with the flow (only displayed with the raw (all) output).
(Dst) AS	Displays the ASN associated with the route to the flow destination IP address associated with the flow (only displayed with the raw (all) output).
vRtr-ID	Displays the Virtual Router ID associated with the reported IP flow (only displayed with the raw (all) output).

Parameters *all* — Display the raw active cache flow data with no aggregation.

aggregate — Display the aggregated active cache flow data.

src-dst-proto — Aggregates the active flow cache based on the source and destination IP address and the IP protocol value.

src-dst-proto-port — Aggregates the active flow cache based on the source and destination IP address, IP protocol value, and the source and destination port numbers.

family — Specifies which IP address family flow data should be displayed.

ipv4 — Displays the IPv4 flow data.

ipv6 — Displays the IPv6 flow data.

packet-size

Syntax **packet-size** [**ipv4** | **ipv6**] [**clear**]

Context tools>dump>cflowd

Description This command displays packet size distribution for sampled IP traffic. Values are displays in decimal format (1.0 = 100%, .500 = 50%). Separate statistics are maintained and shown for IPv4 and IPv6 traffic.

Output The following output is an example of Cflowd packet size information.

Sample Output

```
SR-12# tools dump cflowd packet-size ipv4
 IP packet size distribution (801600 total packets):
   1-32   64   96  128  160  192  224  256  288  320  352  384  416  448  480
   .000 .250 .000 .000 .010 .100 .500 .090 .000 .000 .000 .000 .000 .000 .000

    512  544  576 1024 1536 2048 2560 3072 3584 4096 4608 9000
   .000 .000 .000 .050 .000 .000 .000 .000 .000 .000 .000 .000
```

top-flows

Syntax **top-flows** [**ipv4** | **ipv6** | **mpls**] [**clear**]

Context tools>dump>cflowd

Description This command displays the top 20 (highest traffic volume) flows for IPv4, IPv6 or MPLS traffic types collected since the cflowd top-flow table was last cleared or initialized.

Output The following output is an example of Cflowd top flow information, and Table 88 describes the output fields.

Sample Output

```
1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
Sr1# tools dump cflowd top-flows ipv4

Ingress i/f   SrcIP          Egress i/f     DstIP           Pr  TOS  Flgs  Pkts
 vRtr-ID   S-Port Msk AS     D-Port Msk AS  NextHop         Avg Pkt Size Active
-----------------------------------------------------------------------------------
1000          52.52.52.1      2001          123.123.123.122 0x01 55   0x10  3748
 10201     0000   /8  50         0000 /8  40  202.120.130.2       220     3600
……


         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
Sr1# tools dump cflowd top-flows ipv6
SrcIP (up to IPv6)                      Ingress i/f  Src Port   vRtr ID     ToS
DstIP (upto IPv6)                       Egress i/f   Dst Port    Proto    Flags
   Nexthop (uptoIPv6)                     Total Pkts     Avg Pkt  Active(sec)
2001:0db8:85a3:0000:0000:8a2e:0370:7334  60005        10020        0        0x12
2001:0db8:85a3:0000:0000:8a2e:0280:1234  60325        20010        17       0x23
   2001:0db8:85a3:0000:0000:8a2e:1234:5678 1234567890     1500     13600
……

         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
Sr1# tools dump cflowd top-flows mpls
Label-1    Label-2    Label-3    Label-4    Total Pkts     Avg Pkt   Active(s)
  SrcIP (up to IPv6)                       Ingress i/f  Src Port    ToS
```

```
 DstIP (upto IPv6)                    Egress i/f   Dst Port    Proto    Flags
-------------------------------------------------------------------------------
```

Table 88 **Tools Dump Cflowd Top-flows Out put Fields**

Label	Description
Ingress	Displays the ingress interface ID.
Src IP	Displays the source IP address of the flow (IPv4 or IPv6).
Egress	Displays the egress interface ID.
Dest IP	Displays the destination IP address of the flow (IPv4 or IPv6).
Pr Proto	Displays the protocol type for flow.
TOS	Displays the Type of Service/DSCP buts filed markings.
Flgs	Displays the protocol flag markings.
Pkts	Displays the total number of packets sampled for this flow (since stats were last cleared).
vRtr-ID	Displays the vRouter context the flow was sample in.
S-Port Src Port	Displays the source protocol port number.
Msk	Displays the route prefix length for route to source IP address.
AS	Displays the Autonomous Systems number for the source route (the AS is either originating AS or peer AS depending on Cflowd configuration).
D-Port Dst Port	Displays the destination protocol port number.
Msk	Displays the route prefix length for route to destination IP address (Forwarding route).
AS	Displays the Autonomous Systems number for the destination route (the AS is either originating AS or peer AS depending on Cflowd configuration)
Nexthop	Displays the next-hop address used to forward traffic associated with the flow.
Avg pkt size	Displays the average packet size of a sampled traffic associated with this flow (total number of packets sampled / total number of packets sampled).
Active	Displays the number of seconds the flow has been active.

top-protocols

Syntax **top-protocols**

Context tools>dump>cflowd [clear]

Description This command displays the summary information for the top 20 protocol traffic seen in the Cflowd cache. All statistics are calculated based on the data collected since the last clearing of the cflowd stats with clear keyword for this command.

If the clear optional keyword is given, then the top-flows are displayed, and then this cache is cleared.

Output The following output is an example of Clfowd top protocol traffic information, and Table 89 describes the output fields.

Sample Output

```
SR# tools dump cflowd top-protocols

The top 20 IPv4 protocols seen by cflowd are:
      Current Time: 08/29/2011 15:36:15
Last Cleared Time: 08/29/2011 15:35:08
Protocol ID     Total   Flows   Packets   Bytes   Packets   Duration   % Total
--------        Flows    /Sec     /Flow    /Pkt      /Sec      /Flow   Bandwidth
--------------------------------------------------------------------------------
UDP                 2       0         6     100         0          6         75%
pr1                   1       0         6      64         0          6         24%
--------------------------------------------------------------------------------
TOTALS              3       0         6      88         0          6        100%
```

Table 89 **Tools Dump Cflowd Top-protocols Fields**

Label	Description
Protocol ID	Displays the IPv4 or IPv6 protocol type. This will either print the well known protocol name or the decimal protocol number.
Total Flows	Displays the total number of flows recorded since the last clearing of Cflowd statistics with this protocol type.
Flows/Sec	Displays the average number of flows detected for the associated protocol type. (Total flows / number of seconds since last clear)
Packets/Flow	Displays the average number of packets per flow. (Total number of packets / total flows)

Table 89 Tools Dump Cflowd Top-protocols Fields (Continued)

Label	Description
Bytes/Pkts	Displays the average number of bytes per packet for the associated protocol type. (Total number of bytes for the associated protocol / total number of packets seen for the associated protocol)
Packets/Sec	Displays the average number of packets seen for the associated protocol type. (Number of packets / time since last clear)
Duration/Flow	Displays the average lifetime of a flow for the associated protocol type. (Number of seconds since last clear / total flows)
Bandwidth Total (%)	Displays the percentage of bandwidth consumed by the associated protocol type. (Total protocol bytes / total bytes of all flows)

6.11.2.3 Clear Commands

cflowd

Syntax **cflowd**

Context clear

Description Clears the raw and aggregation flow caches which are sending flow data to the configured collectors. This action will trigger all the flows to be discarded. The cache restarts flow data collection from a fresh state. This command also clears global stats collector stats listed in the cflowd show commands.

7 Standards and Protocol Support

Note: The information presented is subject to change without notice.

Nokia assumes no responsibility for inaccuracies contained herein.

Access Node Control Protocol (ANCP)

draft-ietf-ancp-protocol-02, *Protocol for Access Node Control Mechanism in Broadband Networks*

RFC 5851, *Framework and Requirements for an Access Node Control Mechanism in Broadband Multi-Service Networks*

Application Assurance (AA)

3GPP Release 12 (ADC rules over Gx interfaces)

RFC 3507, *Internet Content Adaptation Protocol (ICAP)*

Asynchronous Transfer Mode (ATM)

AF-ILMI-0065.000, *Integrated Local Management Interface (ILMI) Version 4.0*

AF-PHY-0086.001, *Inverse Multiplexing for ATM (IMA) Specification Version 1.1*

AF-TM-0121.000, *Traffic Management Specification Version 4.1*

AF-TM-0150.00, *Addendum to Traffic Management v4.1 optional minimum desired cell rate indication for UBR*

GR-1113-CORE, *Asynchronous Transfer Mode (ATM) and ATM Adaptation Layer (AAL) Protocols Generic Requirements, Issue 1*

GR-1248-CORE, *Generic Requirements for Operations of ATM Network Elements (NEs), Issue 3*

ITU-T I.432.1, *B-ISDN user-network interface - Physical layer specification: General characteristics (02/99)*

ITU-T I.610, *B-ISDN operation and maintenance principles and functions (11/95)*

RFC 1626, *Default IP MTU for use over ATM AAL5*

RFC 2684, *Multiprotocol Encapsulation over ATM Adaptation Layer 5*

Border Gateway Protocol (BGP)

draft-hares-idr-update-attrib-low-bits-fix-01, *Update Attribute Flag Low Bits Clarification*

draft-ietf-idr-add-paths-04, *Advertisement of Multiple Paths in BGP* draft-ietf-idr-best-external-03, *Advertisement of the best external route in BGP*

draft-ietf-idr-bgp-gr-notification-01, *Notification Message support for BGP Graceful Restart*

draft-ietf-idr-error-handling-03, *Revised Error Handling for BGP UPDATE Messages*

draft-ietf-sidr-origin-validation-signaling-04, *BGP Prefix Origin Validation State Extended Community*

RFC 1772, *Application of the Border Gateway Protocol in the Internet*

RFC 1997, *BGP Communities Attribute*

RFC 2385, *Protection of BGP Sessions via the TCP MD5 Signature Option*

RFC 2439, *BGP Route Flap Damping*

RFC 2545, *Use of BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain Routing*

RFC 2858, *Multiprotocol Extensions for BGP-4*

RFC 2918, *Route Refresh Capability for BGP-4*

RFC 3107, *Carrying Label Information in BGP-4*

RFC 3392, *Capabilities Advertisement with BGP-4*

RFC 4271, *A Border Gateway Protocol 4 (BGP-4)*

RFC 4360, *BGP Extended Communities Attribute*

RFC 4364, *BGP/MPLS IP Virtual Private Networks (VPNs)*

RFC 4456, *BGP Route Reflection: An Alternative to Full Mesh Internal BGP (IBGP)*

RFC 4486, *Subcodes for BGP Cease Notification Message*

RFC 4659, *BGP-MPLS IP Virtual Private Network (VPN) Extension for IPv6 VPN*

RFC 4684, *Constrained Route Distribution for Border Gateway Protocol/ MultiProtocol Label Switching (BGP/MPLS) Internet Protocol (IP) Virtual Private Networks (VPNs)*

RFC 4724, *Graceful Restart Mechanism for BGP* (helper mode)

RFC 4760, *Multiprotocol Extensions for BGP-4*

RFC 4798, *Connecting IPv6 Islands over IPv4 MPLS Using IPv6 Provider Edge Routers (6PE)*

RFC 4893, *BGP Support for Four-octet AS Number Space*

RFC 5004, *Avoid BGP Best Path Transitions from One External to Another*

RFC 5065, *Autonomous System Confederations for BGP*

RFC 5291, *Outbound Route Filtering Capability for BGP-4*

RFC 5575, *Dissemination of Flow Specification Rules*

RFC 5668, *4-Octet AS Specific BGP Extended Community*

RFC 6810, *The Resource Public Key Infrastructure (RPKI) to Router Protocol*

RFC 6811, *Prefix Origin Validation*

RFC 7607, *Codification of AS 0 Processing*

Circuit Emulation

MEF-8, *Implementation Agreement for the Emulation of PDH Circuits over Metro Ethernet Networks, October 2004*

RFC 4553, *Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP)*

RFC 5086, *Structure-Aware Time Division Multiplexed (TDM) Circuit Emulation Service over Packet Switched Network (CESoPSN)*

RFC 5287, *Control Protocol Extensions for the Setup of Time-Division Multiplexing (TDM) Pseudowires in MPLS Networks*

Ethernet

IEEE 802.1AB, *Station and Media Access Control Connectivity Discovery*

IEEE 802.1ad, *Provider Bridges*

IEEE 802.1ag, *Connectivity Fault Management*

IEEE 802.1ah, *Provider Backbone Bridges*

IEEE 802.1ak, *Multiple Registration Protocol*

IEEE 802.1aq, *Shortest Path Bridging*

IEEE 802.1ax, *Link Aggregation*

IEEE 802.1D, *MAC Bridges*

IEEE 802.1p, *Traffic Class Expediting*

IEEE 802.1Q, *Virtual LANs*

IEEE 802.1s, *Multiple Spanning Trees*

IEEE 802.1w, *Rapid Reconfiguration of Spanning Tree*

IEEE 802.1X, *Port Based Network Access Control*

IEEE 802.3ab, *1000BASE-T*

IEEE 802.3ac, *VLAN Tag*

IEEE 802.3ad, *Link Aggregation*

IEEE 802.3ae, *10 Gb/s Ethernet*

IEEE 802.3ah, *Ethernet in the First Mile*

IEEE 802.3ba, *40 Gb/s and 100 Gb/s Ethernet*

IEEE 802.3i, *Ethernet*

IEEE 802.3u, *Fast Ethernet*

IEEE 802.3x, *Ethernet Flow Control*

IEEE 802.3z, *Gigabit Ethernet*

ITU-T G.8031/Y.1342, *Ethernet Linear Protection Switching*

ITU-T G.8032/Y.1344, *Ethernet Ring Protection Switching*

ITU-T Y.1731, *OAM functions and mechanisms for Ethernet based networks*

Ethernet VPN (EVPN)

draft-ietf-bess-evpn-overlay-02, *A Network Virtualization Overlay Solution using EVPN*

draft-ietf-bess-evpn-prefix-advertisement-02, *IP Prefix Advertisement in EVPN*

draft-ietf-bess-evpn-proxy-arp-nd-00, *Operational Aspects of Proxy-ARP/ND in EVPN Networks*

draft-ietf-bess-evpn-vpls-seamless-integ-00, *(PBB-)EVPN Seamless Integration with (PBB-)VPLS*

draft-ietf-bess-evpn-vpws-06, *VPWS support in EVPN*

RFC 7432, *BGP MPLS-Based Ethernet VPN*

RFC 7623, *Provider Backbone Bridging Combined with Ethernet VPN (PBB-EVPN)*

Frame Relay

ANSI T1.617 Annex D, *DSS1 - Signalling Specification For Frame Relay Bearer Service*

FRF.1.2, *PVC User-to-Network Interface (UNI) Implementation Agreement*

FRF.12, *Frame Relay Fragmentation Implementation Agreement*

FRF.16.1, *Multilink Frame Relay UNI/NNI Implementation Agreement*

FRF.5, *Frame Relay/ATM PVC Network Interworking Implementation*

FRF2.2, *PVC Network-to-Network Interface (NNI) Implementation Agreement*

ITU-T Q.933 Annex A, *Additional procedures for Permanent Virtual Connection (PVC) status management*

Generalized Multiprotocol Label Switching (GMPLS)

draft-ietf-ccamp-rsvp-te-srlg-collect-04, *RSVP-TE Extensions for Collecting SRLG Information*

RFC 3471, *Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description*

RFC 3473, *Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions*

RFC 4204, *Link Management Protocol (LMP)*

RFC 4208, *Generalized Multiprotocol Label Switching (GMPLS) User-Network Interface (UNI): Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Support for the Overlay Model*

RFC 4872, *RSVP-TE Extensions in Support of End-to-End Generalized Multi-Protocol Label Switching (GMPLS) Recovery*

Intermediate System to Intermediate System (IS-IS)

draft-ginsberg-isis-mi-bis-01, *IS-IS Multi-Instance* (single topology)

draft-ietf-isis-mi-02, *IS-IS Multi-Instance*

draft-ietf-isis-segment-routing-extensions-04, *IS-IS Extensions for Segment Routing*

draft-kaplan-isis-ext-eth-02, *Extended Ethernet Frame Size Support*

ISO/IEC 10589:2002, Second Edition, Nov. 2002, *Intermediate system to Intermediate system intra-domain routeing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473)*

RFC 1195, *Use of OSI IS-IS for Routing in TCP/IP and Dual Environments*

RFC 2973, *IS-IS Mesh Groups*

RFC 3359, *Reserved Type, Length and Value (TLV) Codepoints in Intermediate System to Intermediate System*

RFC 3719, *Recommendations for Interoperable Networks using Intermediate System to Intermediate System (IS-IS)*

RFC 3787, *Recommendations for Interoperable IP Networks using Intermediate System to Intermediate System (IS-IS)*

RFC 4971, *Intermediate System to Intermediate System (IS-IS) Extensions for Advertising Router Information*

RFC 5120, *M-ISIS: Multi Topology (MT) Routing in IS-IS*

RFC 5130, *A Policy Control Mechanism in IS-IS Using Administrative Tags*

RFC 5301, *Dynamic Hostname Exchange Mechanism for IS-IS*

RFC 5302, *Domain-wide Prefix Distribution with Two-Level IS-IS*

RFC 5303, *Three-Way Handshake for IS-IS Point-to-Point Adjacencies*

RFC 5304, *IS-IS Cryptographic Authentication*

RFC 5305, *IS-IS Extensions for Traffic Engineering TE*

RFC 5306, *Restart Signaling for IS-IS* (helper mode)

RFC 5307, *IS-IS Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)*

RFC 5308, *Routing IPv6 with IS-IS*

RFC 5309, *Point-to-Point Operation over LAN in Link State Routing Protocols*

RFC 5310, *IS-IS Generic Cryptographic Authentication*

RFC 6213, *IS-IS BFD-Enabled TLV*

RFC 6232, *Purge Originator Identification TLV for IS-IS*

RFC 6233, *IS-IS Registry Extension for Purges*

RFC 6329, *IS-IS Extensions Supporting IEEE 802.1aq Shortest Path Bridging*

Internet Protocol (IP) — Fast Reroute

draft-ietf-rtgwg-lfa-manageability-08, *Operational management of Loop Free Alternates*

RFC 5286, *Basic Specification for IP Fast Reroute: Loop-Free Alternates*

RFC 7431, *Multicast-Only Fast Reroute*

RFC 7490, *Remote Loop-Free Alternate (LFA) Fast Reroute (FRR)*

Internet Protocol (IP) — General

draft-grant-tacacs-02, *The TACACS+ Protocol*

draft-ietf-vrrp-unified-spec-02, *Virtual Router Redundancy Protocol Version 3 for IPv4 and IPv6*

RFC 768, *User Datagram Protocol*

RFC 793, *Transmission Control Protocol*

RFC 854, *Telnet Protocol Specifications*

RFC 951, *Bootstrap Protocol (BOOTP)*

RFC 1034, *Domain Names - Concepts and Facilities*

RFC 1035, *Domain Names - Implementation and Specification*

RFC 1350, *The TFTP Protocol (revision 2)*

RFC 1534, *Interoperation between DHCP and BOOTP*

RFC 1542, *Clarifications and Extensions for the Bootstrap Protocol*

RFC 2131, *Dynamic Host Configuration Protocol*

RFC 2132, *DHCP Options and BOOTP Vendor Extensions*

RFC 2347, *TFTP Option Extension*

RFC 2348, *TFTP Blocksize Option*

RFC 2349, *TFTP Timeout Interval and Transfer Size Options*

RFC 2428, *FTP Extensions for IPv6 and NATs*

RFC 2784, *Generic Routing Encapsulation (GRE)*

RFC 2865, *Remote Authentication Dial In User Service (RADIUS)*

RFC 2866, *RADIUS Accounting*

RFC 2867, *RADIUS Accounting Modifications for Tunnel Protocol Support*

RFC 2868, *RADIUS Attributes for Tunnel Protocol Support*

RFC 3046, *DHCP Relay Agent Information Option (Option 82)*

RFC 3315, *Dynamic Host Configuration Protocol for IPv6 (DHCPv6)*

RFC 3596, *DNS Extensions to Support IP version 6*

RFC 3768, *Virtual Router Redundancy Protocol (VRRP)*

RFC 4250, *The Secure Shell (SSH) Protocol Assigned Numbers*

RFC 4251, *The Secure Shell (SSH) Protocol Architecture*

RFC 4252, *The Secure Shell (SSH) Authentication Protocol* (publickey, password)

RFC 4253, *The Secure Shell (SSH) Transport Layer Protocol*

RFC 4254, *The Secure Shell (SSH) Connection Protocol*

RFC 4632, *Classless Inter-domain Routing (CIDR): The Internet Address Assignment and Aggregation Plan*

RFC 5082, *The Generalized TTL Security Mechanism (GTSM)*

RFC 5656, *Elliptic Curve Algorithm Integration in the Secure Shell Transport Layer* (ECDSA)

RFC 5880, *Bidirectional Forwarding Detection (BFD)*

RFC 5881, *Bidirectional Forwarding Detection (BFD) IPv4 and IPv6 (Single Hop)*

RFC 5883, *Bidirectional Forwarding Detection (BFD) for Multihop Paths*

RFC 6398, *IP Router Alert Considerations and Usage* (MLD)

RFC 6528, *Defending against Sequence Number Attacks*

RFC 6929, *Remote Authentication Dial-In User Service (RADIUS) Protocol Extensions*

RFC 7130, *Bidirectional Forwarding Detection (BFD) on Link Aggregation Group (LAG) Interfaces*

Internet Protocol (IP) — Multicast

cisco-ipmulticast/pim-autorp-spec01, *Auto-RP: Automatic discovery of Group-to-RP mappings for IP multicast*

draft-dolganow-bess-mvpn-expl-track-01, *Explicit Tracking with Wild Card Routes in Multicast VPN*

draft-ietf-idmr-traceroute-ipm-07, *A "traceroute" facility for IP Multicast*

draft-ietf-l2vpn-vpls-pim-snooping-07, *Protocol Independent Multicast (PIM) over Virtual Private LAN Service (VPLS)*

RFC 1112, *Host Extensions for IP Multicasting*

RFC 2236, *Internet Group Management Protocol, Version 2*

RFC 2375, *IPv6 Multicast Address Assignments*

RFC 2710, *Multicast Listener Discovery (MLD) for IPv6*

RFC 3306, *Unicast-Prefix-based IPv6 Multicast Addresses*

RFC 3376, *Internet Group Management Protocol, Version 3*

RFC 3446, *Anycast Rendevous Point (RP) mechanism using Protocol Independent Multicast (PIM) and Multicast Source Discovery Protocol (MSDP)*

RFC 3590, *Source Address Selection for the Multicast Listener Discovery (MLD) Protocol*

RFC 3618, *Multicast Source Discovery Protocol (MSDP)*

RFC 3810, *Multicast Listener Discovery Version 2 (MLDv2) for IPv6*

RFC 3956, *Embedding the Rendezvous Point (RP) Address in an IPv6 Multicast Address*

RFC 3973, *Protocol Independent Multicast - Dense Mode (PIM-DM): Protocol Specification (Revised)* (auto-RP groups)

RFC 4541, *Considerations for Internet Group Management Protocol (IGMP) and Multicast Listener Discovery (MLD) Snooping Switches*

RFC 4601, *Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)*

RFC 4604, *Using Internet Group Management Protocol Version 3 (IGMPv3) and Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast*

RFC 4607, *Source-Specific Multicast for IP*

RFC 4608, *Source-Specific Protocol Independent Multicast in 232/8*

RFC 4610, *Anycast-RP Using Protocol Independent Multicast (PIM)*

RFC 4611, *Multicast Source Discovery Protocol (MSDP) Deployment Scenarios*

RFC 5059, *Bootstrap Router (BSR) Mechanism for Protocol Independent Multicast (PIM)*

RFC 5186, *Internet Group Management Protocol Version 3 (IGMPv3) / Multicast Listener Discovery Version 2 (MLDv2) and Multicast Routing Protocol Interaction*

RFC 5384, *The Protocol Independent Multicast (PIM) Join Attribute Format*

RFC 5496, *The Reverse Path Forwarding (RPF) Vector TLV*

RFC 6037, *Cisco Systems' Solution for Multicast in MPLS/BGP IP VPNs*

RFC 6512, *Using Multipoint LDP When the Backbone Has No Route to the Root*

RFC 6513, *Multicast in MPLS/BGP IP VPNs*

RFC 6514, *BGP Encodings and Procedures for Multicast in MPLS/IP VPNs*

RFC 6515, *IPv4 and IPv6 Infrastructure Addresses in BGP Updates for Multicast VPNs*

RFC 6516, *IPv6 Multicast VPN (MVPN) Support Using PIM Control Plane and Selective Provider Multicast Service Interface (S-PMSI) Join Messages*

RFC 6625, *Wildcards in Multicast VPN Auto-Discover Routes*

RFC 6826, *Multipoint LDP In-Band Signaling for Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Path*

RFC 7246, *Multipoint Label Distribution Protocol In-Band Signaling in a Virtual Routing and Forwarding (VRF) Table Context*

RFC 7385, *IANA Registry for P-Multicast Service Interface (PMSI) Tunnel Type Code Points*

Internet Protocol (IP) — Version 4

RFC 791, *Internet Protocol*

RFC 792, *Internet Control Message Protocol*

RFC 826, *An Ethernet Address Resolution Protocol*

RFC 1519, *Classless Inter-Domain Routing (CIDR): an Address Assignment and Aggregation Strategy*

RFC 1812, *Requirements for IPv4 Routers*

RFC 1918, *Address Allocation for Private Internets*

RFC 1981, *Path MTU Discovery for IP version 6*

RFC 2003, *IP Encapsulation within IP*

RFC 2401, *Security Architecture for Internet Protocol*

RFC 3021, *Using 31-Bit Prefixes on IPv4 Point-to-Point Links*

Internet Protocol (IP) — Version 6

RFC 2460, *Internet Protocol, Version 6 (IPv6) Specification*

RFC 2464, *Transmission of IPv6 Packets over Ethernet Networks*

RFC 2473, *Generic Packet Tunneling in IPv6 Specification*

RFC 2529, *Transmission of IPv6 over IPv4 Domains without Explicit Tunnels*

RFC 3122, *Extensions to IPv6 Neighbor Discovery for Inverse Discovery Specification*

RFC 3587, *IPv6 Global Unicast Address Format*

RFC 3633, *IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6*

RFC 3646, *DNS Configuration options for Dynamic Host Configuration Protocol for IPv6 (DHCPv6)*

RFC 3736, *Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6*

RFC 3971, *SEcure Neighbor Discovery (SEND)*

RFC 3972, *Cryptographically Generated Addresses (CGA)*

RFC 4007, *IPv6 Scoped Address Architecture*

RFC 4193, *Unique Local IPv6 Unicast Addresses*

RFC 4291, *Internet Protocol Version 6 (IPv6) Addressing Architecture*

RFC 4443, *Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification*

RFC 4861, *Neighbor Discovery for IP version 6 (IPv6)*

RFC 4862, *IPv6 Stateless Address Autoconfiguration* (router functions)

RFC 4941, *Privacy Extensions for Stateless Address Autoconfiguration in IPv6*

RFC 5007, *DHCPv6 Leasequery*

RFC 5095, *Deprecation of Type 0 Routing Headers in IPv6*

RFC 5952, *A Recommendation for IPv6 Address Text Representation*

RFC 6106, *IPv6 Router Advertisement Options for DNS Configuration*

RFC 6164, *Using 127-Bit IPv6 Prefixes on Inter-Router Links*

Internet Protocol Security (IPsec)

draft-ietf-ipsec-isakmp-mode-cfg-05, *The ISAKMP Configuration Method*

draft-ietf-ipsec-isakmp-xauth-06, *Extended Authentication within ISAKMP/Oakley (XAUTH)*

RFC 2401, *Security Architecture for the Internet Protocol*

RFC 2403, *The Use of HMAC-MD5-96 within ESP and AH*

RFC 2404, *The Use of HMAC-SHA-1-96 within ESP and AH*

RFC 2405, *The ESP DES-CBC Cipher Algorithm With Explicit IV*

RFC 2406, *IP Encapsulating Security Payload (ESP)*

RFC 2409, *The Internet Key Exchange (IKE)*

RFC 2410, *The NULL Encryption Algorithm and Its Use With IPsec*

RFC 2560, *X.509 Internet Public Key Infrastructure Online Certificate Status Protocol - OCSP*

RFC 3526, *More Modular Exponential (MODP) Diffie-Hellman group for Internet Key Exchange (IKE)*

RFC 3566, *The AES-XCBC-MAC-96 Algorithm and Its Use With IPsec*

RFC 3602, *The AES-CBC Cipher Algorithm and Its Use with IPsec*

RFC 3706, *A Traffic-Based Method of Detecting Dead Internet Key Exchange (IKE) Peers*

RFC 3947, *Negotiation of NAT-Traversal in the IKE*

RFC 3948, *UDP Encapsulation of IPsec ESP Packets*

RFC 4210, *Internet X.509 Public Key Infrastructure Certificate Management Protocol (CMP)*

RFC 4211, *Internet X.509 Public Key Infrastructure Certificate Request Message Format (CRMF)*

RFC 4301, *Security Architecture for the Internet Protocol*

RFC 4303, *IP Encapsulating Security Payload*

RFC 4307, *Cryptographic Algorithms for Use in the Internet Key Exchange Version 2 (IKEv2)*

RFC 4308, *Cryptographic Suites for IPsec*

RFC 4434, *The AES-XCBC-PRF-128 Algorithm for the Internet Key Exchange Protocol (IKE)*

RFC 4868, *Using HMAC-SHA-256, HMAC-SHA-384, and HMAC-SHA-512 with IPSec*

RFC 4891, *Using IPsec to Secure IPv6-in-IPv4 Tunnels*

RFC 4945, *The Internet IP Security PKI Profile of IKEv1/ISAKMP, IKEv2 and PKIX*

RFC 5280, *Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile*

RFC 5996, *Internet Key Exchange Protocol Version 2 (IKEv2)*

RFC 5998, *An Extension for EAP-Only Authentication in IKEv2*

RFC 7321, *Cryptographic Algorithm Implementation Requirements and Usage Guidance for Encapsulating Security Payload (ESP) and Authentication Header (AH)*

RFC 7383, *Internet Key Exchange Protocol Version 2 (IKEv2) Message Fragmentation*

Label Distribution Protocol (LDP)

draft-ietf-mpls-ldp-ip-pw-capability-09, *Controlling State Advertisements Of Non-negotiated LDP Applications*

draft-ietf-mpls-ldp-ipv6-15, *Updates to LDP for IPv6*

draft-pdutta-mpls-ldp-adj-capability-00, *LDP Adjacency Capabilities*

draft-pdutta-mpls-ldp-v2-00, *LDP Version 2*

draft-pdutta-mpls-mldp-up-redundancy-00, *Upstream LSR Redundancy for Multi-point LDP Tunnels*

draft-pdutta-mpls-multi-ldp-instance-00, *Multiple LDP Instances*

draft-pdutta-mpls-tldp-hello-reduce-04, *Targeted LDP Hello Reduction*

RFC 3037, *LDP Applicability*

RFC 3478, *Graceful Restart Mechanism for Label Distribution Protocol* (helper mode)

RFC 5036, *LDP Specification*

RFC 5283, *LDP Extension for Inter-Area Label Switched Paths (LSPs)*

RFC 5443, *LDP IGP Synchronization*

RFC 5561, *LDP Capabilities*

RFC 5919, *Signaling LDP Label Advertisement Completion*

RFC 6388, *Label Distribution Protocol Extensions for Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Paths*

RFC 6512, *Using Multipoint LDP When the Backbone Has No Route to the Root*

RFC 6826, *Multipoint LDP in-band signaling for Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Paths*

Layer Two Tunneling Protocol (L2TP) Network Server (LNS)

draft-mammoliti-l2tp-accessline-avp-04, *Layer 2 Tunneling Protocol (L2TP) Access Line Information Attribute Value Pair (AVP) Extensions*

RFC 2661, *Layer Two Tunneling Protocol "L2TP"*

RFC 2809, *Implementation of L2TP Compulsory Tunneling via RADIUS*

RFC 3438, *Layer Two Tunneling Protocol (L2TP) Internet Assigned Numbers: Internet Assigned Numbers Authority (IANA) Considerations Update*

RFC 3931, *Layer Two Tunneling Protocol - Version 3 (L2TPv3)*

RFC 4638, *Accommodating a Maximum Transit Unit/Maximum Receive Unit (MTU/MRU) Greater Than 1492 in the Point-to-Point Protocol over Ethernet (PPPoE)*

RFC 4719, *Transport of Ethernet Frames over Layer 2 Tunneling Protocol Version 3 (L2TPv3)*

RFC 4951, *Fail Over Extensions for Layer 2 Tunneling Protocol (L2TP) "failover"*

Management

draft-ieft-snmpv3-update-mib-05, *Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)*

draft-ietf-isis-wg-mib-06, *Management Information Base for Intermediate System to Intermediate System (IS-IS)*

draft-ietf-mboned-msdp-mib-01, *Multicast Source Discovery protocol MIB*

draft-ietf-mpls-ldp-mib-07, *Definitions of Managed Objects for the Multiprotocol Label Switching, Label Distribution Protocol (LDP)*

draft-ietf-mpls-lsr-mib-06, *Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base Using SMIv2*

draft-ietf-mpls-te-mib-04, *Multiprotocol Label Switching (MPLS) Traffic Engineering Management Information Base*

draft-ietf-ospf-mib-update-08, *OSPF Version 2 Management Information Base*

ianaaddressfamilynumbers-mib, *IANA-ADDRESS-FAMILY-NUMBERS-MIB*

ianagmplstc-mib, *IANA-GMPLS-TC-MIB*

ianaiftype-mib, *IANAifType-MIB*

ianaiprouteprotocol-mib, *IANA-RTPROTO-MIB*

IEEE8021-CFM-MIB, *IEEE P802.1ag(TM) CFM MIB*

IEEE8021-PAE-MIB, *IEEE 802.1X MIB*

IEEE8023-LAG-MIB, *IEEE 802.3ad MIB*

LLDP-MIB, *IEEE P802.1AB(TM) LLDP MIB*

RFC 1157, *A Simple Network Management Protocol (SNMP)*

RFC 1212, *Concise MIB Definitions*

RFC 1213, *Management Information Base for Network Management of TCP/IP-based Internets: MIB-II*

RFC 1215, *A Convention for Defining Traps for use with the SNMP*

RFC 1724, *RIP Version 2 MIB Extension*

RFC 2021, *Remote Network Monitoring Management Information Base Version 2 using SMIv2*

RFC 2115, *Management Information Base for Frame Relay DTEs Using SMIv2*

RFC 2206, *RSVP Management Information Base using SMIv2*

RFC 2213, *Integrated Services Management Information Base using SMIv2*

RFC 2494, *Definitions of Managed Objects for the DS0 and DS0 Bundle Interface Type*

RFC 2514, *Definitions of Textual Conventions and OBJECT-IDENTITIES for ATM Management*

RFC 2515, *Definitions of Managed Objects for ATM Management*

RFC 2570, *SNMP Version 3 Framework*

RFC 2571, *An Architecture for Describing SNMP Management Frameworks*

RFC 2572, *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)*

RFC 2573, *SNMP Applications*

RFC 2574, *User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)*

RFC 2575, *View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)*

RFC 2578, *Structure of Management Information Version 2 (SMIv2)*

RFC 2579, *Textual Conventions for SMIv2*

RFC 2580, *Conformance Statements for SMIv2*

RFC 2787, *Definitions of Managed Objects for the Virtual Router Redundancy Protocol*

RFC 2819, *Remote Network Monitoring Management Information Base*

RFC 2856, *Textual Conventions for Additional High Capacity Data Types*

RFC 2863, *The Interfaces Group MIB*

RFC 2864, *The Inverted Stack Table Extension to the Interfaces Group MIB*

RFC 2933, *Internet Group Management Protocol MIB*

RFC 3014, *Notification Log MIB*

RFC 3164, *The BSD syslog Protocol*

RFC 3165, *Definitions of Managed Objects for the Delegation of Management Scripts*

RFC 3231, *Definitions of Managed Objects for Scheduling Management Operations*

RFC 3273, *Remote Network Monitoring Management Information Base for High Capacity Networks*

RFC 3416. *Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)*

RFC 3417, *Transport Mappings for the Simple Network Management Protocol (SNMP)* (SNMP over UDP over IPv4)

RFC 3419, *Textual Conventions for Transport Addresses*

RFC 3498, *Definitions of Managed Objects for Synchronous Optical Network (SONET) Linear Automatic Protection Switching (APS) Architectures*

RFC 3584, *Coexistence between Version 1, Version 2, and Version 3 of the Internet-standard Network Management Framework*

RFC 3592, *Definitions of Managed Objects for the Synchronous Optical Network/ Synchronous Digital Hierarchy (SONET/SDH) Interface Type*

RFC 3593, *Textual Conventions for MIB Modules Using Performance History Based on 15 Minute Intervals*

RFC 3635, *Definitions of Managed Objects for the Ethernet-like Interface Types*

RFC 3637, *Definitions of Managed Objects for the Ethernet WAN Interface Sublayer*

RFC 3826, *The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model*

RFC 3877, *Alarm Management Information Base (MIB)*

RFC 3895, *Definitions of Managed Objects for the DS1, E1, DS2, and E2 Interface Types*

RFC 3896, *Definitions of Managed Objects for the DS3/E3 Interface Type*

RFC 4001, *Textual Conventions for Internet Network Addresses*

RFC 4022, *Management Information Base for the Transmission Control Protocol (TCP)*

RFC 4113, *Management Information Base for the User Datagram Protocol (UDP)*

RFC 4220, *Traffic Engineering Link Management Information Base*

RFC 4273, *Definitions of Managed Objects for BGP-4*

RFC 4292, *IP Forwarding Table MIB*

RFC 4293, *Management Information Base for the Internet Protocol (IP)*

RFC 4379, *Detecting Multi-Protocol Label Switched (MPLS) Data Plane Failures*

RFC 4511, *Lightweight Directory Access Protocol (LDAP): The Protocol*

RFC 4513, *Lightweight Directory Access Protocol (LDAP): Authentication Methods and Security Mechanisms* (TLS)

RFC 4631, *Link Management Protocol (LMP) Management Information Base (MIB)*

RFC 4878, *Definitions and Managed Objects for Operations, Administration, and Maintenance (OAM) Functions on Ethernet-Like Interfaces*

RFC 5101, *Specification of the IP Flow Information Export (IPFIX) Protocol for the Exchange of IP Traffic Flow Information*

RFC 5102, *Information Model for IP Flow Information Export*

RFC 5246, *The Transport Layer Security (TLS) Protocol Version 1.2* (TLS client, RSA public key)

RFC 5357, *A Two-Way Active Measurement Protocol (TWAMP)* (server, unauthenticated mode)

RFC 5938, *Individual Session Control Feature for the Two-Way Active Measurement Protocol (TWAMP)*

RFC 6020, *YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)*

RFC 6038, *Two-Way Active Measurement Protocol (TWAMP) Reflect Octets and Symmetrical Size Features*

RFC 6241, *Network Configuration Protocol (NETCONF)*

RFC 6242, *Using the NETCONF Protocol over Secure Shell (SSH)*

RFC 6243, *With-defaults Capability for NETCONF*

RFC 6424, *Mechanism for Performing Label Switched Path Ping (LSP Ping) over MPLS Tunnels*

RFC 6425, *Detecting Data Plane Failures in Point-to-Multipoint Multiprotocol Label Switching (MPLS) - Extensions to LSP Ping*

RFC 7420, *Path Computation Element Communication Protocol (PCEP) Management Information Base (MIB) Module*

SFLOW-MIB, *sFlow MIB Version 1.3 (Draft 5)*

Multiprotocol Label Switching - Transport Profile (MPLS-TP)

RFC 5586, *MPLS Generic Associated Channel*

RFC 5921, *A Framework for MPLS in Transport Networks*

RFC 5960, *MPLS Transport Profile Data Plane Architecture*

RFC 6370, *MPLS Transport Profile (MPLS-TP) Identifiers*

RFC 6378, *MPLS Transport Profile (MPLS-TP) Linear Protection*

RFC 6426, *MPLS On-Demand Connectivity and Route Tracing*

RFC 6427, *MPLS Fault Management Operations, Administration, and Maintenance (OAM)*

RFC 6428, *Proactive Connectivity Verification, Continuity Check and Remote Defect indication for MPLS Transport Profile*

RFC 6478, *Pseudowire Status for Static Pseudowires*

RFC 7213, *MPLS Transport Profile (MPLS-TP) Next-Hop Ethernet Addressing*

Multiprotocol Label Switching (MPLS)

RFC 3031, *Multiprotocol Label Switching Architecture*

RFC 3032, *MPLS Label Stack Encoding*

RFC 3443, *Time To Live (TTL) Processing in Multi-Protocol Label Switching (MPLS) Networks*

RFC 4023, *Encapsulating MPLS in IP or Generic Routing Encapsulation (GRE)*

RFC 4182, *Removing a Restriction on the use of MPLS Explicit NULL*

RFC 5332, *MPLS Multicast Encapsulations*

RFC 6790, *The Use of Entropy Labels in MPLS Forwarding*

Network Address Translation (NAT)

draft-ietf-behave-address-format-10, *IPv6 Addressing of IPv4/IPv6 Translators*

draft-ietf-behave-v6v4-xlate-23, *IP/ICMP Translation Algorithm*

draft-miles-behave-l2nat-00, *Layer2-Aware NAT*

draft-nishitani-cgn-02, *Common Functions of Large Scale NAT (LSN)*

RFC 4787, *Network Address Translation (NAT) Behavioral Requirements for Unicast UDP*

RFC 5382, *NAT Behavioral Requirements for TCP*

RFC 5508, *NAT Behavioral Requirements for ICMP*

RFC 6146, *Stateful NAT64: Network Address and Protocol Translation from IPv6 Clients to IPv4 Servers*

RFC 6333, *Dual-Stack Lite Broadband Deployments Following IPv4 Exhaustion*

RFC 6334, *Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Option for Dual-Stack Lite*

RFC 6888, *Common Requirements For Carrier-Grade NATs (CGNs)*

RFC 7383, *Internet Key Exchange Protocol Version 2 (IKEv2) Message Fragmentation*

Open Shortest Path First (OSPF)

draft-ietf-ospf-prefix-link-attr-06, *OSPFv2 Prefix/Link Attribute Advertisement*

draft-ietf-ospf-segment-routing-extensions-04, *OSPF Extensions for Segment Routing*

RFC 1586, *Guidelines for Running OSPF Over Frame Relay Networks*

RFC 1765, *OSPF Database Overflow*

RFC 2328, *OSPF Version 2*

RFC 3101, *The OSPF Not-So-Stubby Area (NSSA) Option*

RFC 3509, *Alternative Implementations of OSPF Area Border Routers*

RFC 3623, *Graceful OSPF Restart Graceful OSPF Restart* (helper mode)

RFC 3630, *Traffic Engineering (TE) Extensions to OSPF Version 2*

RFC 4203, *OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)*

RFC 4222, *Prioritized Treatment of Specific OSPF Version 2 Packets and Congestion Avoidance*

RFC 4552, *Authentication/Confidentiality for OSPFv3*

RFC 4576, *Using a Link State Advertisement (LSA) Options Bit to Prevent Looping in BGP/MPLS IP Virtual Private Networks (VPNs)*

RFC 4577, *OSPF as the Provider/Customer Edge Protocol for BGP/MPLS IP Virtual Private Networks (VPNs)*

RFC 4970, *Extensions to OSPF for Advertising Optional Router Capabilities*

RFC 5185, *OSPF Multi-Area Adjacency*

RFC 5187, *OSPFv3 Graceful Restart* (helper mode)

RFC 5243, *OSPF Database Exchange Summary List Optimization*

RFC 5250, *The OSPF Opaque LSA Option*

RFC 5309, *Point-to-Point Operation over LAN in Link State Routing Protocols*

RFC 5340, *OSPF for IPv6*

RFC 5709, *OSPFv2 HMAC-SHA Cryptographic Authentication*

RFC 5838, *Support of Address Families in OSPFv3*

RFC 6987, *OSPF Stub Router Advertisement*

OpenFlow

ONF *OpenFlow Switch Specification Version 1.3.1* (OpenFlow-hybrid switches)

Path Computation Element Protocol (PCEP)

draft-alvarez-pce-path-profiles-04, *PCE Path Profiles*

draft-ietf-pce-segment-routing-05, *PCEP Extensions for Segment Routing*

draft-ietf-pce-stateful-pce-11, *PCEP Extensions for Stateful PCE*

RFC 5440, *Path Computation Element (PCE) Communication Protocol (PCEP)*

Point-to-Point Protocol (PPP)

RFC 1332, *The PPP Internet Protocol Control Protocol (IPCP)*

RFC 1377, *The PPP OSI Network Layer Control Protocol (OSINLCP)*

RFC 1661, *The Point-to-Point Protocol (PPP)*

RFC 1662, *PPP in HDLC-like Framing*

RFC 1877, *PPP Internet Protocol Control Protocol Extensions for Name Server Addresses*

RFC 1989, *PPP Link Quality Monitoring*

RFC 1990, *The PPP Multilink Protocol (MP)*

RFC 1994, *PPP Challenge Handshake Authentication Protocol (CHAP)*

RFC 2153, *PPP Vendor Extensions*

RFC 2516, *A Method for Transmitting PPP Over Ethernet (PPPoE)*

RFC 2615, *PPP over SONET/SDH*

RFC 2686, *The Multi-Class Extension to Multi-Link PPP*

RFC 2878, *PPP Bridging Control Protocol (BCP)*

RFC 4638, *Accommodating a Maximum Transit Unit/Maximum Receive Unit (MTU/MRU) Greater Than 1492 in the Point-to-Point Protocol over Ethernet (PPPoE)*

RFC 5072, *IP Version 6 over PPP*

Policy Management and Credit Control

3GPP TS 29.212 Release 11, *Policy and Charging Control (PCC); Reference points* (Gx support as it applies to wireline environment (BNG))

RFC 3588, *Diameter Base Protocol*

RFC 4006, *Diameter Credit-Control Application*

Pseudowire

draft-ietf-l2vpn-vpws-iw-oam-04, *OAM Procedures for VPWS Interworking*

MFA Forum 12.0.0, *Multiservice Interworking - Ethernet over MPLS*

MFA Forum 13.0.0, *Fault Management for Multiservice Interworking v1.0*

MFA Forum 16.0.0, *Multiservice Interworking - IP over MPLS*

MFA Forum 9.0.0, *The Use of Virtual trunks for ATM/MPLS Control Plane Interworking*

RFC 3916, *Requirements for Pseudo- Wire Emulation Edge-to-Edge (PWE3)*

RFC 3985, *Pseudo Wire Emulation Edge-to-Edge (PWE3)*

RFC 4385, *Pseudo Wire Emulation Edge-to-Edge (PWE3) Control Word for Use over an MPLS PSN*

RFC 4446, *IANA Allocations for Pseudowire Edge to Edge Emulation (PWE3)*

RFC 4447, *Pseudowire Setup and Maintenance Using the Label Distribution Protocol (LDP)*

RFC 4448, *Encapsulation Methods for Transport of Ethernet over MPLS Networks*

RFC 4619, *Encapsulation Methods for Transport of Frame Relay over Multiprotocol Label Switching (MPLS) Networks*

RFC 4717, *Encapsulation Methods for Transport Asynchronous Transfer Mode (ATM) over MPLS Networks*

RFC 4816, *Pseudowire Emulation Edge-to-Edge (PWE3) Asynchronous Transfer Mode (ATM) Transparent Cell Transport Service*

RFC 5085, *Pseudowire Virtual Circuit Connectivity Verification (VCCV): A Control Channel for Pseudowires*

RFC 5659, *An Architecture for Multi-Segment Pseudowire Emulation Edge-to-Edge*

RFC 5885, *Bidirectional Forwarding Detection (BFD) for the Pseudowire Virtual Circuit Connectivity Verification (VCCV)*

RFC 6073, *Segmented Pseudowire*

RFC 6310, *Pseudowire (PW) Operations, Administration, and Maintenance (OAM) Message Mapping*

RFC 6391, *Flow-Aware Transport of Pseudowires over an MPLS Packet Switched Network*

RFC 6575, *Address Resolution Protocol (ARP) Mediation for IP Interworking of Layer 2 VPNs*

RFC 6718, *Pseudowire Redundancy*

RFC 6829, *Label Switched Path (LSP) Ping for Pseudowire Forwarding Equivalence Classes (FECs) Advertised over IPv6*

RFC 6870, *Pseudowire Preferential Forwarding Status bit*

RFC 7023, *MPLS and Ethernet Operations, Administration, and Maintenance (OAM) Interworking*

RFC 7267, *Dynamic Placement of Multi-Segment Pseudowires*

Quality of Service (QoS)

RFC 2430, *A Provider Architecture for Differentiated Services and Traffic Engineering (PASTE)*

RFC 2474, *Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers*

RFC 2598, *An Expedited Forwarding PHB*

RFC 3140, *Per Hop Behavior Identification Codes*

RFC 3260, *New Terminology and Clarifications for Diffserv*

Resource Reservation Protocol - Traffic Engineering (RSVP-TE)

draft-newton-mpls-te-dynamic-overbooking-00, *A Diffserv-TE Implementation Model to dynamically change booking factors during failure events*

RFC 2702, *Requirements for Traffic Engineering over MPLS*

RFC 2747, *RSVP Cryptographic Authentication*

RFC 2961, *RSVP Refresh Overhead Reduction Extensions*

RFC 3097, *RSVP Cryptographic Authentication -- Updated Message Type Value*

RFC 3209, *RSVP-TE: Extensions to RSVP for LSP Tunnels*

RFC 3473, *Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions* (IF_ID RSVP_HOP object with unnumbered interfaces and RSVP-TE graceful restart helper procedures)

RFC 3477, *Signalling Unnumbered Links in Resource ReSerVation Protocol - Traffic Engineering (RSVP-TE)*

RFC 3564, *Requirements for Support of Differentiated Services-aware MPLS Traffic Engineering*

RFC 3906, *Calculating Interior Gateway Protocol (IGP) Routes Over Traffic Engineering Tunnels*

RFC 4090, *Fast Reroute Extensions to RSVP-TE for LSP Tunnels*

RFC 4124, *Protocol Extensions for Support of Diffserv-aware MPLS Traffic Engineering*

RFC 4125, *Maximum Allocation Bandwidth Constraints Model for Diffserv-aware MPLS Traffic Engineering*

RFC 4127, *Russian Dolls Bandwidth Constraints Model for Diffserv-aware MPLS Traffic Engineering*

RFC 4561, *Definition of a Record Route Object (RRO) Node-Id Sub-Object*

RFC 4875, *Extensions to Resource Reservation Protocol - Traffic Engineering (RSVP-TE) for Point-to-Multipoint TE Label Switched Paths (LSPs)*

RFC 4950, *ICMP Extensions for Multiprotocol Label Switching*

RFC 5151, *Inter-Domain MPLS and GMPLS Traffic Engineering -- Resource Reservation Protocol-Traffic Engineering (RSVP-TE) Extensions*

RFC 5712, *MPLS Traffic Engineering Soft Preemption*

RFC 5817, *Graceful Shutdown in MPLS and Generalized MPLS Traffic Engineering Networks*

Routing Information Protocol (RIP)

RFC 1058, *Routing Information Protocol*

RFC 2080, *RIPng for IPv6*

RFC 2082, *RIP-2 MD5 Authentication*

RFC 2453, *RIP Version 2*

Synchronous Optical Networking (SONET)/Synchronous Digital Hierarchy (SDH)

ITU-G.841, *Types and Characteristics of SDH Networks Protection Architecture, issued in October 1998 and as augmented by Corrigendum 1, issued in July 2002*

Timing

GR-1244-CORE, *Clocks for the Synchronized Network: Common Generic Criteria, Issue 3, May 2005*

GR-253-CORE, *SONET Transport Systems: Common Generic Criteria. Issue 3, September 2000*

IEEE 1588-2008, *IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems*

ITU-T G.781, *Synchronization layer functions, issued 09/2008*

ITU-T G.813, *Timing characteristics of SDH equipment slave clocks (SEC), issued 03/2003*

ITU-T G.8261, *Timing and synchronization aspects in packet networks, issued 04/2008*

ITU-T G.8262, *Timing characteristics of synchronous Ethernet equipment slave clock (EEC), issued 08/2007*

ITU-T G.8264, *Distribution of timing information through packet networks, issued 10/2008*

ITU-T G.8265.1, *Precision time protocol telecom profile for frequency synchronization, issued 10/2010*

ITU-T G.8275.1, *Precision time protocol telecom profile for phase/time synchronization with full timing support from the network, issued 07/2014*

RFC 5905, *Network Time Protocol Version 4: Protocol and Algorithms Specification*

Virtual Private LAN Service (VPLS)

RFC 4761, *Virtual Private LAN Service (VPLS) Using BGP for Auto-Discovery and Signaling*

RFC 4762, *Virtual Private LAN Service (VPLS) Using Label Distribution Protocol (LDP) Signaling*

RFC 5501, *Requirements for Multicast Support in Virtual Private LAN Services*

RFC 6074, *Provisioning, Auto-Discovery, and Signaling in Layer 2 Virtual Private Networks (L2VPNs)*

RFC 7041, *Extensions to the Virtual Private LAN Service (VPLS) Provider Edge (PE) Model for Provider Backbone Bridging*

RFC 7117, *Multicast in Virtual Private LAN Service (VPLS)*

Voice and Video

DVB BlueBook A86, *Transport of MPEG-2 TS Based DVB Services over IP Based Networks*

ETSI TS 101 329-5 Annex E, *QoS Measurement for VoIP - Method for determining an Equipment Impairment Factor using Passive Monitoring*

ITU-T G.1020 Appendix I, *Performance Parameter Definitions for Quality of Speech and other Voiceband Applications Utilizing IP Networks - Mean Absolute Packet Delay Variation & Markov Models*

ITU-T G.107, *The E Model - A computational model for use in planning*

ITU-T P.564, *Conformance testing for voice over IP transmission quality assessment models*

RFC 3550 Appendix A.8, *RTP: A Transport Protocol for Real-Time Applications* (estimating the interarrival jitter)

RFC 4585, *Extended RTP Profile for Real-time Transport Control Protocol (RTCP)-Based Feedback (RTP/AVPF)*

RFC 4588, *RTP Retransmission Payload Format*

Wireless Local Area Network (WLAN) Gateway

3GPP TS 23.402, *Architecture enhancements for non-3GPP accesses* (S2a roaming based on GPRS)

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