ESM IPv4: Multicast with Redirection

In This Chapter

This section describes ESM IPv4 multicast with redirection configurations.

Topics in this section include:

Applicability

This example is applicable to all 7750 SR-12 with IOM3-XP and IMMs, and needs chassis mode c as a minimum. This is also supported on 7450 ESS chassis in mixed mode and also on 7750 SR-c4/12 platform.

The configuration was tested on release 11.0R1 and covers both IPoE and PPPoE subscribers.

Overview

Alcatel-Lucent's Triple Play Service Delivery Architecture (TPSDA) allows operators to integrate High Speed Internet (HSI), voice, and video services within a single network infrastructure. The goal of this example is to walk through a TPSDA multicast architecture with redirection. The topics are divided into the following sections:

- ESM (Enhanced Subscriber management) multicast baseline configuration
- Single BNG with redirection
- SRRP BNG configuration with static SAP
- IPoE ESM multicast configuration
- PPPoE ESM multicast configuration
- Subscriber Routed Redundancy Protocol (SRRP)
  - → Multi-Chassis Synchronization (MCS) walk through

The network topology displayed in Figure 1 shows a typical TPSDA setup. It consists of three 7750s and a single 7450. Two 7750s are configured as Broadband Network Gateways (BNGs) and the third 7750 is configured as a P router. The 7450 is used as an aggregation switch to aggregate all subscribers. In ESM IPv4: Multicast with SRRP on page 2179, multicast is directly distributed to a subscriber through a subscriber SAP. This example walks through another popular model which redirects all multicast streams to a common routed interface for all subscribers. When multicast is put on the common routed interface, one single copy of a multicast stream is delivered to multiple subscribers. In this model, per-subscriber replication of multicast streams is done on an access node or on the aggregation network in order to minimize the bandwidth consumed by the multicast traffic in access/aggregation.

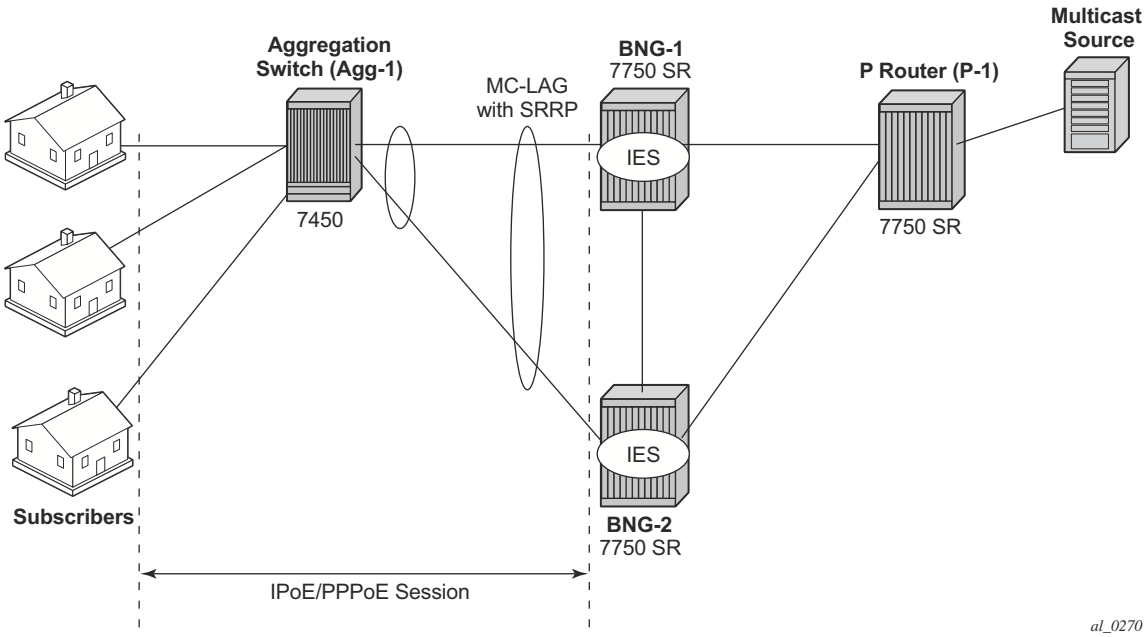

Figure 338: Network Topology Overview

Figure 338 shows two BNGs configured with SRRP to provide redundancy. The P router is connected to the multicast source and is connected to both BNGs. The connections between the BNGs and the P router, and the multicast source and the P router, are also running PIM to provide multicast delivery. On the access side, the two BNGs are connected to an aggregation switch via MC-LAG aggregating the traffic for both PPPoE and IPoE subscribers. The BNGs facing the subscriber side are IGMP aware and will respond to any subscribers' IGMP requests.

There are two requirements for a subscriber to receive multicast streams. First, the ESM group-interface must have IGMP enabled. Second, the customization of each subscriber's subscriber profile to allow them to receive multicast streams. When both requirements are met, the BNG will process the subscribers' IGMP messages, otherwise, IGMP messages are simply dropped. All customer premise device (CPE) IGMP messages are aggregated via the 7450 and passed onto the BNGs. Since the BNGs are running SRRP, the SRRP master is the only BNG processing and answering the IGMP messages. Protocol Independent Multicast (PIM) is then used between the BNG and the P router to request the multicast streams. If PIM is successful in retrieving the multicast group, the multicast stream is forwarded towards the individual subscribers. This is the typical multicast delivery for TPSDA.

Configuration

This example builds on the ESM multicast foundation discussed in ESM IPv4: Multicast with SRRP on page 2179. It starts with a single BNG setup with redirection.

ESM Multicast Interface Redirection

Figure 339 shows a popular ESM multicast model that redirects all multicast streams to a dedicated router interface. When configuring a redirected interface be aware that:

1. Redirection between Global Routing Table (GRT) interfaces and VPRN interfaces is not supported
   - GRT interfaces are interfaces that reside in the base router or in an IES.
2. Redirection can be performed between interfaces in the GRT or between the interfaces in any VPRN (even different VPRNs).

The following steps start with a simple ESM multicast configuration for BNG, without redirection.

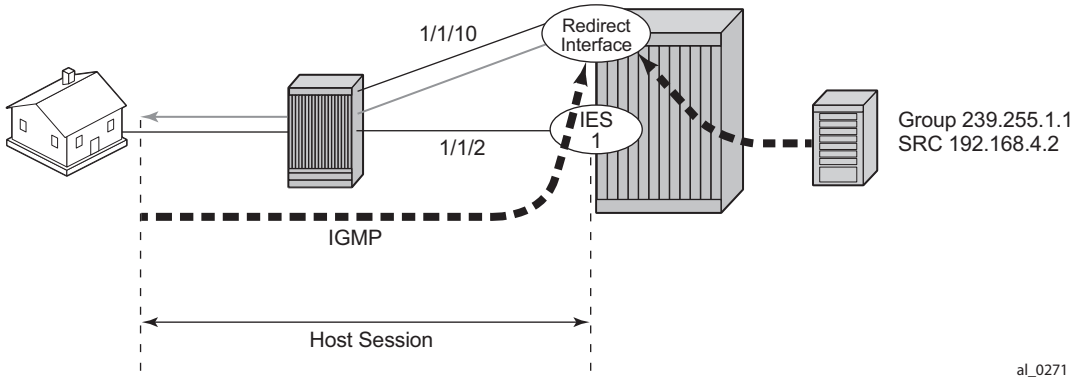

Figure 339: Single BNG Setup with Multicast Redirection

Step 1. Below is the BNG-1 configuration without multicast redirection. Subscribers are located in the 10.0.0.0/8 subnet. The multicast stream (S,G) is (192.168.4.2, 239.255.1.1). The local DHCP server is also on BNG-1.

```
*A:BNG-1>config>router>info
#------------------------------------------------
echo "Local DHCP Server Configuration"
#------------------------------------------------
        dhcp
```

```
            local-dhcp-server "dhcp-local-server" create
                use-gi-address scope pool
                pool "pool-1" create
                    subnet 10.0.0.0/8 create
                        options
                            subnet-mask 255.0.0.0
                            default-router 10.255.255.254
                        exit
                        address-range 10.0.0.10 10.0.0.254
                    exit
                exit
                no shutdown
            exit
        exit
#--------------------------------------------------
echo "IP Configuration"
#--------------------------------------------------
        interface "dhcp-lb1"
            address 192.168.0.1/32
            loopback
            local-dhcp-server "dhcp-local-server"
            no shutdown
        exit

*A:BNG-1>config>service>ies# info
----------------------------------------------
            description "BNG-1"
            interface "int-multicast-source" create
                address 192.168.4.1/30
                sap 1/1/2 create
                    no shutdown
                exit
            exit
            subscriber-interface "sub-int-1" create
                address 10.255.255.254/8
                group-interface "group-int-1" create
                    srrp-enabled-routing
                    dhcp
                        server 192.168.0.1
                        gi-address 10.255.255.254
                        lease-populate 10
                        no shutdown
                    exit
                    authentication-policy "auth-policy-1"
                    sap 1/1/5:4 create
                        sub-sla-mgmt
                            multi-sub-sap 10
                            no shutdown
                        exit
                    exit
                    pppoe
                        no shutdown
                    exit
                exit
            exit

*A:BNG-1>config>router# info
        interface "system"
            address 192.0.2.1/32
```

```
            no shutdown
        exit
        igmp
            group-interface "group-int-1"
                no shutdown
            exit
        exit
        pim
            interface "int-multicast-source"
            no shutdown
            rp
                static
                    address 192.0.2.1
                        group-prefix 224.0.0.0/4
                    exit
            exit
        exit

*A:BNG-1> config subscr-mgmt
     igmp-policy "igmp-policy-1" create
            exit
     exit all
     sub-profile "multicast-profile-1" create
            igmp-policy "igmp-policy-1"
     exit all
```

Step 2. Configure a router interface to redirect all multicast streams to, and then include the router interface in IGMP.

```
*A:BNG-1> config>service>ies# info
----------------------------------------------
            interface "redirected" create
                address 192.168.10.1/30
                sap 1/1/10 create
                exit
            exit

*A:BNG-1>config>router# info
            igmp
                interface "redirected"
----------------------------------------------
```

Step 3. Define a router redirection policy. This will redirect every (S,G) towards the redirected interface.

```
*A:BNG-1> config>router>policy-options# info
----------------------------------------------
            policy-statement "mcast_redirect_if"
                default-action accept
                    multicast-redirection fwd-service 1 "redirected"
                exit
            exit
```

Step 4. Apply the redirection policy created above in the igmp policy.

```
*A:BNG-1> config>subscr-mgmt>igmp-policy# info
----------------------------------------------
            redirection-policy "mcast_redirect_if"
----------------------------------------------
```

From this point on all multicast streams will be redirected to the “redirected” interface.

Now send an IGMPv3 join message and then use the *show router igmp group* command to verify that all multicast streams are redirected. In this example IGMPv3 is used with an (S,G) of (192.168.4.2, 239.255.1.1). The host has the IP address 10.0.0.10. Below is the output for PPPoE and for IPoE subscribers, shown separately.

Step 5a. Redirection with PPPoE subscribers: Viewing the multicast groups. In the PPPoE case, the multicast (S,G) shows up on both the redirected interface and the host.

```
*A:BNG-1> show router igmp group
===============================================================================
IGMP Interface Groups
===============================================================================

(192.168.4.2,239.255.1.1)                   Up Time : 0d 00:00:04
    Fwd List  : redirected
===============================================================================
IGMP Host Groups
===============================================================================
(192.168.4.2,239.255.1.1)
    Fwd List  : 10.0.0.10                   Up Time : 0d 00:00:04
===============================================================================
IGMP SAP Groups
===============================================================================
-------------------------------------------------------------------------------
(*,G)/(S,G) Entries : 2
===============================================================================
```

Step 5b. Redirection with IPoE subscribers: Viewing the multicast groups. In the IPoE case, the multicast (S,G) shows up on both the redirected interface and the SAP.

```
*A:BNG-1> show router igmp group
===============================================================================
IGMP Interface Groups
===============================================================================

(192.168.4.2,239.255.1.1)                   Up Time : 0d 00:00:04
    Fwd List  : redirected
===============================================================================
IGMP Host Groups
===============================================================================
===============================================================================
IGMP SAP Groups
===============================================================================
(192.168.4.2,239.255.1.1)
    Fwd List  : 10.0.0.10                   Up Time : 0d 00:00:04
```

```
-------------------------------------------------------------------------------
(*,G)/(S,G) Entries : 2
===============================================================================
```

Now the “redirected” interface is the only interface sending out multicast streams. The first command shows that the group interface does not register any multicast group (Num-Groups=0). The second command displays all multicast group are registered against the redirected interface (Num-Groups=1).

```
*A:BNG-1> show router igmp group-interface
===============================================================================
IGMP Group-Interfaces
===============================================================================
FwdSvc Group-Interface                  Adm/Opr-State        Import-Policy
       SAP                              Adm/Opr-Version      Num-Groups
-------------------------------------------------------------------------------
1      group-int-1                      Up/Up                none
       1/1/2                            3/3                  0
-------------------------------------------------------------------------------
Group-Interfaces = 1, SAPs = 1
===============================================================================

*A:BNG-1> show router igmp interface
===============================================================================
IGMP Interfaces
===============================================================================
Interface               Adm  Oper Querier         Cfg/Opr Num     Policy
                                                  Version Groups
-------------------------------------------------------------------------------
redirected              Up   Up   192.168.10.1      3/3     1       none
-------------------------------------------------------------------------------
Interfaces : 1
===============================================================================
```

Debug facilities can be used to troubleshoot multicast redirection issues. The output below shows the multicast is redirected to a regular routed interface after an IGMP join.

```
7017 2013/05/24 09:27:50.65 EST MINOR: DEBUG #2001 ies1 IGMP[9]
"IGMP[9]: RX-PKT
[013 00:25:03.310] IGMP host 10.0.0.10 V3 PDU: 10.0.0.10 -> 224.0.0.22 pduLen
20
    Type: V3 REPORT maxrespCode 0x0 checkSum 0xddf6
    Num Group Records: 1
        Group Record 0
        Type: ALW_NEW_SRCS, AuxDataLen 0, Num Sources 1
        Mcast Addr: 239.255.1.1
        Source Address List
            192.168.4.2

"

7018 2013/05/24 09:27:50.65 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9
]
"IGMP[ies1 inst 9]: igmpIfGroupAdd
Adding 239.255.1.1 to IGMP host 10.0.0.10 database"

7019 2013/05/24 09:27:50.65 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9
]
"IGMP[ies1 inst 9]: igmpProcessGroupRec
Process group rec ALW_NEW_SRCS received on host 10.0.0.10 for group 239.255.1.1 i
n mode INCLUDE. Num srcs 1"

7020 2013/05/24 09:27:50.66 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9
]
"IGMP[ies1 inst 9]: igmpIfSrcAdd
Adding i/f source entry for host 10.0.0.10 (192.168.4.2,239.255.1.1) to IGMP fwdList
 Database, redir if interface redirected [ifIndex 13]"
```

The output below shows what happens when an IGMP leave message is sent so that the multicast stream is no longer being forwarded.

```
7024 2013/05/24 09:29:29.85 EST MINOR: DEBUG #2001 ies1 IGMP[9]
"IGMP[9]: RX-PKT
[013 00:26:42.510] IGMP host 10.0.0.10 V3 PDU: 10.0.0.10 -> 224.0.0.22 pduLen
20
    Type: V3 REPORT maxrespCode 0x0 checkSum 0xdcf6
    Num Group Records: 1
        Group Record 0
        Type: BLK_OLD_SRCS, AuxDataLen 0, Num Sources 1
        Mcast Addr: 239.255.1.1
        Source Address List
            192.168.4.2
"
7025 2013/05/24 09:29:29.85 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9
]
"IGMP[ies1 inst 9]: igmpProcessGroupRec
Process group rec BLK_OLD_SRCS received on host 10.0.0.10 for group 239.255.1.1 i
n mode INCLUDE. Num srcs 1"
```

```
7026 2013/05/24 09:29:29.85 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9
]
"IGMP[ies1 inst 9]: igmpProcessIfSrcTimerExp
Source Timer expired for IGMP host 10.0.0.10 (192.168.4.2,239.255.1.1)"

7027 2013/05/24 09:29:29.85 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9
]
"IGMP[ies1 inst 9]: igmpIfSrcDel
Deleting i/f source entry for host 10.0.0.10 (192.168.4.2,239.255.1.1) from IGMP Dat
abase. DeleteFromAvl: 1 Redir 0"

7028 2013/05/24 09:29:29.85 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9
]
"IGMP[ies1 inst 9]: igmpIfGroupDel
Deleting 239.255.1.1 from IGMP host 10.0.0.10 database"

7029 2013/05/24 09:29:29.85 EST MINOR: DEBUG #2001 ies1 IGMP MCS[9]
"IGMP MCS[9]: TX-MCS Data (GlblDel)
host 10.0.0.10
Key Type: HostGroup, Len: 13, Host : 10.0.0.10, Grp Addr: 239.255.1.1
Data Type: Group, Len: 16, Ver: 0, RecType: 1, Compat Mode: 3,
Num Fwd Srcs: 0, Num Blk Srcs: 0
"

7030 2013/05/24 09:29:29.85 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9
]
"IGMP[ies1 inst 9]: igmpMcsDelIfGroup
Deleting MCS entry for host 10.0.0.10, group 239.255.1.1, Glb"
```

ESM SRRP with MC-LAG

Figure 340 shows a numbered SRRP setup with MC-LAG SAPs serving both IPoE and PPPoE subscribers. ESM IPv4: Multicast with SRRP on page 2179 covers the configuration of regular SRRP SAPs, consequently this example provides configuration guidelines to use a different type of SAP: SRRP MC-LAG SAPs. Note that redirection on SRRP SAPs without MC-LAG is also supported. The configuration of the RADIUS server is out of the scope of this example.

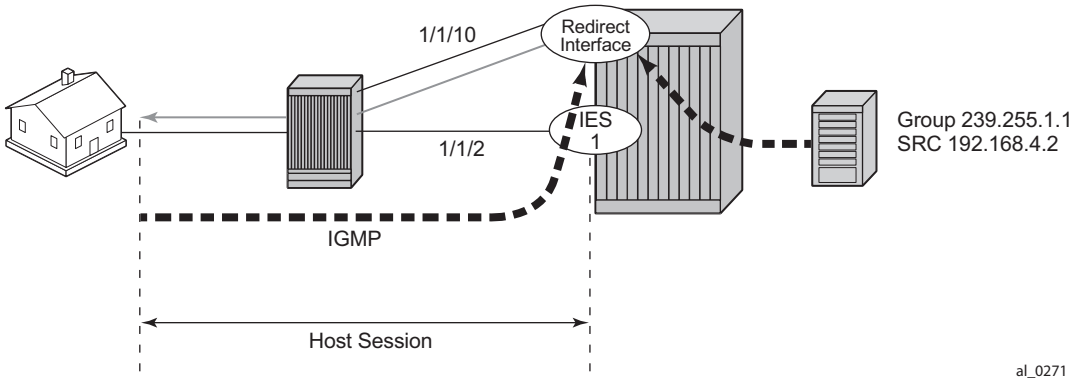

Figure 340: Network Topology with MC-LAG

The baseline configuration for BNG-1 is shown below without any IGMP configuration. The configuration begins with the MC-LAG configuration. ESM is configured in an IES service but it is also possible to configure ESM in a VPRN. The redirection interface must be in the same routing instance as the group-interface, this applies to both regular SRRP SAPs and MC-LAG SAPs. In the following example, the MC-LAG is **lag-1**, customer data traffic is using VLAN 4, MC-LAG control traffic is using VLAN 5, and the redirected multicast streams are using VLAN 4094.

```
A:BNG-1>config>lag# info
----------------------------------------------
        mode access
        encap-type dot1q
        port 1/1/5 priority 1
        lacp active administrative-key 32768
        no shutdown

A:BNG-1>config>redundancy# info
----------------------------------------------
        multi-chassis
            peer 192.0.2.2 create
                mc-lag
                    lag 1 lacp-key 1 system-id 00:00:00:00:00:01 system-priority 100
                    no shutdown
                exit
                sync
```

```
                    igmp
                    srrp
                    sub-mgmt ipoe pppoe
                    port lag-1 create
                        range 4-4 sync-tag "mclagdata"
                        range 5-5 sync-tag "mclagcontrol"
                    exit
                    no shutdown
                exit
                no shutdown
            exit
        exit

A:BNG-1>config>service>ies# info
----------------------------------------------
            description "BNG-1"
            redundant-interface "MClink-BNG-1-BNG-2" create
                address 192.168.1.0/31
                ip-mtu 1500
                spoke-sdp 1:1 create
                    no shutdown
                exit
            exit
            interface "int-BNG-1-P-1" create
                address 192.168.2.1/30
                sap 1/1/2 create
                    no shutdown
                exit
            exit
            interface "lag-redirected" create
                address 192.168.10.253/24
                vrrp 1
                    backup 192.168.10.254
                exit
                sap lag-1:4094 create
                exit
            exit
            subscriber-interface "sub-int-1" create
                address 10.255.255.253/8 gw-ip-address 10.255.255.254 track-srrp 1
                group-interface "group-int-1" create
                    dhcp
                        server 192.168.0.1
                        gi-address 10.255.255.253
                        lease-populate 10
                        no shutdown
                    exit
                    authentication-policy "auth-policy-1"
                    redundant-interface "MClink-BNG-1-BNG-2"
                    sap lag-1:1 create
                        sub-sla-mgmt
                            def-sub-id use-sap-id
                            def-sub-profile "multicast-profile-1"
                            def-sla-profile "sla-profile-1"
                            sub-ident-policy "sub-ident-policy-1"
                            multi-sub-sap 10
                            no shutdown
                        exit
                    exit
                    sap lag-1:5 create
```

```
                    exit
                    srrp 4 create
                        message-path lag-1:5
                        priority 200
                        no shutdown
                    exit
                    pppoe
                        no shutdown
                    exit
                exit
            exit

*A:BNG-1>config>router# info
#------------------------------------------------
echo "IP Configuration"
#------------------------------------------------
        interface "int-BNG-1-BNG-2"
            address 192.168.6.1/30
            port 1/1/1:1
            no shutdown
        exit
        interface "system"
            address 192.0.2.1/32
            bfd 100 receive 100 multiplier 3
            no shutdown
        exit
        autonomous-system 65536
#------------------------------------------------
echo "OSPFv2 Configuration"
#------------------------------------------------
        ospf
            traffic-engineering
            area 0.0.0.0
                interface "system"
                    no shutdown
                exit
                interface "int-BNG-1-BNG-2"
                    interface-type point-to-point
                    metric 10000
                    no shutdown
                exit
                interface "sub-int-1"
                    no shutdown
                exit
                interface "int-BNG-1-P-1"
                    no shutdown
                exit
                interface "lag-redirected"
                    no shutdown
                exit
            exit
        exit
        pim
            interface “int-to_P_router”
        exit
```

The baseline configuration for BNG-2 is shown below without IGMP configuration. The default SRRP priority for BNG-2 is lower than the SRRP priority for BNG-1 and hence BNG-2 will be in standby mode.

```
A:BNG-2>config>lag# info
----------------------------------------------
        mode access
        encap-type dot1q
        port 1/1/5 priority 1
        lacp active administrative-key 32768
        no shutdown

A:BNG-2>config>redundancy# info
----------------------------------------------
        multi-chassis
            peer 192.0.2.1 create
                mc-lag
                    lag 1 lacp-key 1 system-id 00:00:00:00:00:01 system-priority 100
                    no shutdown
                exit
                sync
                    igmp
                    srrp
                    sub-mgmt ipoe pppoe
                    port lag-1 create
                        range 4-4 sync-tag "mclagdata"
                        range 5-5 sync-tag "mclagcontrol"
                    exit
                    no shutdown
                exit
                no shutdown
            exit
        exit


A:BNG-2>config>service>ies# info
----------------------------------------------
            description "BNG SRRP1"
            redundant-interface "MClink-BNG-1-BNG-2" create
                address 192.168.1.1/31
                ip-mtu 1500
                spoke-sdp 1:1 create
                    no shutdown
                exit
            exit
            interface "lag-redirected" create
                address 192.168.10.252/24
                vrrp 2
                    backup 192.168.10.254
                exit
                sap lag-1:4094 create
                exit
            exit
            interface "int-BNG-2-P-1" create
                address 192.168.3.1/30
                sap 1/1/2 create
                    no shutdown
```

```
                exit
            exit
            subscriber-interface "sub-int-1" create
                address 10.255.255.252/8 gw-ip-address 10.255.255.254 track-srrp 1
                group-interface "group-int-1" create
                    dhcp
                        server 192.168.0.1
                        lease-populate 10
                        gi-address 10.255.255.252
                        no shutdown
                    exit
                    authentication-policy "auth-policy-1"
                    redundant-interface "MClink-BNG-1-BNG-2"
                    sap lag-1:4 create
                        sub-sla-mgmt
                            def-sub-id use-sap-id
                            def-sub-profile "multicast-profile-1"
                            def-sla-profile "sla-profile-1"
                            sub-ident-policy "sub-ident-policy-1"
                            multi-sub-sap 10
                            no shutdown
                        exit
                    exit
                    sap lag-1:5 create
                    exit
                    srrp 1 create
                        message-path lag-1:5
                        no shutdown
                    exit
                    pppoe
                        no shutdown
                    exit

                exit
            exit

*A:BNG-2>config>router# info
#--------------------------------------------------
echo "IP Configuration"
#--------------------------------------------------
        interface "int-BNG-2-BNG-1"
            address 192.168.6.1/30
            port 1/1/1:1
            no shutdown
        exit
        interface "system"
            address 192.0.2.2/32
            bfd 100 receive 100 multiplier 3
            no shutdown
        exit
        autonomous-system 65536
#--------------------------------------------------
echo "OSPFv2 Configuration"
#--------------------------------------------------
        ospf
            traffic-engineering
            area 0.0.0.0
                interface "system"
                    no shutdown
```

```
                exit
                interface "int-BNG-2-BNG-1"
                    interface-type point-to-point
                    metric 10000
                    no shutdown
                exit
                interface "sub-int-1"
                    no shutdown
                exit
                interface "lag-redirected"
                    no shutdown
                exit
                interface "int-BNG-2-P-1"
                    no shutdown
                exit
            exit
        exit
        pim
            interface “int-BNG-2-P-1”
        exit
```

The baseline configuration for the 7450 aggregation switch is shown below. It has a LAG interface configured. There are two VPLSs. The first is VPLS 1 which is used to receive all redirected multicast traffic on VLAN 4094. The second is VPLS 2 which is responsible for passing all subscriber traffic on VLAN 4.

```
A:Agg-1>config>lag# info
----------------------------------------------
        mode access
        encap-type dot1q
        port 1/1/2
        port 1/1/3
        lacp active administrative-key 1
        no shutdown

*A:Agg-1>config>service>info
            vpls 1 customer 1 create
                sap lag-1:4094 create
                    no shutdown
                exit
                sap 1/1/1:4094 create
                    no shutdown
                exit
            no shutdown
            exit


*A:Agg-1>config>service>info
            vpls 2 customer 1 create
                sap lag-1:4 create
                    no shutdown
                exit
                sap 1/1/1:4 create
                    no shutdown
                exit
            no shutdown
```

```
            exit
```

The baseline configuration for the P router is shown below. It is now responsible for DHCP address assignment (moved from BNG-1 in the previous configuration to allow for redundant operations in case of failure of either BNG-1 or BNG-2) and is also attached to the multicast source.

```
*A:P-router>config>router>info
#--------------------------------------------------
echo "Local DHCP Server Configuration"
#--------------------------------------------------
        dhcp
            local-dhcp-server "dhcp-local-server" create
                use-gi-address scope pool
                pool "pool-01" create
                    subnet 10.0.0.0/8 create
                        options
                            subnet-mask 255.0.0.0
                            default-router 10.255.255.254
                        exit
                        address-range 10.0.0.10 10.0.0.254
                    exit
                exit
                no shutdown
            exit
        exit
#--------------------------------------------------
echo "IP Configuration"
#--------------------------------------------------
        interface "dhcp-lb1"
            address 192.168.0.1/32
            loopback
            local-dhcp-server "dhcp-local-server"
            no shutdown
        exit
        interface "int-P-1-BNG-1"
            address 192.168.2.2/30
            port 1/1/2
            no shutdown
        exit
        interface "int-P-1-BNG-2"
            address 192.168.3.2/30
            port 1/1/3
            no shutdown
        exit
        interface "P-1-multicast-source"
            address 192.168.4.1/30
            port 1/1/1
            no shutdown
        exit
        interface "system"
            address 192.0.2.3/32
            no shutdown
        exit

#--------------------------------------------------
        ospf
```

```
        area 0.0.0.0
            interface "system"
                no shutdown
            exit
            interface "int-P-1-BNG-1"
                no shutdown
            exit
            interface "int-P-1-BNG-2"
                no shutdown
            exit
            interface "P-1-multicast-source"
                no shutdown
            exit
        exit
    exit
    pim
        interface "int-P-1-BNG-1"
        exit
        interface "int-P-1-BNG-2"
        exit
        interface "P-1-multicast-source"
        exit
    exit
```

Enable IGMP on Group Interface and Redirect Interface on the BNGs

The configuration below shows how to add the group-interface and redirect interface to IGMP. If ESM is configured in a VPRN, each VPRN will have its own IGMP instance. Remember to apply the following configuration to both BNG-1 and BNG-2.

```
*A:BNG-1>config>router>igmp# info
----------------------------------------------
                group-interface "group-int-1"
                    no shutdown
                exit
                interface "lag-redirected"
                    no shutdown
                exit
```

Next, the IGMP policy is configured to redirect all multicast to a dedicated interface. The following configuration outlines the steps necessary to enable multicast redirection.

Step 1. Define a router redirection policy. This will redirect every (S,G) towards the redirected interface.

```
*A:BNG-1> config>router>policy-options# info
----------------------------------------------
            policy-statement "mcast_redirect_if"
                default-action accept
                    multicast-redirection fwd-service 1 "lag-redirected"
                exit
            exit
```

Step 2. Apply the redirection policy to the igmp-policy.

```
*A:BNG-1> config>subscr-mgmt>igmp-policy# info
----------------------------------------------
            redirection-policy "mcast_redirect_if"
----------------------------------------------
```

Step 3. Add multi-chassis synchronization of the redirected interface. This will synchronize the IGMP state on this MC-LAG interface.

```
*A:BNG-1>config>redundancy# info
----------------------------------------------
        multi-chassis
            peer 192.0.2.2 create
                sync
                    port lag-1 create
                        range 4-4 sync-tag "mclagdata"
                        range 5-5 sync-tag "mclagcontrol"
                        range 4094-4094 sync-tag "mclagmulticast"
                    igmp
                    srrp
```

```
sub-mgmt ipoe pppoe
exit
no shutdown
```

ESM IGMP IPoE walkthrough

With the baseline configuration applied, the BNG is ready to process IGMP messages and deliver multicast streams to the subscribers through the redirected interface. Figure 4 shows the message flow for IPoE subscribers requesting and receiving multicast traffic. The key points are highlighted in the dotted box:

- The group-interface and redirect interface must have IGMP enabled.
- The subscriber must be associated with an IGMP-policy via sub-profile.

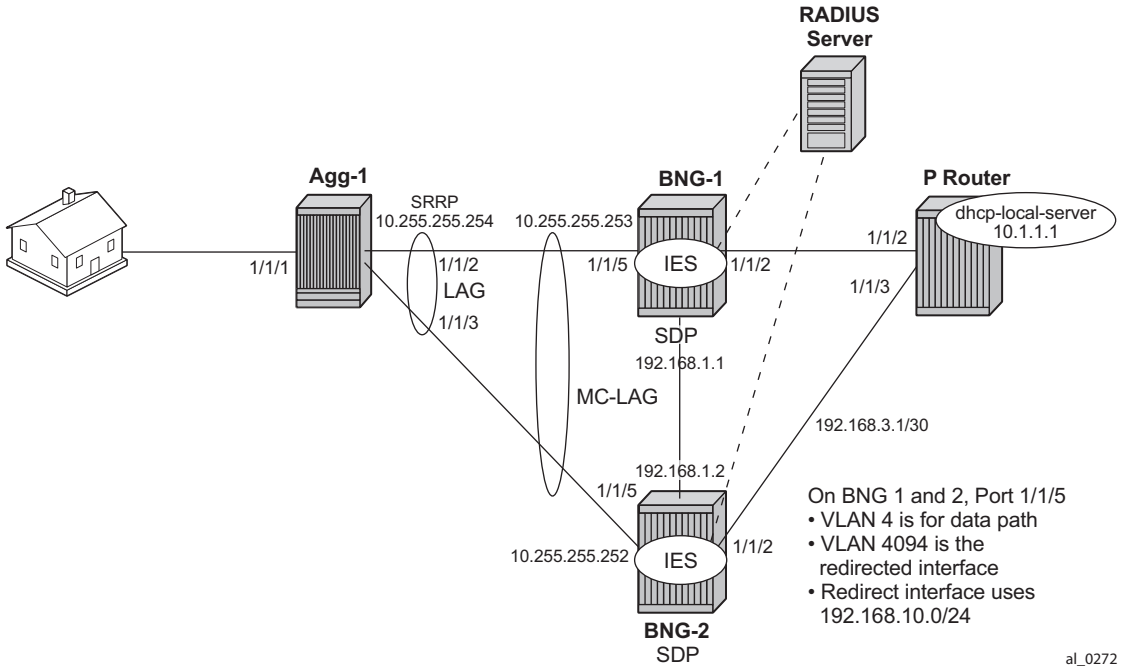

Figure 341: IPoE Multicast Message Flow

To verify the (ESM enabled) group-interface and the redirect interface are ready for multicast, use the show commands as indicated below. Remember the IES service ID is 1, the group-interface name is **group-int-1** and the interface name is **lag-redirected**.

Step 1. Verify if the group-interface and redirected interface have IGMP enabled.

```
*A:BNG-1> show router igmp group-interface
===============================================================================
IGMP Group-Interfaces
===============================================================================
FwdSvc Group-Interface                  Adm/Opr-State        Import-Policy
       SAP                              Adm/Opr-Version      Num-Groups
-------------------------------------------------------------------------------
```

```
1   group-int-1                         Up/Up               none
       lag-1:4                          3/3                 0
-------------------------------------------------------------------------------
Group-Interfaces = 1, SAPs = 1
===============================================================================
*A:BNG-1> show router igmp interface
===============================================================================
IGMP Interfaces
===============================================================================
Interface               Adm  Oper Querier         Cfg/Opr Num     Policy
                                                  Version Groups
-------------------------------------------------------------------------------
lag-redirected          Up   Down 0.0.0.0         3/3     0       none
-------------------------------------------------------------------------------
Interfaces : 1
===============================================================================
```

Step 2. Ensure the subscriber is associated with an IGMP-policy. Since the IGMP-policy is associated with a subscriber-profile, verification of an IGMP-policy is performed via the sub-profile.

```
*A:BNG-1> show subscriber-mgmt sub-profile "multicast-profile-1"
===============================================================================
Subscriber Profile multicast-profile-1
===============================================================================
Description      : (Not Specified)
I. Sched. Policy : N/A
E. Sched. Policy : N/A                           E. Agg Rate Limit: Max
I. Policer Ctrl. : N/A
E. Policer Ctrl. : N/A
Q Frame-Based Ac*: Disabled
Acct. Policy     : N/A                           Collect Stats    : Disabled
Rad. Acct. Pol.  : N/A
Dupl. Acct. Pol. : N/A
ANCP Pol.        : N/A
HostTrk Pol.     : N/A
IGMP Policy      : igmp-policy-1
Sub. MCAC Policy : N/A
NAT Policy       : N/A
Def. Encap Offset: none                          Encap Offset Mode: none
Avg Frame Size   : N/A
Preference       : 5
-------------------------------------------------------------------------------
HSMDA-2
-------------------------------------------------------------------------------
I. Qos Policy    : 1                             E. Qos Policy    : 1
                                                 E. Agg Rate Limit: Max
E. WRR Policy    : N/A                           Pkt Byte Offset  : add 0*
-------------------------------------------------------------------------------
Last Mgmt Change : 05/14/2013 10:12:49
===============================================================================
* indicates that the corresponding row element may have been truncated.
```

After the verification, the BNGs are ready to deliver multicast streams. Next, initiate an IGMP report from a subscriber requesting a multicast channel. In this example, IGMPv3 with SSM is used. If the IPoE subscriber is receiving multicast through the subscriber SAP then the IGMP group will be associated with the SAP. Since redirection is used, the IGMP group is associated with the redirected interface instead. The output below shows that when an IGMP message is received and processed, an (S,G) binding is associated with the redirected interface. The example uses an IGMPv3 SSM message requesting (192.168.4.2, 239.255.1.1). The subscriber IP address is 10.0.0.2.

```
*A:BNG-1> show router igmp group
===============================================================================
IGMP Interface Groups
===============================================================================

(192.168.4.2,239.255.1.1)               Up Time : 0d 00:00:12
    Fwd List  : lag-redirected
===============================================================================
IGMP Host Groups
===============================================================================
(192.168.4.2,239.255.1.1)
    Fwd List  : 10.0.0.2                Up Time : 0d 00:00:12
===============================================================================
IGMP SAP Groups
===============================================================================
-------------------------------------------------------------------------------
(*,G)/(S,G) Entries : 2
===============================================================================
```

Next, verify the individual subscribers and their IGMP information. First verify the IGMP policy related to the subscriber.

```
*A:BNG-1> show service active-subscribers igmp detail
===============================================================================
Active Subscribers Detail
===============================================================================
Subscriber                      IGMP-Policy
  HostAddr                      GrpItf                            NumGroups
    GrpAddr                     Type            Up-Time           Mode
      SrcAddr                   Type                              Blk/Fwd
-------------------------------------------------------------------------------
video_user_01                   igmp-policy-1
  10.0.0.2                      sub-int-1                 1
    239.255.1.1                 Dynamic         0d 00:01:26       Include
      192.168.4.2               Dynamic                           Fwd
-------------------------------------------------------------------------------
Number of Subscribers : 1
===============================================================================
```

Since the IGMP-policy controls bandwidth, interoperability and restricts multicast groups, it is useful to view what is defined in the IGMP-policy if the subscriber fails to receive multicast streams.

```
*A:BNG-1> show subscriber-mgmt igmp-policy "igmp-policy-1"
===============================================================================
IGMP Policy igmp-02
===============================================================================
Import Policy                       :
Admin Version                       : 3
Num Subscribers                     : 1
Host Max Group                      : No Limit
Host Max Sources                    : No Limit
Host Max Group Sources              : No Limit
Fast Leave                          : yes
Redirection Policy                  : mcast_redirect_if
Per Host Replication                : no
Egress Rate Modify                  : no
Mcast Reporting Destination Name    :
Mcast Reporting Admin State         : Disabled
===============================================================================
```

Below is a command to view the (S,G)s that all subscribers are requesting. Notice that the operational status for the host is not forwarding (notFwding), this is because multicast is not delivered directly over the subscriber SAP. All multicast traffic is delivered over the redirected interface instead.

```
*A:BNG-1> show router igmp hosts detail
===============================================================================
IGMP Host 10.0.0.2
===============================================================================
Oper Status      : notFwding  MacAddress     : 00:00:10:10:10:12
Oper version     : 3          Subscriber     : video_user_01
Num Groups       : 1          GrpItf         : sub-int-1
Max Grps Till Now: 1          IGMP-Policy    : igmp-policy-1
PPPoE SessionId  : N/A
FwdSvcId         : 1       Max Srcs Allow*: No Limit
Max Grps Allowed : No Limit   Max Grp Srcs A*: No Limit
-------------------------------------------------------------------------------
IGMP Group
-------------------------------------------------------------------------------
Group Address    : 239.255.1.1      Up Time    : 0d 00:02:38
Expires          : Not running    Mode       : Include
V1 Host Timer    : Not running    Type       : Dynamic
V2 Host Timer    : Not running    Compat Mode: IGMP Version 3
Redir.SvcId      : 1           Redir.Intf : lag-redirected
-------------------------------------------------------------
Source Address     Expires        Type         Fwd/Blk
-------------------------------------------------------------
192.168.4.2           0d 00:01:42    Dynamic      Fwd
-------------------------------------------------------------------------------
Hosts : 1
===============================================================================
```

ESM IGMP PPPoE Walkthrough

The same baseline configuration is used for PPPoE subscriber. Figure 342 shows the message flow for delivery of multicast streams to PPPoE subscribers.

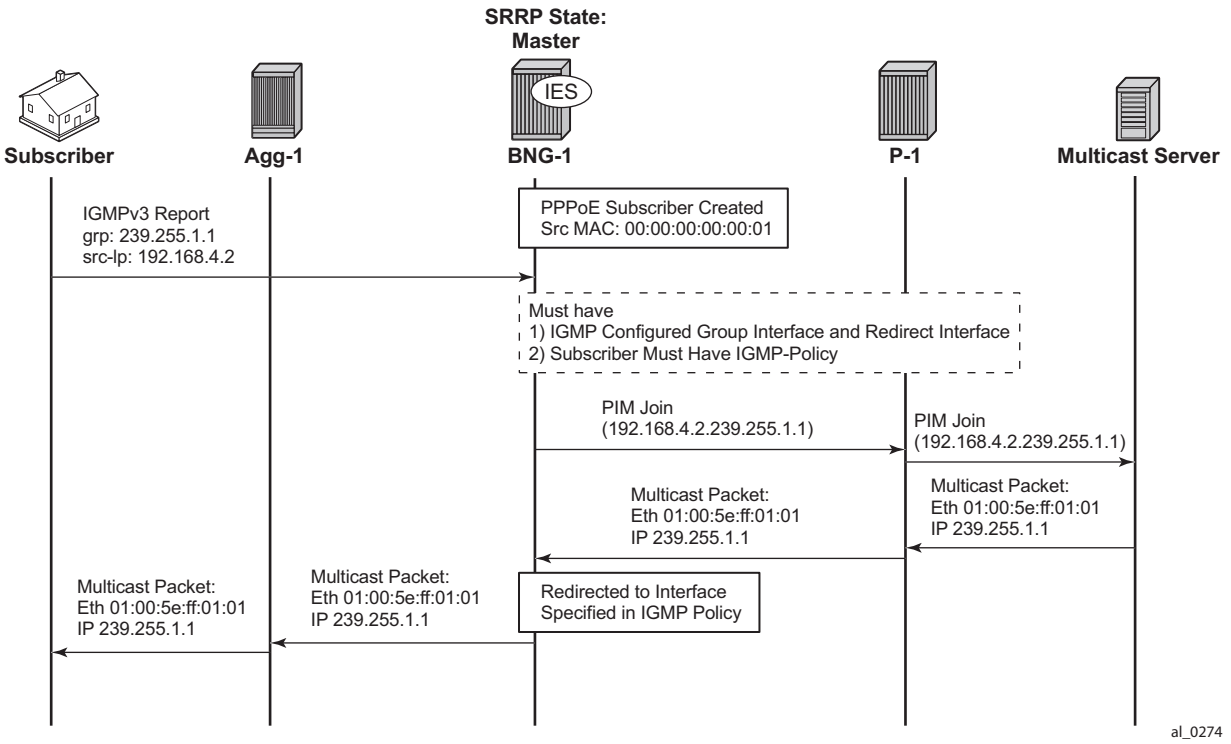

Figure 342: PPPoE Multicast Flow

The important items are highlighted in the dotted box. By default, PPPoE subscribers receive multicast streams via Ethernet unicast over subscriber SAPs. PPPoE does not have a multicast mechanism and requires all data traffic to be unicasted. However, because multicast streams are redirected, the streams are sent as multicast at both Layers 2 and 3 (the Layer 2 header will have a multicast destination MAC address and the Layer 3 header will have a multicast destination IP address).

Verify the IGMP on the group-interface. It shows very little difference from the IPoE group interface. No multicast streams are delivered directly over the subscriber SAP group-interface.

```
*A:BNG-1> show router igmp group-interface detail
===============================================================================
IGMP Group-Interfaces
===============================================================================
FwdSvc/Grp-Intf    : 1/group-int-1
Admin-Status       : Up                Oper-Status        : Up
```

```
Import-Policy      : none               Subnet-Check       : Enabled
Router-Alert-Check : Enabled            Sub-Hosts-Only     : Enabled
MCAC Policy Name   :                    MCAC Const Adm St  : Enable
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
-------------------------------------------------------------------------------
 SAP               : lag-1:4
 Admin/Oper version: 3/3                Num Groups         : 0
 Max Groups Allowed: No Limit           Max Groups Till Now: 0
 Max Sources Allow*: No Limit
 Max Grp Srcs Allo*: No Limit
-------------------------------------------------------------------------------
Group-Interfaces = 1, SAPs = 1
===============================================================================
* indicates that the corresponding row element may have been truncated.
```

All multicast streams should be delivered over the redirected interface. The output below shows the IGMP group for a PPPoE subscriber and also that the multicast stream is associated with the redirected interface. The (S,G) is (192.168.4.2, 239.255.1.1) and the subscriber IP address is 10.0.0.2.

```
*A:BNG-1> show router igmp group
===============================================================================
IGMP Interface Groups
===============================================================================
(192.168.4.2,239.255.1.1)               Up Time : 0d 00:05:15
    Fwd List  : lag-redirected
===============================================================================
IGMP Host Groups
===============================================================================
(192.168.4.2,239.255.1.1)
    Fwd List  : 10.0.0.2                Up Time : 0d 00:05:15
===============================================================================
IGMP SAP Groups
===============================================================================
-------------------------------------------------------------------------------
(*,G)/(S,G) Entries : 2
===============================================================================
```

The following output shows all the subscribers and the (S,G)s they have joined. Note that there is only one PPPoE subscriber and the multicast stream is redirected.

```
*A:BNG-1> show router igmp hosts detail
===============================================================================
IGMP Host 10.0.0.2
===============================================================================
Oper Status      : Up          MacAddress     : 52:e0:50:bd:00:00
Oper version     : 3           Subscriber     : user-ppp-1
Num Groups       : 1           GrpItf         : group-int-1
Max Grps Till Now: 1           IGMP-Policy    : igmp-policy-1
PPPoE SessionId  : 1           Next query time: 0d 00:01:47
FwdSvcId         : 1           Max Srcs Allow*: No Limit
Max Grps Allowed : No Limit    Max Grp Srcs A*: No Limit
-------------------------------------------------------------------------------
```

```
IGMP Group
-------------------------------------------------------------------------------
Group Address    : 239.255.1.1    Up Time    : 0d 00:00:36
Expires          : Not running    Mode       : Include
V1 Host Timer    : Not running    Type       : Dynamic
V2 Host Timer    : Not running    Compat Mode: IGMP Version 3
Redir.SvcId      : 1              Redir.Intf : lag-redirected
-------------------------------------------------------------
Source Address     Expires        Type         Fwd/Blk
-------------------------------------------------------------
192.168.4.2        0d 00:04:03    Dynamic      Fwd
-------------------------------------------------------------------------------
Hosts : 1
===============================================================================
* indicates that the corresponding row element may have been truncated.
```

To view the (S,G)s of a single subscriber, use the following command.

```
*A:BNG-1> show service active-subscribers igmp subscriber "user-ppp-1" detail
===============================================================================
Active Subscribers Detail
===============================================================================
Subscriber                      IGMP-Policy
  HostAddr                      GrpItf                          NumGroups
    GrpAddr                     Type            Up-Time         Mode
      SrcAddr                   Type                            Blk/Fwd
-------------------------------------------------------------------------------
user-ppp-1                    igmp-policy-1
  10.0.0.2                    group-int-1                     1
    239.255.1.1               Dynamic         0d 00:02:07     Include
      192.168.4.2             Dynamic                         Fwd
-------------------------------------------------------------------------------
Number of Subscribers : 1
===============================================================================
```

ESM IGMP MCS

The BNGs are configured with SRRP for both IPoE and PPPoE subscribers. This provides stateful redundancy when the master BNG fails. The SRRP master BNG will be the only BNG processing and answering IGMP messages, while the standby BNG synchronizes the state information of all subscribers via MCS in real time. In the event of a failure, the standby takes over and starts processing all IGMP messages. As the standby BNG has the full state information of all subscribers, including the (S,G)s they have joined, PIM starts sending joins for those (S,G)s immediately after failover. Restoration of all multicast streams happens quickly and relies on the PIM configuration and the underlying routing infrastructure. Note that the PIM command *non-dr-attract-traffic* can be used to reduce the failover outage by attracting multicast to the non designated PIM router.

The following output shows the items that are synchronized between the BNGs. To reduce the ESM multicast restoration time, it is important that all subscriber related data (IPoE, PPPoE, SRRP and IGMP) are kept in sync. BNG-1 has system IP address 192.0.2.1 and BNG-2 has system IP address 192.0.2.2.

```
*A:BNG-1> show redundancy multi-chassis sync peer 192.0.2.2 detail
===============================================================================
Multi-chassis Peer Table
===============================================================================
Peer
-------------------------------------------------------------------------------
Peer IP Address         : 192.0.2.2
Description             : (Not Specified)
Authentication          : Disabled
Source IP Address       : 192.0.2.1
Admin State             : Enabled
-------------------------------------------------------------------------------
Sync-status
-------------------------------------------------------------------------------
Client Applications     : IGMP SUBMGMT-IPOE SUBMGMT-PPPOE SRRP
Sync Admin State        : Up
Sync Oper State         : Up
DB Sync State           : inSync
Num Entries             : 15
Lcl Deleted Entries     : 0
Alarm Entries           : 0
Rem Num Entries         : 15
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
===============================================================================
MCS Application Stats
===============================================================================
Application             : igmp
Num Entries             : 1
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 1
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
```

```
-------------------------------------------------------------------------------
Application             : subMgmtIpoe
Num Entries             : 1
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 1
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
-------------------------------------------------------------------------------
Application             : srrp
Num Entries             : 14
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 14
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
-------------------------------------------------------------------------------
Application             : subMgmtPppoe
Num Entries             : 1
Lcl Deleted Entries     : 0
Alarm Entries           : 0
-------------------------------------------------------------------------------
Rem Num Entries         : 1
Rem Lcl Deleted Entries : 0
Rem Alarm Entries       : 0
-------------------------------------------------------------------------------
===============================================================================
```

To check the details of the sync data across the BNGs, a tools command giving a detailed description of the IGMP information synced across MCS can be used.

```
*A:BNG-1> tools dump redundancy multi-chassis sync-database application igmp detail

If no entries are present for an application, no detail will be displayed.

FLAGS LEGEND: ld - local delete; da - delete alarm; pd - pending global delete

Peer Ip 192.0.2.2


Application IGMP
Sap-id             Client Key
 SyncTag                          DLen  Flags    timeStamp
  deleteReason code and description
-------------------------------------------------------------------------------
lag-1:4094        Host=10.0.0.2, HostGroup=239.255.1.1
 mclagdata                        20    -- -- -- 07/03/2013 15:20:49
  0x0
lag-1:4           Group=239.255.1.1
 mclagmulticast                   20    -- -- -- 07/03/2013 15:20:49
  0x0

The following totals are for:
 peer ip ALL, port/lag ALL, sync-tag ALL, application IGMP
Valid Entries:                   2
```

```
Locally Deleted Entries:         0
Locally Deleted Alarmed Entries: 0
Pending Global Delete Entries:   0
```

ESM IGMP Debug

Debug facilities allow for real-time monitoring of events happening on the system. This includes tools for debugging ESM multicast streams.

First enable the required debug on the system, then send an IGMP message to join a multicast group (S,G). The message used in this example is an IGMPv3 message with SSM.

Below is the debug information for an ESM IGMP report message at packet level.

```
debug
    router
        igmp
            packet mode egr-ingr-and-dropped
        exit
    exit

2977 2013/05/23 13:01:45.43 EST MINOR: DEBUG #2001 IGMP[9]
"IGMP[9]: RX-PKT
[012 03:58:58.090] IGMP host 10.0.0.2 V3 PDU: 10.0.0.2 -> 224.0.0.22 pduLen
20
    Type: V3 REPORT maxrespCode 0x0 checkSum 0xddf7
    Num Group Records: 1
        Group Record 0
        Type: ALW_NEW_SRCS, AuxDataLen 0, Num Sources 1
        Mcast Addr: 239.255.1.1
        Source Address List
            192.168.4.2

"
```

Below is the debug information for an ESM IGMP host. Notice the multicast stream is redirected to the LAG interface and that an MCS entry is installed for the new IGMP group.

```
debug
    router
        igmp
            host "10.0.0.2"
        exit
    exit


9 2013/07/03 15:26:32.74 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpIfGroupAdd
Adding 239.255.1.1 to IGMP host 10.0.0.2 database"

10 2013/07/03 15:26:32.74 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpProcessGroupRec
Process group rec ALW_NEW_SRCS received on host 10.0.0.2 for group 239.255.1.1 i
n mode INCLUDE. Num srcs 1"

11 2013/07/03 15:26:32.74 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpIfSrcAdd
Adding i/f source entry for host 10.0.0.2 (192.168.4.2,239.255.1.1) to IGMP fwdList
```

```
Database, redir if interface lag-redirected [ifIndex 16]"

12 2013/07/03 15:26:32.73 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpMcsAddIfGroup
Building MCS entry for host 10.0.0.2, group 239.255.1.1"
```

Below is the debug information for ESM IGMP when MCS sync is enabled. The MCS sends a sync message for the redirect interface.

```
debug
    router
        igmp
            mcs "lag-redirected"
        exit
    exit


20 2013/07/03 15:28:26.20 EST MINOR: DEBUG #2001 ies1 IGMP MCS[9]
"IGMP MCS[9]: TX-MCS Data
interface lag-redirected [ifIndex 16]
Key Type: Group, Len: 9, Grp Addr: 239.255.1.1
Data Type: Group, Len: 20, Ver: 0, RecType: 1, Compat Mode: 3,
Num Fwd Srcs: 1, Num Blk Srcs: 0
Fwd Sources:
    192.168.4.2
"

21 2013/07/03 15:28:26.20 EST MINOR: DEBUG #2001 ies1 IGMP MCS[9]
"IGMP MCS[9]: TX-MCS Data
interface lag-redirected [ifIndex 16]
Key Type: Group, Len: 9, Grp Addr: 239.255.1.1
Data Type: Group, Len: 20, Ver: 0, RecType: 1, Compat Mode: 3,
Num Fwd Srcs: 1, Num Blk Srcs: 0
Fwd Sources:
    192.168.4.2
"
```

The corresponding debug information for ESM IGMP MCS sync on BNG-2 looks as follows:

```
2 2013/07/03 20:30:24.97 UTC MINOR: DEBUG #2001 ies1 IGMP MCS[5]
"IGMP MCS[5]: RX-MCS Data
interface lag-redirected [ifIndex 15]
Key Type: Group, Len: 9, Grp Addr: 239.255.1.1
Data Type: Group, Len: 20, Ver: 0, RecType: 1, Compat Mode: 3,
Num Fwd Srcs: 1, Num Blk Srcs: 0
Fwd Sources:
    192.168.4.2
"
```

The same debug commands can be used for viewing IGMP leave messages. Below is the debug information for an ESM IGMP leave at the packet level. The leave report message received over the subscriber SAP results in the multicast stream being stopped on the redirected interface, after ensuring no other CPE devices still require the multicast streams (by means of a query).

```
debug
    router
        igmp
            packet mode egr-ingr-and-dropped
        exit
    exit


37 2013/07/03 15:32:10.05 EST MINOR: DEBUG #2001 ies1 IGMP[9]
"IGMP[9]: RX-PKT
[001 03:23:17.050] IGMP host 10.0.0.2 V3 PDU: 10.0.0.2 -> 224.0.0.22 pduLen
20
    Type: V3 REPORT maxrespCode 0x0 checkSum 0xddf3
    Num Group Records: 1
        Group Record 0
        Type: BLK_OLD_SRCS, AuxDataLen 0, Num Sources 1
        Mcast Addr: 239.255.1.1
        Source Address List
            192.168.4.2

"

38 2013/07/03 15:32:10.05 EST MINOR: DEBUG #2001 ies1 IGMP[9]
"IGMP[9]: TX-PKT
[001 03:23:17.050] IGMP interface lag-redirected [ifIndex 16] V3 PDU: 192.168.10.253
-> 239.255.1.1 pduLen 16
    Type: QUERY maxrespCode 0xa checkSum 0xf26d
    GroupAddr: 239.255.1.1
        S bit 0, QRV 2, Encoded-QQIC 125, NumSources 1
        Source Address List:
            192.168.4.2
"

39 2013/07/03 15:32:11.36 EST MINOR: DEBUG #2001 ies1 IGMP[9]
"IGMP[9]: TX-PKT
[001 03:23:18.370] IGMP interface lag-redirected [ifIndex 16] V3 PDU: 192.168.10.253
-> 239.255.1.1 pduLen 16
    Type: QUERY maxrespCode 0xa checkSum 0xf26d
    GroupAddr: 239.255.1.1
        S bit 0, QRV 2, Encoded-QQIC 125, NumSources 1
        Source Address List:
            192.168.4.2
"
```

Below is the debug information for an ESM IGMP host showing various IGMP events. The MCS also signals the removal of the IGMP entry in the database.

```
debug
    router
        igmp
            host "192.168.0.10"
        exit
    exit

44 2013/07/03 15:33:06.00 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpProcessGroupRec
Process group rec BLK_OLD_SRCS received on host 10.0.0.2 for group 239.255.1.1 i
n mode INCLUDE. Num srcs 1"

45 2013/07/03 15:33:06.00 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpProcessIfSrcTimerExp
Source Timer expired for IGMP host 10.0.0.2 (192.168.4.2,239.255.1.1)"

46 2013/07/03 15:33:06.00 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpIfSrcDel
Deleting i/f source entry for host 10.0.0.2 (192.168.4.2,239.255.1.1) from IGMP Data
base. DeleteFromAvl: 1 Redir 0"

47 2013/07/03 15:33:06.00 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpIfGroupDel
Deleting 239.255.1.1 from IGMP host 10.0.0.2 database"

48 2013/07/03 15:33:05.99 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpMcsDelIfGroup
Deleting MCS entry for host 10.0.0.2, group 239.255.1.1, Glb"

49 2013/07/03 15:33:05.99 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpMcsDelIfGroup
Deleting MCS entry for host 10.0.0.2, group 239.255.1.1, Glb"

50 2013/07/03 15:33:06.00 EST MINOR: DEBUG #2001 ies1 IGMP[ies1 inst 9]
"IGMP[ies1 inst 9]: igmpMcsDelIfGroup
Deleting MCS entry for host 10.0.0.2, group 239.255.1.1, Glb"
```

The debug information when MCS removes the entry on BNG-1 is shown below. Notice MCS also triggers the backup BNG to remove the multicast stream.

```
debug
    router
        igmp
            mcs "group-int-1"
        exit
    exit

69 2013/07/03 15:34:42.43 EST MINOR: DEBUG #2001 ies1 IGMP MCS[9]
"IGMP MCS[9]: TX-MCS Data
interface lag-redirected [ifIndex 16]
Key Type: Group, Len: 9, Grp Addr: 239.255.1.1
Data Type: Group, Len: 20, Ver: 0, RecType: 1, Compat Mode: 3,
```

```
Num Fwd Srcs: 1, Num Blk Srcs: 0
Fwd Sources:
    192.168.4.2
"

70 2013/07/03 15:34:42.43 EST MINOR: DEBUG #2001 ies1 IGMP MCS[9]
"IGMP MCS[9]: TX-MCS Data
interface lag-redirected [ifIndex 16]
Key Type: Group, Len: 9, Grp Addr: 239.255.1.1
Data Type: Group, Len: 20, Ver: 0, RecType: 1, Compat Mode: 3,
Num Fwd Srcs: 1, Num Blk Srcs: 0
Fwd Sources:
    192.168.4.2
"

71 2013/07/03 15:34:44.36 EST MINOR: DEBUG #2001 ies1 IGMP MCS[9]
"IGMP MCS[9]: TX-MCS Data (GlblDel)
interface lag-redirected [ifIndex 16]
Key Type: Group, Len: 9, Grp Addr: 239.255.1.1
Data Type: Group, Len: 16, Ver: 0, RecType: 1, Compat Mode: 3,
Num Fwd Srcs: 0, Num Blk Srcs: 0
"

72 2013/07/03 15:34:44.37 EST MINOR: DEBUG #2001 ies1 IGMP MCS[9]
"IGMP MCS[9]: TX-MCS Data (GlblDel)
interface lag-redirected [ifIndex 16]
Key Type: Group, Len: 9, Grp Addr: 239.255.1.1
Data Type: Group, Len: 16, Ver: 0, RecType: 1, Compat Mode: 3,
Num Fwd Srcs: 0, Num Blk Srcs: 0
"
```

The debug information on BNG-2 shows the sync message received over MCS for the removal of the multicast (S,G).

```
13 2013/07/03 20:34:44.37 UTC MINOR: DEBUG #2001 ies1 IGMP MCS[5]
"IGMP MCS[5]: RX-MCS Data
interface lag-redirected [ifIndex 15]
Key Type: Group, Len: 9, Grp Addr: 239.255.1.1
Data Type: Group, Len: 20, Ver: 0, RecType: 1, Compat Mode: 3,
Num Fwd Srcs: 1, Num Blk Srcs: 0
Fwd Sources:
    192.168.4.2
"
```

Conclusion

Multicast is an essential part of Triple Play Services. The SR 7750 TPSDA solution is much more than a baseline multicast delivery, it includes individual subscriber awareness and offers a full state redundancy option. Subscriber awareness allows for fine tuning of subscriber multicast settings and for troubleshooting on a per subscriber basis. Full state redundancy reduces failover time and ensures high availability of multicast services. This example provided a complete configuration walk through of both the IPoE and PPPoE SRRP model with redirection. All multicast streams can be redirected to a dedicated interface for all subscribers to receive.