

## Configuring MPLS and RSVP with CLI

This section provides information to configure MPLS and RSVP using the command line interface.

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- [MPLS Configuration Overview on page 180](#)
  - ☞ [LSPs on page 180](#)
  - ☞ [Paths on page 180](#)
  - ☞ [Router Interface on page 181](#)
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## MPLS Configuration Overview

Multiprotocol Label Switching (MPLS) enables routers to forward traffic based on a simple label embedded into the packet header. A router examines the label to determine the next hop for the packet, saving time for router address lookups to the next node when forwarding packets. MPLS is not enabled by default and must be explicitly enabled.

In order to implement MPLS, the following entities must be configured:

- [LSPs on page 180](#)
  - [Paths on page 180](#)
  - [Router Interface on page 181](#)
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### LSPs

To configure MPLS-signaled label-switched paths (LSPs), an LSP must run from an ingress router to an egress router. Configure only the ingress router and configure LSPs to allow the software to make the forwarding decisions or statically configure some or all routers in the path. The LSP is set up by Resource Reservation Protocol (RSVP), through RSVP signaling messages. The router automatically manages label values. Labels that are automatically assigned have values ranging from 1,024 through 1,048,575 (see [Label Values on page 30](#)).

A static LSP is a manually set up LSP where the nexthop IP address and the outgoing label are explicitly specified.

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### Paths

To configure signaled LSPs, you must first create one or more named paths on the ingress router. For each path, the transit routers (hops) in the path are specified.

## Router Interface

At least one router interface and one system interface must be defined in the `config>router>interface` context in order to configure MPLS on an interface.

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## Choosing the Signaling Protocol

In order to configure a static or a RSVP signaled LSP, you must enable MPLS on the router which automatically enables RSVP and adds automatically the system interface into both contexts. Any other network IP interface, other than loopbacks, added to MPLS is also automatically enabled in RSVP and becomes a TE link. When the interface is enabled in RSVP, the IGP instance will advertise the Traffic Engineering (TE) information for the link to other routers in the network in order to build their TE database and compute CSPF paths. Operators must enable the traffic-engineering option in the ISIS or OSPF instance for this. Operators can also configure under the RSVP context of the interface the RSVP protocol parameters for that interface.

If only static label switched paths are used in your configurations, then operators must manually define the paths through the MPLS network. Label mappings and actions configured at each hop must be specified. Operators can disable RSVP on the interface if it is used only for incoming or outgoing static LSP label by shutting down the interface in the RSVP context. The latter causes IGP to withdraw the TE link from its advertisement which removes it from its local and neighbors TE database.

If dynamic LSP signaling is implemented in an operator's network then they must keep RSVP enabled on the interfaces they want to use for explicitly defined or CSPF calculated LSP path.

## Basic MPLS Configuration

This section provides information to configure MPLS and configuration examples of common configuration tasks. To enable MPLS, you must configure at least one MPLS interface. The other MPLS configuration parameters are optional. This follow displays an example of an MPLS configuration.

```
ALA-1>config>router>if-attr# info
-----
admin-group "green" 15
admin-group "yellow" value 20
admin-group "red" value 25
-----
A:ALA-1>config>router>mpls# info
-----
interface "system"
exit
interface "StaticLabelPop"
  admin-group "green"
  label-map 50
  pop
  no shutdown
exit
exit
interface "StaticLabelPop"
  label-map 35
  swap 36 nexthop 10.10.10.91
  no shutdown
exit
exit
path "secondary-path"
  no shutdown
exit
path "to-NYC"
  hop 1 10.10.10.104 strict
  no shutdown
exit
lsp "lsp-to-eastcoast"
  to 10.10.10.104
  from 10.10.10.103
  fast-reroute one-to-one
  exit
  primary "to-NYC"
  exit
  secondary "secondary-path"
  exit
  no shutdown
exit
static-lsp "StaticLabelPush"
  to 10.10.11.105
  push 60 nexthop 10.10.11.105
  no shutdown
exit
no shutdown
-----
A:ALA-1>config>router>mpls#
```

## Common Configuration Tasks

This section provides a brief overview of the tasks to configure MPLS and provides the CLI commands.

The following protocols must be enabled on each participating router.

- MPLS
- RSVP (for RSVP-signaled MPLS only), which is automatically enabled when MPLS is enabled.

In order for MPLS to run, you must configure at least one MPLS interface in the **config>router>mpls** context.

- An interface must be created in the **config>router>interface** context before it can be applied to MPLS.
- In the **config>router>mpls** context, configure path parameters for configuring LSP parameters. A path specifies some or all hops from ingress to egress. A path can be used by multiple LSPs.
- When an LSP is created, the egress router must be specified in the **to** command and at least one primary or secondary path must be specified. All other statements under the LSP hierarchy are optional.

## Configuring MPLS Components

Use the MPLS and RSVP CLI syntax displayed below for:

- [Configuring Global MPLS Parameters on page 184](#)
- [Configuring an MPLS Interface on page 185](#)
- [Configuring MPLS Paths on page 186](#)
- [Configuring an MPLS LSP on page 187](#)
- [Configuring a Static LSP on page 188](#)
- [Configuring Manual Bypass Tunnels on page 189](#)
- [Configuring RSVP Parameters on page 191](#)
- [Configuring RSVP Message Pacing Parameters on page 192](#)
- [Configuring Graceful Shutdown on page 193](#)

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## Configuring Global MPLS Parameters

Admin groups can signify link colors, such as red, yellow, or green. MPLS interfaces advertise the link colors it supports. CSPF uses the information when paths are computed for constrained-based LSPs. CSPF must be enabled in order for admin groups to be relevant.

To configure MPLS admin-group parameters, enter the following commands:

**CLI Syntax:**

```

if-attribute
  admin-group group-name value group-value
mpls
  frr-object
  resignal-timer minutes

```

The following displays an admin group configuration example:

```

ALA-1>config>router>if-attr# info
-----
  admin-group "green" value 15
  admin-group "yellow" value 20
  admin-group "red" value 25
-----
A:ALA-1>config>router>mpls# info
-----
  resignal-timer 500
...
-----
A:ALA-1>config>router>mpls#

```

## Configuring an MPLS Interface

Configure the **label-map** parameters if the interface is used in a static LSP.  
To configure an MPLS interface on a router, enter the following commands:

```
CLI Syntax: config>router>mpls
                interface
                no shutdown
                admin-group group-name [group-name...(up to 32 max)]
                label-map
                pop
                swap
                no shutdown
                srlg-group group-name [group-name...(up to 5 max)]
                te-metric value
```

The following displays an interface configuration example:

```
A:ALA-1>config>router>mpls# info
-----
...
        interface "to-104"
            admin-group "green"
            admin-group "red"
            admin-group "yellow"
            label-map 35
                swap 36 nexthop 10.10.10.91
            no shutdown
        exit
    exit
    no shutdown
...
-----
A:ALA-1>config>router>mpls#
```

## Configuring MPLS Paths

Configure an LSP path to use in MPLS. When configuring an LSP, the IP address of the hops that the LSP should traverse on its way to the egress router must be specified. The intermediate hops must be configured as either **strict** or **loose** meaning that the LSP must take either a direct path from the previous hop router to this router (**strict**) or can traverse through other routers (**loose**).

Use the following CLI syntax to configure a path:

```
CLI Syntax: config>router> mpls
                path path-name
                  hop hop-index ip-address {strict|loose}
                no shutdown
```

The following displays a path configuration example:

```
A:ALA-1>config>router>mpls# info
-----
      interface "system"
      exit
      path "secondary-path"
        hop 1 10.10.0.121 strict
        hop 2 10.10.0.145 strict
        hop 3 10.10.0.1 strict
        no shutdown
      exit
      path "to-NYC"
        hop 1 10.10.10.103 strict
        hop 2 10.10.0.210 strict
        hop 3 10.10.0.215 loose
      exit
-----
A:ALA-1>config>router>mpls#
```



## Configuring an MPLS LSP

Configure an LSP path for MPLS. When configuring an LSP, you must specify the IP address of the egress router in the **to** statement. Specify the primary path to be used. Secondary paths can be explicitly configured or signaled upon the failure of the primary path. All other statements are optional.

The following displays an MPLS LSP configuration:

```
A:ALA-1>config>router>mplp# info
-----
...
    lsp "lsp-to-eastcoast"
      to 192.168.200.41
      rsvp-resv-style ff
      cspf
      include "red"
      exclude "green"
      adspec
      fast-reroute one-to-one
      exit
      primary "to-NYC"
        hop-limit 10
      exit
      secondary "secondary-path"
        bandwidth 50000
      exit
      no shutdown
    exit
  no shutdown
-----
A:ALA-1>config>router>mpls#
```

## Configuring a Static LSP

An LSP can be explicitly (statically) configured. Static LSPs are configured on every node along the path. The label's forwarding information includes the address of the next hop router.

Use the following CLI syntax to configure a static LSP:

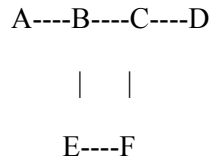
```
CLI Syntax: config>router>mpls
                static-lsp lsp-name
                    to ip-address
                    push out-label nexthop ip-addr
                    no shutdown
```

The following displays a static LSP configuration example:

```
A:ALA-1>config>router>mpls# info
-----
...
    static-lsp "static-LSP"
        to 10.10.10.124
        push 60 nexthop 10.10.42.3
        no shutdown
    exit
...
-----
A:ALA-1>config>router>mpls#
```

## Configuring Manual Bypass Tunnels

Consider the following network setup.



The user first configures the option to disable the dynamic bypass tunnels on node B if required. The CLI for this configuration is:

```
config>router>mpls>dynamic-bypass [disable | enable]
```

By default, dynamic bypass tunnels are enabled.

Next, the user configures an LSP on node B, such as B-E-F-C to be used only as bypass. The user specifies each hop in the path, for example, the bypass LSP has a strict path.

Note that including the bypass-only keyword disables the following options under the LSP configuration:

- bandwidth
- fast-reroute
- secondary

The following LSP configuration options are allowed:

- adaptive
- adspec
- cspf
- exclude
- hop-limit
- include
- metric

The following example displays a bypass tunnel configuration:

```
A:ALA-48>config>router>mpls>path# info
-----
...
    path "BEFC"
      hop 10 10.10.10.11  strict
      hop 20 10.10.10.12  strict
      hop 30 10.10.10.13  strict
      no shutdown
    exit

    lsp "bypass-BC"
      to 10.10.10.15
      primary "BEFC"
      exit
      no shutdown
...
-----
A:ALA-48>config>router>mpls>path#
```

Next, the configures an LSP from A to D and indicates fast-reroute bypass protection by selecting facility as the FRR method (**config>router>mpls>lsp>fast-reroute facility**). If the LSP goes through B, and bypass is requested, and the next hop is C, and there is a manually configured bypass-only tunnel from B to C, excluding link BC, then node B uses that.

## Configuring RSVP Parameters

RSVP is used to set up LSPs. RSVP must be enabled on the router interfaces that are participating in signaled LSPs. The **keep-multiplier** and **refresh-time** default values can be modified in the RSVP context.

Initially, interfaces are configured in the **config>router>mpls>interface** context. Only these existing (MPLS) interfaces are available to modify in the **config>router>rsvp** context. Interfaces cannot be directly added in the RSVP context.

The following example displays an RSVP configuration example:

```
A:ALA-1>config>router>rsvp# info
-----
      interface "system"
        no shutdown
      exit
      interface to-104
        hello-interval 4000
        no shutdown
      exit
      no shutdown
-----
A:ALA-1>config>router>rsvp#
```

## Configuring RSVP Message Pacing Parameters

RSVP message pacing maintains a count of the messages that were dropped because the output queue for the egress interface was full.

Use the following CLI syntax to configure RSVP parameters:

```
CLI Syntax: config>router>rsvp
               no shutdown
               msg-pacing
                 period milli-seconds
                 max-burst number
```

The following example displays a RSVP message pacing configuration example:

```
A:ALA-1>config>router>rsvp# info
-----
    keep-multiplier 5
    refresh-time 60
    msg-pacing
      period 400
      max-burst 400
    exit
    interface "system"
      no shutdown
    exit
    interface to-104
      hello-interval 4000
      no shutdown
    exit
    no shutdown
-----
A:ALA-1>config>router>rsvp#
```

## Configuring Graceful Shutdown

TE graceful shutdown can be enabled on a specific interface using the **config>router>rsvp>interface>graceful-shutdown** command. This interface is referred to as the maintenance interface.

Graceful shutdown can be disabled by executing the **no** form of the command at the RSVP interface level or at the RSVP level. In this case, the user configured TE parameters of the maintenance links are restored and the maintenance node floods them.

## MPLS Configuration Management Tasks

This section discusses the following MPLS configuration management tasks:

- [Modifying MPLS Parameters on page 194](#)
  - [Modifying MPLS Path Parameters on page 196](#)
  - [Modifying MPLS Static LSP Parameters on page 197](#)
  - [Deleting an MPLS Interface on page 198](#)
- 

### Deleting MPLS

**NOTE:** In order to remove the MPLS instance, MPLS must be disabled (shutdown) and all SDP bindings to LSPs removed. If MPLS is not shutdown first, when the **no mpls** command is executed, a warning message on the console displays indicating that MPLS is still administratively up.

When MPLS is shut down, the **no mpls** command deletes the protocol instance and removes all configuration parameters for the MPLS instance.

To disable MPLS, use the **shutdown** command.

To remove MPLS on a router, enter the following command:

**CLI Syntax:** `config>router# no mpls`

---

### Modifying MPLS Parameters

**NOTE:** You must shut down MPLS entities in order to modify parameters. Re-enable (**no shutdown**) the entity for the change to take effect.



## Modifying an MPLS LSP

Some MPLS LSP parameters such as primary and secondary, must be shut down before they can be edited or deleted from the configuration.

The following displays a MPLS LSP configuration example. Refer to the LSP configuration on [page 187](#).

```
A:ALA-1>>config>router>mpls>lsp# info
-----
      shutdown
      to 10.10.10.104
      from 10.10.10.103
      rsvp-resv-style ff
      include "red"
      exclude "green"
      fast-reroute one-to-one
      exit
      primary "to-NYC"
        hop-limit 50
      exit
      secondary "secondary-path"
      exit
-----
A:ALA-1>config>router>mpls#
```

## Modifying MPLS Path Parameters

In order to modify path parameters, the **config>router>mpls>path** context must be shut down first.

The following displays a path configuration example. Refer to the LSP configuration on [page 186](#).

```
A:ALA-1>config>router>mpls# info
#-----
echo "MPLS"
#-----
...
    path "secondary-path"
        hop 1 10.10.0.111  strict
        hop 2 10.10.0.222  strict
        hop 3 10.10.0.123  strict
        no shutdown
    exit
    path "to-NYC"
        hop 1 10.10.10.104  strict
        hop 2 10.10.0.210  strict
        no shutdown
    exit
...
-----
A:ALA-1>config>router>mpls#
```

## Modifying MPLS Static LSP Parameters

In order to modify static LSP parameters, the **config>router>mpls>path** context must be shut down first.

The following displays a static LSP configuration example. Refer to the static LSP configuration on [page 188](#).

```
A:ALA-1>config>router>mpls# info
-----
...
    static-lsp "static-LSP"
        to 10.10.10.234
        push 102704 nexthop 10.10.8.114
        no shutdown
    exit
    no shutdown
-----
A:ALA-1>config>router>mpls#
```

## Deleting an MPLS Interface

In order to delete an interface from the MPLS configuration, the interface must be shut down first.

Use the following CLI syntax to delete an interface from the MPLS configuration:

**CLI Syntax:** `mpls`  
                  `[no] interface ip-int-name`  
                  `shutdown`

```
ALA-1>config>router>if-attr# info
-----
admin-group "green" value 15
admin-group "yellow" value 20
admin-group "red" value 25
-----
A:ALA-1>config>router>mpls# info
-----
...
interface "system"
exit
no shutdown
-----
A:ALA-1>config>router>mpls#
```

## RSVP Configuration Management Tasks

This section discusses the following RSVP configuration management tasks:

- [Modifying RSVP Parameters on page 199](#)
  - [Modifying RSVP Message Pacing Parameters on page 200](#)
  - [Deleting an Interface from RSVP on page 200](#)
- 

### Modifying RSVP Parameters

Only interfaces configured in the MPLS context can be modified in the RSVP context.

The **no rsvp** command deletes this RSVP protocol instance and removes all configuration parameters for this RSVP instance.

The **shutdown** command suspends the execution and maintains the existing configuration.

The following example displays a modified RSVP configuration example:

```
A:ALA-1>config>router>rsvp# info
-----
      keep-multiplier 5
      refresh-time 60
      msg-pacing
        period 400
        max-burst 400
      exit
      interface "system"
      exit
      interface "test1"
        hello-interval 5000
      exit
      no shutdown
-----
A:ALA-1>config>router>rsvp#
```

## Modifying RSVP Message Pacing Parameters

RSVP message pacing maintains a count of the messages that were dropped because the output queue for the egress interface was full.

The following example displays command usage to modify RSVP parameters:

The following example displays a modified RSVP message pacing configuration example. Refer to the RSVP message pacing configuration on [page 191](#).

```
A:ALA-1>config>router>rsvp# info
-----
      keep-multiplier 5
      refresh-time 60
      msg-pacing
        period 200
        max-burst 200
      exit
      interface "system"
      exit
      interface "to-104"
      exit
      no shutdown
-----
A:ALA-1>config>router>rsvp#
```

---

## Deleting an Interface from RSVP

Interfaces cannot be deleted directly from the RSVP configuration. An interface must have been configured in the MPLS context, which enables it automatically in the RSVP context. The interface must first be deleted from the MPLS context. This removes the association from RSVP.

See [Deleting an MPLS Interface on page 198](#) for information on deleting an MPLS interface.