MPLS Traffic Engineering Path Link and Node Protection Configuration Guide, Cisco IOS XE 16 (NCS 4200 Series)

First Published: 2017-06-09

Last Modified: 2020-07-01

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB's public domain version of the UNIX operating system. All rights reserved. Copyright © 1981, Regents of the University of California.

NOTWITHSTANDING ANY OTHER WARRANTY HEREIN, ALL DOCUMENT FILES AND SOFTWARE OF THESE SUPPLIERS ARE PROVIDED “AS IS" WITH ALL FAULTS. CISCO AND THE ABOVE-NAMED SUPPLIERS DISCLAIM ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

All printed copies and duplicate soft copies of this document are considered uncontrolled. See the current online version for the latest version.

Cisco has more than 200 offices worldwide. Addresses and phone numbers are listed on the Cisco website at www.cisco.com/go/offices.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: https://www.cisco.com/c/en/us/about/legal/trademarks.html. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1721R)

© 2017–2020 Cisco Systems, Inc. All rights reserved.

CONTENTS

CHAPTER 1 **MPLS Traffic Engineering Nonstop Routing Support** 1

Finding Feature Information 1

Prerequisites for MPLS Traffic Engineering Nonstop Routing Support 2

Restrictions for MPLS Traffic Engineering Nonstop Routing Support 2

Information About MPLS Traffic Engineering Nonstop Routing Support 2

MPLS Traffic Engineering Nonstop Routing Support Overview 2

How to Configure MPLS Traffic Engineering Nonstop Routing Support 3

Configuring MPLS Traffic Engineering Nonstop Routing Support 3

Verifying MPLS Traffic Engineering Nonstop Routing Support 4

Configuration Examples for MPLS Traffic Engineering Nonstop Routing Support 5

Example: Configuring MPLS Traffic Engineering Nonstop Routing Support 5

Example: Verifying MPLS Traffic Engineering Nonstop Routing Support 5

Additional References for MPLS Traffic Engineering Nonstop Routing Support 12

Feature Information for MPLS Traffic Engineering Nonstop Routing Support 13

CHAPTER 2 **MPLS Traffic Engineering over Bridge Domain Interfaces** 15

Prerequisites for Configuring MPLS TE over BDI 15

Restrictions for MPLS TE over BDI 15

Information About MPLS Traffic Engineering over BDI 16

Features of MPLS Traffic Engineering over BDI 16

Supported Features 16

How to Configure MPLS Traffic Engineering over BDI 16

Configuring MPLS TE over BDI 16

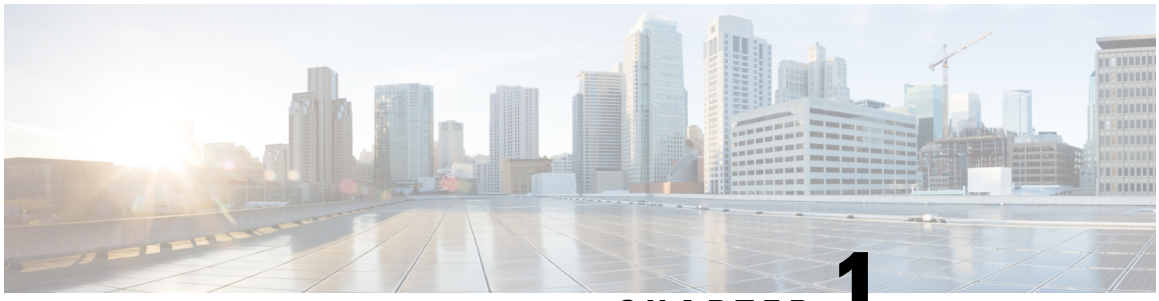
Configuring the RSVP Bandwidth 17

Verifying That MPLS TE over BDI Is Operational 18

Troubleshooting Tips 19

Configuration Example for MPLS Traffic Engineering over BDI 20
Configuring Interface Tunnel Example 20
Configuring RSVP Bandwidth Example 20

CHAPTER 3 **MPLS Traffic Engineering – Bundled Interface Support** 21
Prerequisites for MPLS TE – Bundled Interface Support 21
Restrictions for MPLS TE – Bundled Interface Support 22
Information About MPLS TE – Bundled Interface Support 22
Cisco EtherChannel Overview 22
Cisco Gigabit EtherChannel Overview 23
Load Balancing and Min-Links in EtherChannel 23
How to Configure MPLS TE – Bundled Interface Support 23
Configuring MPLS TE on an EtherChannel Interface 23
Configuration Examples for MPLS TE Bundled Interface Support 24
Example: Configuring MPLS TE on an EtherChannel Interface 24
Example: Configuring MPLS TE - Bundled Interface Support over Gigabit Etherchannel 25



CHAPTER 1

MPLS Traffic Engineering Nonstop Routing Support

Note This technology is not applicable for the Cisco ASR 900 RSP3 Module.

The MPLS Traffic Engineering Nonstop Routing Support feature assists the Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) routing devices to recover from an interruption in service. This feature also defines the checkpoint and recovery scheme for the devices.

- Finding Feature Information, on page 1
- Prerequisites for MPLS Traffic Engineering Nonstop Routing Support, on page 2
- Restrictions for MPLS Traffic Engineering Nonstop Routing Support , on page 2
- Information About MPLS Traffic Engineering Nonstop Routing Support , on page 2
- How to Configure MPLS Traffic Engineering Nonstop Routing Support, on page 3
- Verifying MPLS Traffic Engineering Nonstop Routing Support, on page 4
- Configuration Examples for MPLS Traffic Engineering Nonstop Routing Support, on page 5
- Additional References for MPLS Traffic Engineering Nonstop Routing Support, on page 12
- Feature Information for MPLS Traffic Engineering Nonstop Routing Support, on page 13

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for MPLS Traffic Engineering Nonstop Routing Support

Your network must support the following Cisco features before you enable Multiprotocol Label Switching (MPLS) Traffic Engineering (TE):

- MPLS
- Cisco Express Forwarding
- Intermediate System-to-Intermediate System (IS-IS) or Open Shortest Path First (OSPF)

Before enabling MPLS TE Nonstop Routing (NSR), a full-mode check needs to be done by the system to verify if the **mpls traffic-eng nsr** command is permitted or is restricted due to conflicts or user privileges.

Restrictions for MPLS Traffic Engineering Nonstop Routing Support

Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Nonstop Routing (NSR) and Resource Reservation Protocol (RSVP) Graceful Restart (GR) are both mutually exclusive recovery mechanisms. Hence, MPLS TE NSR cannot be enabled when RSVP GR is enabled.

Information About MPLS Traffic Engineering Nonstop Routing Support

MPLS Traffic Engineering Nonstop Routing Support Overview

Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Nonstop Routing (NSR) enables routing devices to recover from an interruption in service. The MPLS TE NSR functionality defines a checkpoint for the control plane of the routing devices. Resource Reservation Protocol (RSVP) Graceful Restart (GR) is another method for recovering and restarting interrupted services.

To avoid conflict and guarantee deterministic behavior, only one of the above mentioned recovery methods can be configured at a given time.

The MPLS TE NSR feature differs from the RSVP GR feature in the following ways:

- MPLS TE NSR devices are fully independent and do not rely on neighbor nodes for a stateful switchover (SSO) recovery.
- MPLS TE NSR supports the SSO recovery of Fast Reroute (FRR) active tunnels.
- MPLS TE NSR has an active standby mode. This helps with most of the recovery states being created before the SSO recovery actually happens, ensuring a faster recovery after SSO.
- MPLS TE NSR **show** commands display recovery information in standby mode as well.

- Label switched paths (LSPs) which are not fully signaled, do not resume signaling after an interruption and will go down on SSO.

How to Configure MPLS Traffic Engineering Nonstop Routing Support

Configuring MPLS Traffic Engineering Nonstop Routing Support

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip cef**
4. **mpls traffic-eng nsr**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip cef** **Example:** `Device(config)# ip cef`	Enables standard Cisco Express Forwarding operations.
Step 4	**mpls traffic-eng nsr** **Example:** `Device(config)# mpls traffic-eng nsr`	Enables the MPLS Traffic Engineering (TE) Non-Stop Routing (NSR) functionality on a device. **Note** Enabling the MPLS TE NSR functionality automatically enables the Resource Reservation Protocol (RSVP) NSR functionality as well.
Step 5	**end** **Example:** `Device(config)# end`	Exits global configuration mode and returns to privileged EXEC mode.

Verifying MPLS Traffic Engineering Nonstop Routing Support

SUMMARY STEPS

1. **enable**
2. **show mpls traffic-eng nsr**
3. **show mpls traffic-eng nsr counters**
4. **show mpls traffic-eng nsr database**
5. **show mpls traffic-eng nsr oos**
6. **show mpls traffic-eng nsr summary**
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

Step 2	**show mpls traffic-eng nsr**
	Example:
	`Device# show mpls traffic-eng nsr`
	`  counters  TE NSR counters`
	`  database  TE NSR check pointed data`
	`  oos  TE NSR out of sync database`
	`  summary  TE NSR summary`
	`  |  Output modifiers`
	`  <cr>`
		Displays options to obtain Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Nonstop Routing (NSR) configuration information such as the database status, counter numbers, devices which are out of sync, and the summary of all the devices.

Step 3	**show mpls traffic-eng nsr counters** **Example:** `Device# show mpls traffic-eng nsr counters`	Displays information about the data structures or states that are successfully created or removed, along with errors counts.
Step 4	**show mpls traffic-eng nsr database** **Example:** `Device# show mpls traffic-eng nsr database`	Displays information pertaining to the write and read databases supporting MPLS TE NSR. The write and read databases store the data that is used for recovering TE state on a standby device after stateful switchover (SSO).
Step 5	**show mpls traffic-eng nsr oos** **Example:** `Device# show mpls traffic-eng nsr oos`	Displays information pertaining to the out of sync databases supporting MPLS TE NSR. The out of sync databases indicate the devices whose states are not in sync with each other.

	Command or Action	Purpose
Step 6	**show mpls traffic-eng nsr summary** **Example:** `Device# show mpls traffic-eng nsr summary`	Displays a summary of MPLS TE NSR information such as the current TE NSR state (standby-hot / recovering / staling / active), recovery time, and the recovery result (success / failure).
Step 7	**end** **Example:** `Device(config)# end`	Exits privileged EXEC mode.

Configuration Examples for MPLS Traffic Engineering Nonstop Routing Support

Example: Configuring MPLS Traffic Engineering Nonstop Routing Support

The following example shows how to configure Multiprotocol (MPLS) Traffic Engineering (TE) Nonstop Routing (NSR) support on a device:

```
enable
 configure terminal
  ip cef
  mpls traffic-eng nsr
  end
```

Example: Verifying MPLS Traffic Engineering Nonstop Routing Support

Displaying MPLS Traffic Engineering Nonstop Routing Support Verification Options

The following example shows how to display the options that help you verify Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Nonstop Routing (NSR) information:

```
enable
 show mpls traffic-eng nsr ?
  counters  TE NSR counters
  database  TE NSR check pointed data
  oos       TE NSR out of sync database
  summary   TE NSR summary
  |         Output modifiers
  <cr>
```

Verifying MPLS Traffic Engineering Nonstop Routing Support Counters

The following example shows how to verify information about the data structures or states that are successfully created or removed, along with errors counts:

```
enable
 show mpls traffic-eng nsr counters

State: Active

Bulk sync
  Last bulk sync was successful (entries sent: 24)
  initiated: 1

Send timer
  started: 7

Checkpoint Messages (Items) Sent
  Succeeded:      13  (101)
    Acks accepted:13  (101)
    Acks ignored:     (0)
    Nacks:        0  (0)
  Failed:         0  (0)
  Buffer alloc:   13
  Buffer freed:   13

ISSU:
  Checkpoint Messages Transformed:
    On Send:
      Succeeded:         13
      Failed:            0
      Transformations:   0
    On Recv:
      Succeeded:         0
      Failed:            0
      Transformations:   0

  Negotiation:
    Started:              1
    Finished:             1
    Failed to Start:      0
    Messages:
      Sent:
        Send succeeded:   5
        Send failed:      0
        Buffer allocated:        5
        Buffer freed:            0
        Buffer alloc failed:     0
      Received:
        Succeeded:        7
        Failed:           0
        Buffer freed:     7
  Init:
    Succeeded:            1
    Failed:               0

  Session Registration:
    Succeeded:            0
    Failed:               0

  Session Unregistration:
```

```
    Succeeded:            0
    Failed:               0

Errors:
  None
```

Verifying MPLS Traffic Engineering Nonstop Routing Support Databases

The following example shows how to verify information pertaining to the write and read databases supporting MPLS TE NSR. The write and read databases store the data that is used for recovering TE state on a standby device after Stateful Switchover (SSO):

```
Device# show mpls traffic-eng nsr database if-autotun
IF_AUTOTUN WRITE DB

  Header:
    State: Checkpointed     Action: Add
    Seq #: 14               Flags: 0x0
  Data:
    te_nsr_seq_num: 28
    Tunnel ID: 100 (if_handle: 25), prot_if_handle: 3
    template_unit: n/a, dest: 10.2.0.1, flags=0x0

IF_AUTOTUN READ DB

Device# show mpls traffic-eng nsr database lsp-ac ?
  |  Output modifiers
  <cr>

Device# show mpls traffic-eng nsr database lsp-ac
 LM Tunnel WRITE DB:

Tun ID: 1   LSP ID: 11   (P2MP)
  SubGrp ID:   1
  SubGrp Orig: 10.1.0.1
  Dest:   10.2.0.1
  Sender: 10.1.0.1     Ext. Tun ID: 10.1.0.1
  Header:
    State: Checkpointed     Action: Add
    Seq #: 7                Flags: 0x0
    TE NSR Seq #: 14

LM Tunnel READ DB:

Device# show mpls traffic-eng nsr database internal

Write DB:
                    Checkpointed
   Entry Type       or Ack-Pending  Send-Pending
     PCALC Node                  0             0
     PCALC Link                  0             0
     PCALC Auto-Mes              0             0
     PCALC SRLG                  0             0
     lm_tunnel_t                 0             0
     NSR LSP FRR                 0             0
     nsr_if_autotun              0             0
     nsr_tspvif_set              0             0
     nsr_slsp_head               0             0

Read DB:
```

```
   Entry Type        Checkpointed
     PCALC Node                 5
     PCALC Link                12
     PCALC Auto-Mesh            0
     PCALC SRLG                 0
     lm_tunnel_t                5
     NSR LSP FRR                0
     nsr_if_autotun             0
     nsr_tspvif_setup           3
     nsr_slsp_head              5

TE NSR Sequence Bulk Sync List:
Entries: 0; next avail seq num: 132

TE NSR Sequence State Creation List:
Entries: 30; next expected seq num: 132
   Seq Num: 7  EntryPtr: 0x5A03B208
     Type: PCALC Node  Action: Add  Bundle Seq #: 1
   Seq Num: 8  EntryPtr: 0x5A0B8B38
     Type: PCALC Link  Action: Add  Bundle Seq #: 2
   Seq Num: 9  EntryPtr: 0x5A0B8DA0
     Type: PCALC Link  Action: Add  Bundle Seq #: 2
   Seq Num: 10  EntryPtr: 0x59FF1BB0
     Type: PCALC Node  Action: Add  Bundle Seq #: 1
   Seq Num: 11  EntryPtr: 0x5A0B9008
     Type: PCALC Link  Action: Add  Bundle Seq #: 2
   Seq Num: 32  EntryPtr: 0x586F2A50
     Type: PCALC Node  Action: Add  Bundle Seq #: 4
   Seq Num: 33  EntryPtr: 0x5949FC58
     Type: PCALC Link  Action: Add  Bundle Seq #: 5
   Seq Num: 34  EntryPtr: 0x5949FEC0
     Type: PCALC Link  Action: Add  Bundle Seq #: 5
   Seq Num: 60  EntryPtr: 0x5725BC30
     Type: lm_tunnel_t  Action: Add  Bundle Seq #: 12
   Seq Num: 61  EntryPtr: 0x5725BE00
     Type: nsr_tspvif_setup  Action: Add  Bundle Seq #: 12
   Seq Num: 62  EntryPtr: 0x59FC9E80
     Type: nsr_slsp_head  Action: Add  Bundle Seq #: 12
   Seq Num: 79  EntryPtr: 0x59296190
     Type: lm_tunnel_t  Action: Add  Bundle Seq #: 16
   Seq Num: 80  EntryPtr: 0x59296360
     Type: nsr_tspvif_setup  Action: Add  Bundle Seq #: 16
   Seq Num: 81  EntryPtr: 0x571EB7F8
     Type: nsr_slsp_head  Action: Add  Bundle Seq #: 16
   Seq Num: 98  EntryPtr: 0x5A04B770
     Type: lm_tunnel_t  Action: Add  Bundle Seq #: 20
   Seq Num: 99  EntryPtr: 0x59296108
     Type: nsr_tspvif_setup  Action: Add  Bundle Seq #: 20
   Seq Num: 100  EntryPtr: 0x57258670
     Type: nsr_slsp_head  Action: Add  Bundle Seq #: 20
   Seq Num: 101  EntryPtr: 0x5A060348
     Type: lm_tunnel_t  Action: Add  Bundle Seq #: 20
   Seq Num: 102  EntryPtr: 0x5A03B2B0
     Type: nsr_slsp_head  Action: Add  Bundle Seq #: 20
   Seq Num: 103  EntryPtr: 0x5B1F12B0
     Type: lm_tunnel_t  Action: Add  Bundle Seq #: 20
   Seq Num: 104  EntryPtr: 0x5A03B400
     Type: nsr_slsp_head  Action: Add  Bundle Seq #: 20
   Seq Num: 121  EntryPtr: 0x57258358
     Type: PCALC Node  Action: Add  Bundle Seq #: 21
   Seq Num: 122  EntryPtr: 0x59FAF080
     Type: PCALC Link  Action: Add  Bundle Seq #: 22
   Seq Num: 123  EntryPtr: 0x59502AC0
     Type: PCALC Link  Action: Add  Bundle Seq #: 23
```

```
   Seq Num: 124  EntryPtr: 0x594AE918
     Type: PCALC Link  Action: Add  Bundle Seq #: 21
   Seq Num: 125  EntryPtr: 0x59502120
     Type: PCALC Link  Action: Add  Bundle Seq #: 23
   Seq Num: 126  EntryPtr: 0x59FAFA20
     Type: PCALC Link  Action: Add  Bundle Seq #: 22
   Seq Num: 129  EntryPtr: 0x59FC9CC0
     Type: PCALC Node  Action: Add  Bundle Seq #: 24
   Seq Num: 130  EntryPtr: 0x5A060518
     Type: PCALC Link  Action: Add  Bundle Seq #: 24
   Seq Num: 131  EntryPtr: 0x59FAFC88
     Type: PCALC Link  Action: Add  Bundle Seq #: 24

Device# show mpls traffic-eng nsr database lsp-frr
LSP-FRR WRITE DB

Tun ID: 1   LSP ID: 10   (P2MP)
  SubGrp ID:   1
  SubGrp Orig: 10.1.0.1
  Dest:   10.2.0.1
  Sender: 10.1.0.1     Ext. Tun ID: 10.1.0.1
  Header:
    State: Checkpointed     Action: Add
    Seq #: 45               Flags: 0x0
  Data:
    te_nsr_seq_num: 164
    LSP Protected if_num: 3 (Ethernet0/0)
    LSP Next-Hop Info: rrr_id 10.2.0.1, address 10.2.0.1, label 17
    LSP Next-Next-Hop Info: rrr_id 0.0.0.0, address 0.0.0.0, label 16777216
    LSP Hold Priority: 7
    LSP bw_type: any pool
    LSP desired_bit_type: 0x0n    LSP Backup ERO address 10.1.2.2
    LSP advertise_bw: NO

LSP-FRR READ DB

Device# show mpls traffic-eng nsr database lsp-frr filter destination ?
  Hostname or A.B.C.D  IP addr or name of destination (tunnel tail)

Device# show mpls traffic-eng nsr database lsp-frr filter lsp-id ?
  <0-65535>  LSP ID

Device# show mpls traffic-eng nsr database lsp-frr filter source ?
  Hostname or A.B.C.D  IP addr or name of sender (tunnel head)

Device# show mpls traffic-eng nsr database lsp-frr filter tunnel-id ?
  <0-65535>  tunnel ID

Device# show mpls traffic-eng nsr database lsp-head
SLSP_HEAD WRITE DB

  Tun ID: 0  (P2P), lsp_id: 7
  Header:
    State: Checkpointed     Action: Add
    Seq #: 6                Flags: 0x0
  Data:
    te_nsr_seq_num: 18
    bandwidth: 5, thead_flags: 0x1, popt: 1
    feature flags: none
    output_if_num: 11, output_nhop: 10.1.3.2
    backup_output_if_num: 0
    output_tag: 19
    backup_output_tag: 16777218
    RRR path setup info
```

```
      Destination: 10.3.0.1, Id: 10.3.0.1 Router Node (ospf) flag:0x0
      IGP: ospf, IGP area: 0, Number of hops: 3, metric: 128
      Hop 0: 10.1.3.2, Id: 10.2.0.1 Router Node (ospf), flag:0x0
      Hop 1: 10.2.3.3, Id: 10.3.0.1 Router Node (ospf), flag:0x0
      Hop 2: 10.3.0.1, Id: 10.3.0.1 Router Node (ospf), flag:0x0

SLSP_HEAD READ DB

Device# show mpls traffic-eng nsr database lsp-head filter destination ?
  Hostname or A.B.C.D  IP addr or name of destination (tunnel tail)

Device# show mpls traffic-eng nsr database lsp-head filter lsp-id ?
  <0-65535>  LSP ID

Device# show mpls traffic-eng nsr database lsp-head filter source ?
  Hostname or A.B.C.D  IP addr or name of sender (tunnel head)

Device# show mpls traffic-eng nsr database lsp-head filter tunnel-id ?
  <0-65535>  tunnel ID

Device# show mpls traffic-eng nsr database pcalc auto-mesh
  PCALC Auto-Mesh WRITE DB:

  PCALC Auto-Mesh READ DB:

Device# show mpls traffic-eng nsr database pcalc nbr
 PCALC Link WRITE DB:
  Header:
    State: Checkpointed     Action: Add
    Seq #: 4                Flags: 0x0
    TE NSR Seq #: 26
    IGP Id:10.1.2.2     Area:0   Nbr IGP Id:10.1.2.2
    IP:10.1.2.1         Nbr IP:0.0.0.0  Framgment ID:1
    Intf ID    Local:0     Remote:0


 PCALC Link READ DB:

Device# show mpls traffic-eng nsr database pcalc node
 PCALC Node WRITE DB:
  Header:
    State: Checkpointed     Action: Add
    Seq #: 4                Flags: 0x0
    TE NSR Seq #: 25
    Router Id 10.1.0.1
    node_id 1
    num_links 2
    tlvs_len 0
    flags 0x6
    rid_frag_id 0
    bcid_mismatch 0
    incarnation  0

Device# show mpls traffic-eng nsr database pcalc srlg
 PCALC SRLGs WRITE DB:

 PCALC SRLGs READ DB:

Device# show mpls traffic-eng nsr database summary
MPLS-TE Non-Stop-Routing is ENABLED

Write DB Coalescing: INACTIVE
Write DB:
  Send-Pending:     0
```

```
  Ack-Pending :     0
  Checkpointed:    35
  Total       :    35

Read DB:
  Total       :     0

Device# show mpls traffic-eng nsr database tun-setup
TSPVIF_SETUP WRITE DB

  Tun ID: 0, lsp_id: 7
  Header:
    State: Checkpointed     Action: Add
    Seq #: 6                Flags: 0x0
  Data:
    te_nsr_seq_num: 17
    Setup Evt: allocating current tspsetup, chkpt_flags: 0x0

TSPVIF_SETUP READ DB
```

Verifying MPLS Traffic Engineering Nonstop Routing Support Out-of-Sync Databases

The following example shows how to verify information pertaining to the out-of-sync databases supporting MPLS TE NSR. The out-of-sync databases indicate the **active and standby RSP** whose states are not in sync with each other:

```
enable
 show mpls traffic-eng nsr oos
  Tunnel: 4000
  Time created: 02/20/13-12:03:13
  Time synced: 02/20/13-12:03:14
  Key:
    Source:                    10.1.0.1
    Destination:               10.2.0.1
    ID:                        4000
    Ext Tun ID:                10.1.0.1
    Instance:                  4
    Slsp p2mp ID:              0
    Slsp p2mp subgroup ID:     0
    Slsp p2mp subgroup origin: 0

  RSVP States:
    Signal:       Unknown
    Fast-Reroute: Disabled
    Delete State: True

  TE States:
    Signal:       Unknown
    Fast-Reroute: Disabled
    Delete State: True

  Update History:
    Total number of updates: 2

      Update Time: 02/20/13-12:03:13
        Client Updating: RSVP
        Update State:
          Signal:       Unknown
          Fast-Reroute: Unknown
          Delete State: True
```

```
Update Time: 02/20/13-12:03:14
  Client Updating: TE
  Update State:
    Signal:       Unknown
    Fast-Reroute: Unknown
    Delete State: True
```

Verifying MPLS Traffic Engineering Nonstop Routing Support Information Summary

The following example shows how to view a summary of MPLS TE NSR information such as the current TE NSR state (standby-hot / recovering / staling / active), recovery time, and the recovery result (success / failure):

```
enable
 show mpls traffic-eng nsr summary
  State:
  Graceful-Restart: Disabled
  HA state: Active
  Checkpointing: Allowed
  Messages:
   Send timer: not running (Interval: 1000 msec)
   Items sent per Interval: 200
   CF buffer size used: 3968
```

Additional References for MPLS Traffic Engineering Nonstop Routing Support

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multiprotocol Label Switching High Availability Configuration Guide	Cisco IOS XE Multiprotocol Label Switching High Availability Configuration Guide
MPLS TE commands	Cisco IOS Multiprotocol Label Switching Command Reference

Standards and RFCs

Standard/RFC	Title
RFC 2205	*Resource Reservation Protocol (RSVP)*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

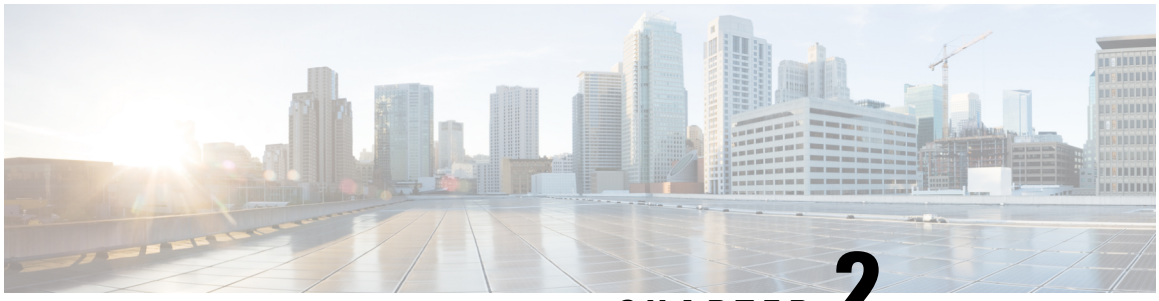
Feature Information for MPLS Traffic Engineering Nonstop Routing Support

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1: Feature Information for MPLS Traffic Engineering Nonstop Routing Support

Feature Name	Releases	Feature Information
MPLS Traffic Engineering Nonstop Routing Support	Cisco IOS XE Release 3.10S, 3.13S	The MPLS Traffic Engineering Non-Stop Routing Support feature assists the Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) routing devices to recover from an interruption in service. The MPLS TE Nonstop Routing (NSR) support functionality also defines the checkpoint and recovery scheme for the devices. From Cisco IOS XE 3.13S, support was provided for ASR 903. The following commands were introduced: **mpls traffic-eng nsr** and **show mpls traffic-eng nsr**.



CHAPTER 2

MPLS Traffic Engineering over Bridge Domain Interfaces

The MPLS Traffic Engineering(TE) over Bridge Domain Interfaces(BDI) feature enables MPLS traffic engineering over Bridge Domain Interfaces.

- Prerequisites for Configuring MPLS TE over BDI, on page 15
- Restrictions for MPLS TE over BDI, on page 15
- Information About MPLS Traffic Engineering over BDI , on page 16
- How to Configure MPLS Traffic Engineering over BDI, on page 16
- Configuration Example for MPLS Traffic Engineering over BDI, on page 20

Prerequisites for Configuring MPLS TE over BDI

You must have:

- Enabled MPLS TE on all relevant routers and interfaces
- Configured MPLS TE tunnels

Your network must support the following Cisco IOS features:

- IP Cisco Express Forwarding
- Multiprotocol Label Switching (MPLS)

Your network must support at least one of the following protocols:

- Intermediate SystemtoIntermediate System (ISIS)
- Open Shortest Path First (OSPF)

Restrictions for MPLS TE over BDI

- Explicit Path Node exclusion
- P2MP TE Tunnels
- Auto-tunnel one-hops and backups
- Auto bandwidth

- Inter area or AS TE
- Auto route destinations
- FRR link ornode protection

Information About MPLS Traffic Engineering over BDI

Features of MPLS Traffic Engineering over BDI

The MPLS Traffic Engineering over BDI feature enables MPLS TE tunnels over BDI.

Supported Features

Your network must support the following:

- MPLS TE tunnels
- Policy Routing onto MPLS TE Tunnels
- MPLS TE - Forwarding Adjacency
- MPLS TE – RSVP Hello State Timer
- MPLS TE - LSP Attributes
- MPLS TE - IP Explicit Address Exclusion
- MPLS TE - Configurable Path Calculation Metric for Tunnels
- MPLS TE - Verbatim Path Support
- Pseudo-wire mapping onto TE tunnels.

How to Configure MPLS Traffic Engineering over BDI

This section assumes that you want to configure MPLS TE over BDI.

Configuring MPLS TE over BDI

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface bdi30**
4. **mpls traffic-eng tunnels**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters interface configuration mode.
Step 3	**interface bdi30** **Example:** `Router(config)# interface bdi30`	Specifies the bridge domain interface and enters interface configuration mode.
Step 4	**mpls traffic-eng tunnels** **Example:** `Router(config-if)# mpls traffic-eng tunnels`	Enables an MPLS TE tunnel to use an established tunnel for the bridge domain interface.
Step 5	**end** **Example:** `Router(config-if)# end`	Returns to privileged EXEC mode.

Configuring the RSVP Bandwidth

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type slot* / *subslot* / *port*
4. **ip rsvp bandwidth** [*interface-kbps* [*single-flow-kbps*[**bc1** *kbps* | **sub-pool** *kbps*]*]*| **percent** *percent-bandwidth* [*single-flow-kbps*]]
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type slot / subslot / port* **Example:** `Router(config)# interface gigabitEthernet 0/0/0`	Configures the interface type and enters interface configuration mode.
Step 4	**ip rsvp bandwidth** [*interface-kbps* [*single-flow-kbps*[**bc1** *kbps* | **sub-pool** *kbps*]]| **percent** *percent-bandwidth* [*single-flow-kbps*]] **Example:** `Router(config-if)# ip rsvp bandwidth 7500 7500`	Enables RSVP on an interface. • The optional *interface-kbps* and *single-flow-kbps* arguments specify the amount of bandwidth that can be allocated by RSVP flows or to a single flow, respectively. Values are from 1 to 10000000. • The optional **sub-pool**and *kbps*keyword and argument specify subpool traffic and the amount of bandwidth that can be allocated by RSVP flows. Values are from 1 to 10000000. **Note** Repeat this command for each interface on which you want to enable RSVP.
Step 5	**end** **Example:** `Router(config-if)# end`	(Optional) Returns to privileged EXEC mode.

Verifying That MPLS TE over BDI Is Operational

To verify that MPLS TE over BDI can function, perform the following task.

SUMMARY STEPS

1. **enable**
2. **show mpls traffic-eng tunnels brief**
3. **show mpls traffic-eng tunnels summary**
4. **show mpls traffic-eng tunnels tunnel1**

DETAILED STEPS

Step 1 **enable**

Enables privileged EXEC mode.

Step 2 **show mpls traffic-eng tunnels brief**

Use this command to monitor and verify the state of the tunnels.

Step 3 **show mpls traffic-eng tunnels summary**

Use this command to monitor and verify the state of the tunnels.

Step 4 **show mpls traffic-eng tunnels tunnel1**

Use this command to verify that tunnels are up and using BDI.

Troubleshooting Tips

This section describes how you can use the `show mpls traffic-eng tunnels tunnel5` to check for issues.

```
Router# show mpls traffic-eng tunnels tunnel5

Name: router_t5                           (Tunnel5) Destination: 3.3.3.3
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected
    path option 1, type dynamic (Basis for Setup, path weight 2)

  Config Parameters:
    Bandwidth: 0        kbps (Global)  Priority: 5  5   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute: disabled LockDown: disabled Loadshare: 0 [0] bw-based
    auto-bw: disabled
  Active Path Option Parameters:
    State: dynamic path option 1 is active
    BandwidthOverride: disabled  LockDown: disabled  Verbatim: disabled


  InLabel  :  -
  OutLabel : BDI31, 21
  Next Hop : 12.0.0.2
  RSVP Signalling Info:
       Src 1.1.1.1, Dst 3.3.3.3, Tun_Id 5, Tun_Instance 1
    RSVP Path Info:
      My Address: 12.0.0.1
      Explicit Route: 12.0.0.2 14.0.0.2 14.0.0.1 3.3.3.3
      Record   Route:   NONE
      Tspec: ave rate=0 kbits, burst=1000 bytes, peak rate=0 kbits
    RSVP Resv Info:
      Record   Route:   NONE
      Fspec: ave rate=0 kbits, burst=1000 bytes, peak rate=0 kbits
  Shortest Unconstrained Path Info:
    Path Weight: 2 (TE)
    Explicit Route: 12.0.0.1 12.0.0.2 14.0.0.2 14.0.0.1
                    3.3.3.3
  History:
    Tunnel:
      Time since created: 1 minutes, 38 seconds
      Time since path change: 1 minutes, 36 seconds
      Number of LSP IDs (Tun_Instances) used: 1
    Current LSP: [ID: 1]
      Uptime: 1 minutes, 36 seconds
```

Configuration Example for MPLS Traffic Engineering over BDI

The following example enables the BDI on the router:

```
Router(config)#interface bdi30
Router(config-if)#mpls traffic-eng tunnels
```

Configuring Interface Tunnel Example

The following example configures an interface tunnel

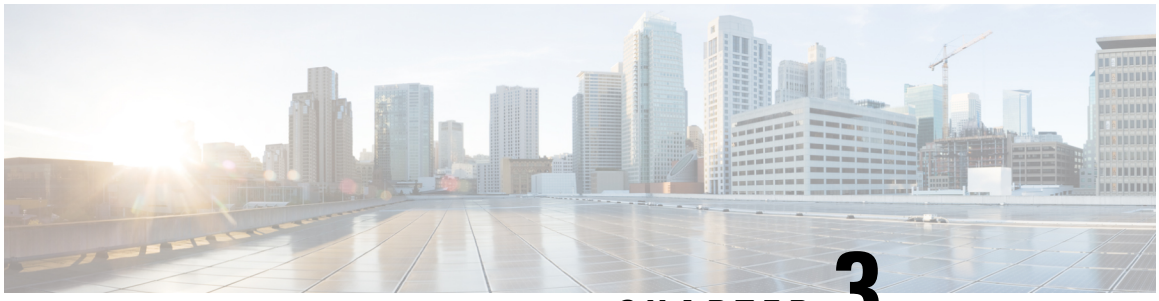
```
interface Tunnel1
ip unnumbered Loopback0
tunnel source Loopback0
tunnel mode mpls traffic-eng
tunnel destination 4.4.4.4
tunnel mpls traffic-eng path-option 1 dynamic
```

Configuring RSVP Bandwidth Example

The following example configures RSVP bandwidth

ip rsvp bandwidth [*interface-kbps*] [*single-flow-kbps*]

```
Router(config-if)# ip rsvp bandwidth 500 500
```



CHAPTER 3

MPLS Traffic Engineering – Bundled Interface Support

Note This technology is not applicable for the Cisco ASR 900 RSP3 Module.

The MPLS Traffic Engineering - Bundled Interface Support feature enables Multiprotocol Label Switching (MPLS) traffic engineering (TE) tunnels over the bundled interfaces—EtherChannel and Gigabit EtherChannel (GEC).

The Resource Reservation Protocol (RSVP) notifies TE about bandwidth changes that occur when member links are added or deleted, or when links become active or inactive. TE notifies other nodes in the network via Interior Gateway Protocol (IGP) flooding. By default, the bandwidth available to TE Label-Switched Paths (LSPs) is 75 percent of the interface bandwidth. You can change the percentage of the global bandwidth available for TE LSPs by using an RSVP command on the bundled interface. Bandwidth reservation and preemption are supported.

The Fast Reroute (FRR) feature is supported on bundled interfaces. FRR is activated when a bundled interface goes down; for example, if you enter the **shutdown** command to shut down the interface or fewer than the required minimum number of links are operational.

- Prerequisites for MPLS TE – Bundled Interface Support, on page 21
- Restrictions for MPLS TE – Bundled Interface Support, on page 22
- Information About MPLS TE – Bundled Interface Support, on page 22
- How to Configure MPLS TE – Bundled Interface Support, on page 23
- Configuration Examples for MPLS TE Bundled Interface Support, on page 24

Prerequisites for MPLS TE – Bundled Interface Support

- Configure Multiprotocol Label Switching (MPLS) traffic engineering (TE) tunnels.
- Enable Cisco Express Forwarding in global configuration mode.
- Enable Resource Reservation Protocol (RSVP) feature.
- Configure EtherChannel.
- Configure Gigabit EtherChannel.

Restrictions for MPLS TE – Bundled Interface Support

- Traffic engineering over switch virtual interfaces (SVIs) is not supported unless the SVI consists of a bundle of links that represent a single point-to-point interface.
- There must be a valid IP address configuration on the bundled interface and there must not be an IP address configuration on the member links.

Information About MPLS TE – Bundled Interface Support

Cisco EtherChannel Overview

Cisco EtherChannel technology builds upon standards-based 802.3 full-duplex Fast Ethernet to provide network managers with a reliable, high-speed solution for the campus network backbone. EtherChannel technology provides bandwidth scalability within the campus by providing up to 800 Mbps, 8 Gbps, or 80 Gbps of aggregate bandwidth for a Fast EtherChannel, Gigabit EtherChannel, or 10 Gigabit EtherChannel connection, respectively. Each of these connection speeds can vary in amounts equal to the speed of the links used (100 Mbps, 1 Gbps, or 10 Gbps). Even in the most bandwidth-demanding situations, EtherChannel technology helps to aggregate traffic, keeps oversubscription to a minimum, and provides effective link-resiliency mechanisms.

Cisco EtherChannel Benefits

Cisco EtherChannel technology allows network managers to provide higher bandwidth among servers, routers, and switches than a single-link Ethernet technology can provide.

Cisco EtherChannel technology provides incremental scalable bandwidth and the following benefits:

- Standards-based—Cisco EtherChannel technology builds upon IEEE 802.3-compliant Ethernet by grouping multiple, full-duplex point-to-point links. EtherChannel technology uses IEEE 802.3 mechanisms for full-duplex autonegotiation and autosensing, when applicable.
- Flexible incremental bandwidth—Cisco EtherChannel technology provides bandwidth aggregation in multiples of 100 Mbps, 1 Gbps, or 10 Gbps, depending on the speed of the aggregated links. For example, network managers can deploy EtherChannel technology that consists of pairs of full-duplex Fast Ethernet links to provide more than 400 Mbps between the wiring closet and the data center. In the data center, bandwidths of up to 800 Mbps can be provided between servers and the network backbone to provide large amounts of scalable incremental bandwidth.
- Load balancing—Cisco EtherChannel technology comprises several Fast Ethernet links and is capable of load balancing traffic across those links. Unicast, broadcast, and multicast traffic is evenly distributed across the links, providing improved performance and redundant parallel paths. When a link fails, traffic is redirected to the remaining links within the channel without user intervention and with minimal packet loss.
- Resiliency and fast convergence—When a link fails, Cisco EtherChannel technology provides automatic recovery by redistributing the load across the remaining links. When a link fails, Cisco EtherChannel technology redirects traffic from the failed link to the remaining links in less than one second. This convergence is transparent to the end user—no host protocol timers expire and no sessions are dropped.

Cisco Gigabit EtherChannel Overview

Cisco Gigabit EtherChannel (GEC) is a high-performance Ethernet technology that provides transmission rates in Gigabit per second (Gbps). A Gigabit EtherChannel bundles individual ethernet links (Gigabit Ethernet and 10 Gigabit Ethernet) into a single logical link that provides the aggregate bandwidth up to four physical links. All LAN ports in each EtherChannel must be of the same speed and must be configured as either Layer 2 or Layer 3 LAN ports. Inbound broadcast and multicast packets on one link in an EtherChannel are blocked from returning on any other link in the EtherChannel.

Load Balancing and Min-Links in EtherChannel

Load balancing affects the actual and practical bandwidth that can be used for TE. Multilink load balancing uses a per-packet load balancing method. All of the bundle interface bandwidth is available. EtherChannel load balancing has various load balancing methods, depending on the traffic pattern and the load balancing configuration. The total bandwidth available for TE may be limited to the bandwidth of a single member link.

On EtherChannel, min-links is supported only in the Link Aggregation Control Protocol (LACP). For other EtherChannel protocols, the minimum is one link, by default, and it is not configurable. To configure min-links for EtherChannel, use the **port-channel min-links** command.

How to Configure MPLS TE – Bundled Interface Support

Configuring MPLS TE on an EtherChannel Interface

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number* [*name-tag*]
4. **ip address** *ip-address mask* [**secondary**]
5. **mpls traffic-eng tunnels**
6. **mpls traffic-eng backup-path** *tunnel*
7. **port-channel min-links** *min-num*
8. **ip rsvp bandwidth** [*interface-kbps*] [*single-flow-kbps*]
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Device# configure terminal`	
Step 3	**interface** *type number* [*name-tag*] **Example:** `Device(config)# interface port-channel 1`	Creates an EtherChannel bundle, assigns a group number to the bundle, and enters interface configuration mode.
Step 4	**ip address** *ip-address mask* [**secondary**] **Example:** `Device(config-if)# ip address 10.0.0.4 255.255.255.0`	Specifies an IP address for the EtherChannel group.
Step 5	**mpls traffic-eng tunnels** **Example:** `Device(config-if)# mpls traffic-eng tunnels`	Enables MPLS TE tunnel signaling on an interface. • MPLS TE tunnel should be enabled on the device before enabling the signaling.
Step 6	**mpls traffic-eng backup-path** *tunnel* **Example:** `Device(config-if)# mpls traffic-eng backup-path Tunnel120`	(Optional) Configures the physical interface to use a backup tunnel in the event of a detected failure on that interface.
Step 7	**port-channel min-links** *min-num* **Example:** `Device(config-if)# port-channel min-links 2`	Specifies that a minimum number of bundled ports in an EtherChannel is required before the channel can be active.
Step 8	**ip rsvp bandwidth** [*interface-kbps*] [*single-flow-kbps*] **Example:** `Device(config-if)# ip rsvp bandwidth 100`	Enables RSVP for IP on an interface and specifies a percentage of the total interface bandwidth as available in the RSVP bandwidth pool.
Step 9	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Configuration Examples for MPLS TE Bundled Interface Support

Example: Configuring MPLS TE on an EtherChannel Interface

```
Device> enable
```

```
Device# configure terminal
Device(config)# interface port-channel 1
Device(config-if)# ip address 10.0.0.4 255.255.255.0
Device(config-if)# mpls traffic-eng tunnels
Device(config-if)# mpls traffic-eng backup-path Tunnel 120
Device(config-if)# port-channel min-links 2
Device(config-if)# ip rsvp bandwidth 100
Device(config-if)# end
```

Example: Configuring MPLS TE - Bundled Interface Support over Gigabit Etherchannel

The following example shows how to enable MPLS TE – bundled interface support over GEC on Cisco devices:

```
Device> enable
Device# configure terminal

! Enable global MPLS TE on routers
Device(config)# router ospf 100
Device(config-router)# network 10.0.0.1 0.0.0.255 area 0
Device(config-router)# mpls traffic-eng area 0
Device(config-router)# mpls traffic-eng router-id Loopback 0
Device(config-router)# exit

! Configure  GEC  interface and enable MPLS TE and RSVP on interface
Device(config)# interface Port-channel 1
Device(config-if)# ip address 10.0.0.1 255.255.255.0
Device(config-if)# mpls traffic-eng tunnels
Device(config-if)# ip rsvp bandwidth
Device(config-if)# exit

! Define explicit path
Device(config)# ip explicit-path name primary enable
Device(cfg-ip-expl-path)# next-address 172.12.1.2
Device(cfg-ip-expl-path)# next-address 172.23.1.2
Device(cfg-ip-expl-path)# next-address 172.34.1.2
Device(cfg-ip-expl-path)# next-address 10.4.4.4
Device(cfg-ip-expl-path)# exit

! Configure primary tunnel on head-end device
Device(config)# interface Tunnel 14
Device(config-if)# ip unnumbered Loopback 0
Device(config-if)# tunnel mode mpls traffic-eng
Device(config-if)# tunnel destination 10.10.10.0
Device(config-if)# tunnel mpls traffic-eng autoroute announce
Device(config-if)# tunnel mpls traffic-eng path-option 10 explicit name primary
Device(config-if)# tunnel mpls traffic-eng fast-reroute
Device(config-if)# exit

! Configure backup tunnel on head-end or mid-point device
Device(config)# interface Tunnel 23
Device(config-if)# ip unnumbered Looback 0
Device(config-if)# tunnel mode mpls traffic-eng
Device(config-if)# tunnel destination 10.20.10.0
Device(config-if)# tunnel mpls traffic-eng path-option 10 explicit name backup
Device(config-if)# exit
```

```
! Configure backup tunnel on protected GEC interface
Device(config)# interface Port-channel 1
Device(config-if)# ip address 10.0.0.1 255.255.255.0
Device(config-if)# mpls traffic-eng tunnels
Device(config-if)# mpls traffic-eng backup-path Tunnel 23
Device(config-if)# ip rsvp bandwidth percent 20
Device(config-if)# lacp min-bundle 2
Device(config-if)# exit

! Configure GEC interface
Device(config)# interface GigabitEthernet 0/0/1
Device(config-if)# no ip address
Device(config-if)# channel-group 1 mode active
Device(config-if)# exit

! Configure GEC interface
Device(config)# interface GigabitEthernet 0/0/2
Device(config-if)# no ip address
Device(config-if)# channel-group 1 mode active
Device(config-if)# exit
```

The **show mpls traffic-eng tunnels** command output displays information about a tunnel or one–line information about all tunnels configured on the device:

```
Device# show mpls traffic-eng tunnels tunnel 14

Name: ASR1013_t14                         (Tunnel10) Destination: 10.4.4.4
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected
    path option 1, type explicit toR4overR3R3 (Basis for Setup, path weight 3)

  Config Parameters:
    Bandwidth: 0        kbps (Global)  Priority: 7  7   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    AutoRoute: enabled  LockDown: disabled Loadshare: 0 [0] bw-based
    auto-bw: disabled
  Active Path Option Parameters:
    State: explicit path option 1 is active
    BandwidthOverride: disabled  LockDown: disabled  Verbatim: disabled


      InLabel  :  -
  OutLabel : Port-channel1, 1608
  Next Hop : 172.16.1.2
  FRR OutLabel : Tunnel23, 4868
  RSVP Signalling Info:
       Src 10.1.1.1, Dst 10.4.4.4, Tun_Id 14, Tun_Instance 35
    RSVP Path Info:
      My Address: 172.12.1.1
      Explicit Route: 172.12.1.2 172.23.1.1 172.23.1.2 172.34.1.1
                      172.34.1.2 10.4.4.4

  History:
    Tunnel:
      Time since created: 17 hours
      Time since path change: 18 minutes, 22 seconds
      Number of LSP IDs (Tun_Instances) used: 35
    Current LSP: [ID: 35]
      Uptime: 18 minutes, 22 seconds
      Selection: reoptimization
    Prior LSP: [ID: 32]
```

```
      ID: path option unknown
      Removal Trigger: signalling shutdown

Device# show mpls traffic-eng tunnels brief

show mpls traffic-eng tunnels brief
Signalling Summary:
    LSP Tunnels Process:            running
    Passive LSP Listener:           running
    RSVP Process:                   running
    Forwarding:                     enabled
    Periodic reoptimization:        every 3600 seconds, next in 3299 seconds
    Periodic FRR Promotion:         Not Running
    Periodic auto-bw collection:    every 300 seconds, next in 299 seconds

P2P TUNNELS/LSPs:
TUNNEL NAME                      DESTINATION      UP IF     DOWN IF   STATE/PROT^M
ASR1013_t14                      10.4.1.1                      -         Po12      up/up
On Mid Router:
P2P TUNNELS/LSPs:
TUNNEL NAME                      DESTINATION      UP IF     DOWN IF   STATE/PROT
ASR1013_t14                       10.4.1.1                   Po12       Po23       up/up
ASR1002F_t23                      10.2.1.1                   Po25        -         up/up
```

The **show mpls traffic-eng fast-reroute** command output displays information about FRR-protected MPLS TE tunnels originating, transmitting, or terminating on this device.

```
Device# show mpls traffic-eng fast-reroute database

P2P Headend FRR information:
Protected tunnel               In-label Out intf/label   FRR intf/label   Status
---------------------------    -------- --------------   --------------   ------

P2P LSP midpoint frr information:
LSP identifier                 In-label Out intf/label   FRR intf/label   Status
---------------------------    -------- --------------   --------------   ------
10.1.1.1 1 [2]                 16        Po23:16          Tu23:16          active
```