



# MPLS Traffic Engineering Nonstop Routing Support

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

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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.

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## 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
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>ip cef</b> <b>Example:</b> Device(config)# ip cef	Enables standard Cisco Express Forwarding operations.
<b>Step 4</b>	<b>mpls traffic-eng nsr</b> <b>Example:</b> Device(config)# mpls traffic-eng nsr	Enables the MPLS Traffic Engineering (TE) Non-Stop Routing (NSR) functionality on a device. <b>Note</b> Enabling the MPLS TE NSR functionality automatically enables the Resource Reservation Protocol (RSVP) NSR functionality as well.
<b>Step 5</b>	<b>end</b> <b>Example:</b> 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
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>show mpls traffic-eng nsr</b> <b>Example:</b> 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.
<b>Step 3</b>	<b>show mpls traffic-eng nsr counters</b> <b>Example:</b> 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.
<b>Step 4</b>	<b>show mpls traffic-eng nsr database</b> <b>Example:</b> 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).
<b>Step 5</b>	<b>show mpls traffic-eng nsr oos</b> <b>Example:</b> 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.
<b>Step 6</b>	<b>show mpls traffic-eng nsr summary</b> <b>Example:</b> 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).
<b>Step 7</b>	<b>end</b> <b>Example:</b> 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
```

**Example: Verifying MPLS Traffic Engineering Nonstop Routing Support**

```

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:

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

```

## Example: Verifying MPLS Traffic Engineering Nonstop Routing Support

```

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

```

## Example: Verifying MPLS Traffic Engineering Nonstop Routing Support

```

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	<a href="#">Cisco IOS Master Command List, All Releases</a>
Multiprotocol Label Switching High Availability Configuration Guide	<a href="#">Cisco IOS XE Multiprotocol Label Switching High Availability Configuration Guide</a>
MPLS TE commands	<a href="#">Cisco IOS Multiprotocol Label Switching Command Reference</a>

### Standards and RFCs

Standard/RFC	Title
RFC 2205	<i>Resource Reservation Protocol (RSVP)</i>

### 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.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

# 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](http://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	<p>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.</p> <p>From Cisco IOS XE 3.13S, support was provided for ASR 903.</p> <p>The following commands were introduced: <b>mpls traffic-eng nsr</b> and <b>show mpls traffic-eng nsr</b>.</p>

