



## NSF SSO—Any Transport over MPLS and AToM Graceful Restart

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The NSF/SSO—Any Transport over MPLS and AToM Graceful Restart feature allows Any Transport over MPLS (AToM) to use Cisco nonstop forwarding (NSF), stateful switchover (SSO), and Graceful Restart (GR) to facilitate a Route Processor (RP) to recover from a disruption in control plane service without losing its Multiprotocol Label Switching (MPLS) forwarding state.

NSF with SSO is effective at increasing the availability of network services. Cisco NSF with SSO provides continuous packet forwarding, even during a network processor hardware or software failure. In a redundant system, the secondary processor recovers the control plane service during a critical failure in the primary processor. SSO synchronizes the network state information between the primary and the secondary processor.



### Note

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In this document, the NSF/SSO—Any Transport over MPLS and AToM Graceful Restart feature is referred to as AToM NSF for brevity.

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## 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 at the end of this module.

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.

## Prerequisites for AToM NSF

Before you configure AToM NSF, ensure the following tasks are completed:

- AToM virtual circuits (VCs) are configured on the router. For information on configuring AToM, see the Any Transport over MPLS feature module. For configuring L2VPN Interworking, see the L2VPN Interworking feature module.
- SSO is configured on the Route Processors. For configuration information, see the Stateful Switchover feature module.
- Nonstop forwarding is configured on the routers. You must enable nonstop forwarding on the routing protocols running between the provider edge (PE) and customer edge (CE) routers. The routing protocols are Open Shortest Path First (OSPF), Intermediate System-to-Intermediate System (IS-IS), and Border Gateway Protocol (BGP). For configuring nonstop forwarding, see the Cisco Nonstop Forwarding feature module.
- The routers must be configured to detect and interact with the neighbor routers in the MPLS high availability (HA) environment. AToM NSF requires that neighbor networking devices be able to perform AToM GR. In Cisco IOS Releases 12.2(25)S and 12.2(28)SB, the Cisco 7200 and Cisco 7500 routers support AToM GR and can be used as neighbor networking devices. In Cisco IOS Release 12.2(33)SRC, the Cisco 7600 routers support AToM high availability HA and MPLS Label Distribution Protocol (LDP) GR.
- The Route Processors for SSO and GR are configured. For more information, see the Stateful Switchover feature module.
- NSF on the routing protocols running between the PE, and CE routers must be enabled. The routing protocols are as follows:
  - BGP
  - IS-IS
  - OSPF

For more information, see the Cisco Nonstop Forwarding feature module.

## Supported Hardware

For hardware requirements for this feature, see the following documents:

- For Cisco IOS Release 12.2(25)S, see the “Supported Hardware” section of the Cross-Platform Release Notes for Cisco IOS Release 12.2S.
- For Cisco IOS Release 12.2(28)SB, see the “Supported Hardware” section of the Cross-Platform Release Notes for Cisco IOS Release 12.2SB.
- For Cisco IOS Release 12.2(33)SRC, see the “Supported Hardware” section of the Release Notes for Cisco IOS Release 12.2SR for the Cisco 7600 Series Routers.

## Restrictions for AToM NSF

- Tag Distribution Protocol (TDP) sessions are not supported. Only LDP sessions are supported.
- AToM NSF cannot be configured on label-controlled ATM (LC-ATM) interfaces.
- AToM NSF does not support Layer 2 Tunnel Protocol Version 3 (L2TPv3) Interworking; only AToM Layer 2 Virtual Private Network (L2VPN) Interworking is supported.
- AToM NSF interoperates with Layer 2 local switching. However, AToM NSF has no effect on interfaces configured for local switching.
- You must disable fair queuing on serial interfaces to allow distributed Cisco Express Forwarding to work on the interfaces.
- On Cisco 7500 series routers, distributed Cisco Express Forwarding is needed to support AToM NSF.
- The Cisco 7500 router does not support AToM Ethernet-VLAN interworking IP; however, AToM Ethernet-VLAN interworking Ethernet is supported.

## Information About AToM NSF

### How AToM NSF Works

AToM NSF improves the availability of the network of the service provider that uses AToM to provide Layer 2 VPN services. HA provides the ability to detect failures and handle them with minimal disruption to the service being provided. AToM NSF is achieved by SSO and NSF mechanisms. A standby RP provides control-plane redundancy. The control plane state and data plane provisioning information for the attachment circuits (ACs) and AToM pseudowires (PWs) are checkpointed to the standby RP to provide NSF for AToM L2VPNs.

### AToM Information Checkpointing

Checkpointing is a function that copies state information from the active RP to the backup RP, thereby ensuring that the backup RP has the latest information. If the active RP fails, the backup RP can take over the copying of state information.

For the AToM NSF feature, the checkpointing function copies the active RP's information bindings to the backup RP. The active RP sends updates to the backup RP when information is modified.

To display checkpointing data, use the **show acircuit checkpoint** command on the active and backup RPs. The active and backup RPs have identical copies of the information.

### Checkpointing Troubleshooting Tips

To help troubleshoot checkpointing errors, use the following commands:

- Use the **debug acircuit checkpoint** command to enable checkpointing debug messages for ACs.

- Use the **debug mpls l2transport checkpoint** command to enable checkpointing debug messages for AToM.
- Use the **debug vfi checkpoint** command to debug virtual forwarding instance (VFI) checkpointing events and errors.
- Use the **show acircuit checkpoint** command to display AC checkpoint information.
- Use the **show mpls l2transport checkpoint** command to display whether checkpointing is allowed, how many AToM VCs were bulk-synchronized (on the active RP), and how many AToM VCs have checkpoint data (on the standby RP).
- Use the **show mpls l2transport vc detail** command to display details of VC checkpointed information.
- Use the **show vfi checkpoint** command to display checkpointing information on a VFI.

## ISSU Support

Beginning with Cisco IOS Release 12.2(33)SRC, AToM NSF supports the In Service Software Upgrade (ISSU) capability. Virtual Private LAN Services (VPLS) NSF/SSO and HA with ISSU work together to enable upgrades or downgrades of a Cisco IOS image without control and data plane outages. With ISSU, all message data structures that are used for checkpointing and exchanges between the active RP and standby RP are versioned.

The maximum transmission length (MTU) of checkpoint messages can be negotiated. The VPLS ISSU client transforms checkpoint messages by converting Source Specific Multicast (SSM) IDs and VFI IDs of an individual VFI to AC and PW, respectively.

## Configuring MPLS LDP Graceful Restart

To configure MPLS LDP Graceful Restart, perform the following task. MPLS LDP Graceful Restart (GR) is enabled globally. When you enable LDP GR, it has no effect on existing LDP sessions. LDP GR is enabled for new sessions that are established after the feature has been globally enabled.

### Before You Begin

- RPs must be configured for SSO. See the Stateful Switchover feature module for more information:
- You must enable Nonstop Forwarding on the routing protocols running between the P, PE, routers, and CE routers. See the Cisco Nonstop Forwarding feature module for more information.

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **ip cef [distributed]**
4. **mpls ldp graceful-restart**
5. **interface** *type slot / subslot / port* [*.subinterface-number*]
6. **mpls ip**
7. **mpls label protocol ldp**
8. **exit**
9. **exit**

**DETAILED STEPS**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> 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> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>ip cef [distributed]</b>  <b>Example:</b> Router(config)# ip cef distributed	Enables distributed Cisco Express Forwarding.
<b>Step 4</b>	<b>mpls ldp graceful-restart</b>  <b>Example:</b> Router (config)# mpls ldp graceful-restart	Enables the router to protect the LDP bindings and MPLS forwarding state during a disruption in service.
<b>Step 5</b>	<b>interface</b> <i>type slot / subslot / port</i> [ <i>.subinterface-number</i> ]  <b>Example:</b> Router(config)# interface pos 0/3/0	Specifies an interface and enters interface configuration mode.

	Command or Action	Purpose
<b>Step 6</b>	<b>mpls ip</b>  <b>Example:</b> Router(config-if)# mpls ip	Configures MPLS hop-by-hop forwarding for an interface.
<b>Step 7</b>	<b>mpls label protocol ldp</b>  <b>Example:</b> Router(config-if)# mpls label protocol ldp	Configures the use of LDP for an interface. You must use LDP. You can also issue the <b>mpls label protocol ldp</b> command in global configuration mode, which enables LDP on all interfaces configured for MPLS.
<b>Step 8</b>	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	Exits interface configuration mode and returns to global configuration mode.
<b>Step 9</b>	<b>exit</b>  <b>Example:</b> Router(config)# exit	Exits global configuration mode and returns to privileged EXEC mode.

# Configuration Examples for AToM NSF

## Example Ethernet to VLAN Interworking with AToM NSF

The following example shows how to configure AToM NSF on two PE routers:

PE1	PE2
<pre> ip cef distributed ! redundancy mode sso ! boot system flash disk2:rsp-pv-mz ! mpls ldp graceful-restart mpls ip mpls label protocol ldp mpls ldp router-id Loopback0 force mpls ldp advertise-labels ! pseudowire-class atom-eth   encapsulation mpls   interworking ethernet ! interface Loopback0   ip address 10.8.8.8 255.255.255.255 ! interface FastEthernet1/1/0   xconnect 10.9.9.9 123 encap mpls pw-class atom-eth interface POS6/1/0   ip address 10.1.1.1 255.255.255.0   mpls ip   mpls label protocol ldp   clock source internal   crc 32 ! interface Loopback0   ip address 10.8.8.8 255.255.255.255   no shutdown ! router ospf 10   nsf   network 10.8.8.8 0.0.0.0 area 0   network 19.1.1.1 0.0.0.0 area 0 </pre>	<pre> ip cef distributed ! redundancy mode sso ! boot system flash disk2:rsp-pv-mz mpls ldp graceful-restart mpls ip mpls label protocol ldp mpls ldp router-id Loopback0 force mpls ldp advertise-labels ! pseudowire-class atom-eth   encapsulation mpls   interworking eth ! interface Loopback0   ip address 10.9.9.9 255.255.255.255 ! interface FastEthernet3/0/0   ip route-cache cef ! interface FastEthernet3/0/0.3   encapsulation dot1Q 10   xconnect 10.8.8.8 123 encap mpls pw-class atom-eth interface POS1/0/0   ip address 10.1.1.2 255.255.255.0   mpls ip   mpls label protocol ldp   clock source internal   crc 32 ! interface Loopback0   ip address 10.9.9.9 255.255.255.255 ! router ospf 10   nsf   network 10.9.9.9 0.0.0.0 area 0   network 10.1.1.2 0.0.0.0 area 0 </pre>

## Additional References

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>

Related Topic	Document Title
Cisco IOS Multiprotocol Label Switching Command Reference	<i>Cisco IOS Multiprotocol Label Switching Command Reference</i>
Stateful switchover	Stateful Switchover
MPLS Label Distribution Protocol	MPLS Label Distribution Protocol (LDP)
Cisco nonstop forwarding	Cisco Nonstop Forwarding
Any Transport over MPLS	<a href="#">Any Transport over MPLS</a>
L2VPN Interworking configuration	L2VPN Interworking

### Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

### MIBs

MIBs	MIBs Link
MPLS Label Distribution Protocol MIB Version 8 Upgrade	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

### RFCs

RFCs	Title
RFC 3036	<i>LDP Specification</i>
RFC 3478	<i>Graceful Restart Mechanism for Label Distribution</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 AToM NSF

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.

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**Table 1: Feature Information for AToM NSF Any Transport over MPLS and AToM Graceful Restart**

Feature Name	Releases	Feature Information
AToM NSF	12.2(25)S 12.2(28)SB 12.2(33)SRC	<p>This feature uses NSF, SSO, and Graceful Restart to allow a Route Processor to recover from a disruption in control plane service without losing its MPLS forwarding state.</p> <p>In 12.2(25)S, this feature was introduced on the Cisco 7500 series router.</p> <p>In 12.2(28)SB, this feature was integrated into the release.</p> <p>In 12.2(33)SRC, this feature was integrated into the release for the Cisco 7600 router. Support for ISSU was added.</p> <p>The following commands were introduced or modified: <b>debug acircuit checkpoint</b>, <b>debug mpls l2transport checkpoint</b>, <b>show acircuit checkpoint</b>, <b>show mpls l2transport checkpoint</b>, <b>show mpls l2transport vc</b>.</p>

Feature Name	Releases	Feature Information
AToM over MPLS	12.2(50)SY	<p>The HA capabilities such as SSO and Non-Stop Forwarding to MPLS over AToM were added to the feature.</p> <p>The following commands were introduced or modified: <b>debug vfi checkpoint</b>, <b>show vfi checkpoint</b>.</p>