

NSF SSO--Any Transport over MPLS and AToM Graceful Restart

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

In Cisco IOS XE software, AToM NSF supports the following attachment circuits:

- ATM
- Ethernet to Ethernet VLAN interworking

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Prerequisites for AToM NSF

Before you can configure AToM NSF, make sure the following tasks have been completed:

- AToM virtual circuits (VCs) have been configured on the router. See the Any Transport over MPLS for information on configuring AToM. For configuring L2VPN Interworking, see the L2VPN Interworking feature module.
- SSO has been configured on the RPs. See the Stateful Switchover feature module for configuration information.
- Nonstop forwarding has been configured on the routers. You must enable nonstop forwarding on the routing protocols running between the P routers, PE routers, and CE routers. The routing protocols are the following:
  - Open Shortest Path First (OSPF),
  - Intermediate System-to-Intermediate System (IS-IS), and
  - Border Gateway Protocol (BGP).

See the Cisco Nonstop Forwarding feature module for configuration information.

- AToM NSF requires that neighbor networking devices be able to perform AToM GR.

Restrictions for AToM NSF

- AToM NSF cannot be configured on label-controlled ATM (LC-ATM) interfaces.
- AToM NSF supports AToM Layer 2 Virtual Private Network (L2VPN) Interworking. However, Layer 2 Tunnel Protocol Version 3 (L2TPv3) Interworking is not supported.
- AToM NSF interoperates with Layer 2 local switching. However, AToM NSF has no effect on interfaces configured for local switching.
- To allow distributed Cisco Express Forwarding to work on the interfaces, disable fair queueing on serial interfaces.

Information About AToM NSF

How AToM NSF Works

AToM NSF improves the availability of a service provider's network that uses AToM to provide Layer 2 VPN services to its customers. 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.

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, issue 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 for AToM NSF

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 **show acircuit checkpoint** command to display the 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.

NSF SSO Support for Ethernet to Ethernet VLAN Interworking

The NSF/SS0--Ethernet to Ethernet VLAN Interworking features enables SSO and NSF capabilities for Ethernet to VLAN attachment circuits. Changes in the learned MAC address for interworking are reflected on the standby RP so that identical values exist on the active and standby RPs.

ISSU Support for AToM NSF

AToM NSF supports 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 XE 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.

How to Configure AToM NSF

There is no AToM-specific configuration for AToM NSF. Before you configure AToM NSF, you need to configure MPLS LDP Graceful Restart. You enable MPLS LDP Graceful Restart to assist a neighboring router configured with AToM NSF to maintain its forwarding state while the LDP session is disrupted. See the LDP Graceful Restart document for information about how MPLS LDP Graceful Restart works and how you can customize it for your network.

MPLS LDP Graceful Restart is enabled globally. When you enable MPLS LDP Graceful Restart, it has no effect on existing LDP sessions. MPLS LDP Graceful Restart is enabled for new sessions that are established after the feature has been globally enabled.

This section contains the following task:

Configuring MPLS LDP Graceful Restart

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

Procedure

	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 global configuration mode.
Step 3	**ip cef distributed** **Example:** `Router(config)# ip cef distributed`	Enables distributed Cisco Express Forwarding. **Note** In Cisco ASR 1000 Series Aggregation Services Routers, the **distributed** keyword is mandatory.
Step 4	**mpls ldp graceful-restart** **Example:** `Router (config)# mpls ldp graceful-restart`	Enables the router to protect the LDP bindings and MPLS forwarding state during a disruption in service.
Step 5	**interface** *type slot / subslot / port* [**.** *subinterface-number*] **Example:** `Router(config)# interface pos 0/3/0`	Specifies an interface and enters interface configuration mode.

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

```
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 POS0/1/0
 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 10.19.1.1 0.0.0.0 area 0
```

PE2

```
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 FastEthernet0/3/0
 ip route-cache cef
!
interface FastEthernet0/3/0.3
 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
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Stateful switchover	Stateful Switchover
MPLS Label Distribution Protocol	MPLS Label Distribution Protocol (LDP)
Cisco nonstop forwarding	Cisco Nonstop Forwarding
Any Transport over MPLS	Any Transport over MPLS
L2VPN Interworking configuration	L2VPN Interworking
MPLS AToM and LDP commands	*Cisco IOS Multiprotocol Label Switching Command Reference*
High availability commands	*Cisco IOS High Availability Command Reference*

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: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
RFC 3036	*LDP Specification*
RFC 3478	*Graceful Restart Mechanism for Label Distribution*

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 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.

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 AToM NSF Any Transport over MPLS and AToM Graceful Restart

Feature Name	Releases	Feature Information
NSF/SSO--AToM ATM Attachment Circuit	Cisco IOS XE Release 2.3	This feature provides support for AToM NSF/SSO support for ATM over MPLS (ATMoMPLS), which allows ATMoMPLS to use Cisco nonstop forwarding (NSF), stateful switchover (SSO), and Graceful Restart (GR) to allow a Route Processor (RP) to recover from a disruption in control plane service without losing its Multiprotocol Label Switching (MPLS) forwarding state. In Cisco IOS XE Release 2.3, this feature was implemented on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: **debug acircuit checkpoint**, **debug mpls l2transport checkpoint**, **show acircuit checkpoint**, **show mpls l2transport checkpoint**, **show mpls l2transport vc**.
ISSU--AToM ATM Attachment Circuit	Cisco IOS XE Release 2.3	This feature supports 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 XE 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. In Cisco IOS XE Release 2.3, this feature was implemented on the Cisco ASR 1000 Series Aggregation Services Routers. No commands were introduced or modified for this feature.

Feature Name	Releases	Feature Information
NSF/SSO--Ethernet to Ethernet VLAN Interworking	Cisco IOS XE Release 2.4	The NSF/SS0--Ethernet to Ethernet VLAN Interworking features enables stateful switchover (SSO) and nonstop forwarding (NSF) capabilities for Ethernet to VLAN attachment circuits. Changes in the learned MAC address for interworking are reflected on the standby RP so that identical values exist on the Active and Standby RPs. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Aggregation Routers. No commands were introduced or modified for this feature.