



# Multirouter APS on the Cisco 10000 Series

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This feature provides multirouter automatic protection switching (multirouter APS) on the Cisco 10000 series routers. APS refers to the mechanism of using a protect interface in the SONET network as the backup for a working interface. When the working interface fails, the protect interface quickly assumes its traffic load. In a multirouter environment, this feature allows the protect SONET interface to reside in a different router from the working SONET interface. This feature supports High Availability.

## Feature History for the Multirouter APS on the Cisco 10000 Series Feature

Release	Modification
12.0(23)SX	This feature was introduced on the OC3ATM and OC12ATM line cards for the Cisco 10000 series.
12.0(26)S	This feature was integrated into Cisco IOS Release 12.0(26)S, and support was added for the CHOC12, CHSTM1, OC3POS, and OC12POS line cards for the Cisco 10000 series.

## Finding Support Information for Platforms and Cisco IOS Software Images

Use Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access Cisco Feature Navigator at <http://www.cisco.com/go/fn>. You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click **Cancel** at the login dialog box and follow the instructions that appear.

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## Prerequisites for Multirouter APS on the Cisco 10000 Series

Familiarity with the Cisco IOS APS and SONET interface commands is assumed.

## Restrictions for Multirouter APS on the Cisco 10000 Series

Multirouter APS is supported on the following line cards for the Cisco 10000 series:

- CHOC12
- CHSTM1
- OC3ATM
- OC3POS
- OC12ATM
- OC12POS

Multirouter APS is not supported on the OC48POS line card. Single router APS is supported on the OC48POS line card.

## Information About Multirouter APS on the Cisco 10000 Series

To configure multirouter APS, you should understand the following concept:

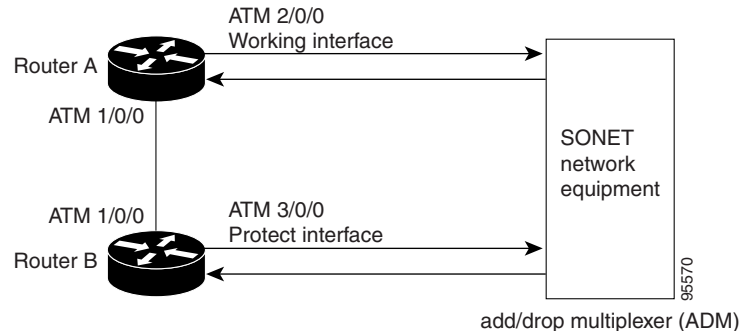
- [Multirouter APS, page 2](#)
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## Multirouter APS

Multirouter APS provides the ability to switch SONET connections between two different routers in the event of a circuit failure. The ability to switch from one SONET circuit to another SONET circuit in the event of circuit failure is often required when SONET equipment is connected to telco equipment. SONET interfaces can be switched in response to a router failure, degradation or loss of channel signal, or manual intervention.

The protection mechanism used for this feature has a linear 1+1 architecture as described in the Bellcore publication TR-TSY-000253, SONET Transport Systems; Common Generic Criteria, Section 5.3. The connection may be bidirectional or unidirectional and revertive or nonrevertive.

In the 1+1 architecture, a protect interface (circuit) is paired with each working interface. Normally, the protect and working interfaces are connected to a SONET ADM (add/drop multiplexer), which sends the same signal payload to the working and protect interfaces. [Figure 1](#) shows a multirouter APS configuration with Packet-over-SONET (POS) interfaces with the working and protect circuits terminating in different adapter cards in two different routers. Multirouter APS also supports ATM and channelized SONET interfaces. Interfaces in a multirouter APS configuration can be configured with either SONET or SDH framing.

**Figure 1 Multirouter APS Configuration**

On the protect circuit, the K1 and K2 bytes from the line overhead (LOH) of the SONET frame indicate the current status of the APS connection and convey any requests for action. This signalling channel is used by the two ends of the connection to maintain synchronization.

The working and protect circuits themselves, within the router or routers in which they terminate, are synchronized over an independent communication channel, not involving the working and protect circuits. This independent channel may be a different SONET connection or a lower-bandwidth connection. In a router configured for multirouter APS, the configuration for the protect interface includes the IP address of the router (normally its loopback address) that has the working interface.

## High Availability APS on the Cisco 10000 Series

To support high availability (HA), APS state information is maintained on the secondary performance routing engine (PRE). The primary PRE synchronizes incoming events that affect the APS state with the secondary PRE as the events occur. When a new secondary PRE starts, HA APS synchronizes the current APS state to the newly started secondary PRE to initialize the APS state.

HA APS supports Route Processor Redundancy Plus (RPR+) and Stateful Switchover (SSO) redundancy modes. These modes immediately synchronize and command-line interface (CLI) commands you enter on the primary router to the secondary router.

## How to Configure Multirouter APS on the Cisco 10000 Series

This section contains the following tasks:

- [Configuring Multirouter APS, page 4](#) (required)
- [Configuring Multirouter APS with Static Routes, page 6](#) (optional)

## Configuring Multirouter APS

Perform this task to configure the working and protect SONET interfaces on different routers to enable multirouter APS. For more details on configuring other APS options, refer to the [Automatic Protection Switching of Packet-over-SONET Circuits](#) feature in Cisco IOS Release 11.2 P.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **redundancy**
4. **associate slot *slot-one* mr-aps**
5. **exit**
6. **interface *type number***
7. **aps group *group-number***
8. **aps working *circuit-number***
9. **exit**
10. Repeat Step 1 to Step 7 on the second router for the protect interface, substituting appropriate parameters.
11. **aps protect *circuit-number ip-address***
12. **exit**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<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>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>redundancy</b>  <b>Example:</b> Router(config)# redundancy	Enters redundancy configuration mode. <ul style="list-style-type: none"> <li>• This command enters the configuration mode in which two line cards can be associated as a redundant pair.</li> </ul>

	Command or Action	Purpose
Step 4	<p><b>associate slot</b> <i>slot-one</i> <b>mr-aps</b></p> <p><b>Example:</b> Router(config-r)# associate slot 3 mr-aps</p>	<p>Logically associates slots for APS processor redundancy.</p> <ul style="list-style-type: none"> <li>In the example, slot 3 is configured on the working interface of one router in a multirouter APS configuration.</li> <li>A corresponding protect interface on a second router must be configured with the <b>associate slot</b> command to allow multirouter APS to operate.</li> <li>The syntax shown here is for multirouter APS. Using a modified form of the syntax, single router APS is supported.</li> </ul>
Step 5	<p><b>exit</b></p> <p><b>Example:</b> Router(config-r)# exit</p>	<p>Exits redundancy configuration mode and returns the router to global configuration mode.</p>
Step 6	<p><b>interface</b> <i>type number</i></p> <p><b>Example:</b> Router(config)# interface pos 2/0/0</p>	<p>Specifies the interface type and number and enters interface configuration mode.</p>
Step 7	<p><b>aps group</b> <i>group-number</i></p> <p><b>Example:</b> Router(config-if)# aps group 1</p>	<p>Permits more than one APS protect and working interface to be supported on a router.</p>
Step 8	<p><b>aps working</b> <i>circuit-number</i></p> <p><b>Example:</b> Router(config-if)# aps working 1</p>	<p>Configures a POS interface as a working interface.</p>
Step 9	<p><b>exit</b></p> <p><b>Example:</b> Router(config-if)# exit</p>	<p>Exits interface configuration mode and returns the router to global configuration mode.</p>
Step 10	<p>Repeat Step 1 to Step 7.</p>	<p>Repeat Step 1 to Step 7 on the second router to configure the protect interface. Substitute appropriate slot numbers, interface types, and interface numbers.</p> <ul style="list-style-type: none"> <li>After Step 7 is configured for the protect interface, proceed to Step 11.</li> </ul>
Step 11	<p><b>aps protect</b> <i>circuit-number ip-address</i></p> <p><b>Example:</b> Router(config-if)# aps protect 1 10.7.7.7</p>	<p>Configures a POS interface as a protect interface.</p> <ul style="list-style-type: none"> <li>Use the <i>ip-address</i> argument to specify the IP address of the router that has the working POS interface.</li> </ul>
Step 12	<p><b>exit</b></p> <p><b>Example:</b> Router(config-if)# exit</p>	<p>Exits interface configuration mode and returns the router to global configuration mode.</p>

## Troubleshooting Tips

- If the interfaces appear to be down, use the **ping** command to check connectivity.
- Check that the ADM is sourcing the SONET clocking.
- Use the **show aps** command to check the current APS configuration for each interface.
- Use the **debug aps** command to check specific interface APS activity.

## What to Do Next

Proceed to the “[Configuration Examples for Multirouter APS on the Cisco 10000 Series](#)” section on [page 9](#) to view multirouter APS configuration examples.

## Configuring Multirouter APS with Static Routes

Perform this task to configure the optional **ip route static update immediate** command for APS configurations on a Cisco 10000 series router with a limited number of static routes. To improve the router performance when only a few routes are configured, use static routes instead of dynamic routing protocols. The static route must be configured to ensure that traffic will still flow after a switch to the secondary processor. We recommend specifying the optional static route IP address of the interface to improve the routing performance.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **redundancy**
4. **associate slot** *slot-one* **mr-aps**
5. **exit**
6. **ip route** *prefix mask* {*ip-address* | *interface-type interface-number* [*ip-address*]} [*distance*] [*name*] [**permanent**] [**tag** *tag*]
7. **interface** *type number*
8. **ip route static update immediate**
9. **carrier-delay** [ *seconds* | **msec** *milliseconds*]
10. **aps group** *group-number*
11. **aps working** *circuit-number*
12. **exit**
13. Repeat Step 1 to Step 10 on the second router for the protect interface, substituting appropriate parameters.
14. **aps protect** *circuit-number ip-address*
15. **exit**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<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>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>redundancy</b>  <b>Example:</b> Router(config)# redundancy	Enters redundancy configuration mode. <ul style="list-style-type: none"> <li>This command enters the configuration mode in which two line cards can be associated as a redundant pair.</li> </ul>
Step 4	<b>associate slot slot-one mr-aps</b>  <b>Example:</b> Router(config-r)# associate slot 3 mr-aps	Logically associates slots for APS processor redundancy. <ul style="list-style-type: none"> <li>In the example, slot 3 is configured on the working interface of one router in a multirouter APS configuration.</li> <li>A corresponding protect interface on a second router must be configured with the <b>associate slot</b> command to allow multirouter APS to operate.</li> <li>The syntax shown here is for multirouter APS. Using a modified form of the syntax, single router APS is supported.</li> </ul>
Step 5	<b>exit</b>  <b>Example:</b> Router(config-r)# exit	Exits redundancy configuration mode and returns the router to global configuration mode.
Step 6	<b>ip route prefix mask {ip-address   interface-type interface-number [ip-address]} [distance] [name] [permanent] [tag tag]</b>  <b>Example:</b> Router(config)# ip route 172.17.1.0 255.255.255.0 pos 2/0/0 10	Configures a static IP address. <ul style="list-style-type: none"> <li>When configuring APS we recommend specifying the optional IP address of the interface to improve routing performance.</li> </ul>
Step 7	<b>interface type number</b>  <b>Example:</b> Router(config)# interface pos 2/0/0	Specifies the interface type and number and enters interface configuration mode.
Step 8	<b>ip route static update immediate</b>  <b>Example:</b> Router(config-if)# ip route static update immediate	(Optional) Specifies that static routes will be added to the routing table immediately after the interface becomes active.

	Command or Action	Purpose
Step 9	<p><b>carrier-delay</b> [<i>seconds</i>   <b>msec</b> <i>seconds</i>]</p> <p><b>Example:</b> Router(config-if)# carrier-delay msec 8</p>	<p>Sets the carrier delay timer value in seconds or milliseconds.</p> <ul style="list-style-type: none"> <li>This command allows link outages to be filtered and not reported as a link down event if they occur before the carrier delay timer expires. In multirouter APS system performance can be enhanced if link down event messages are kept to a minimum.</li> </ul>
Step 10	<p><b>aps group</b> <i>group-number</i></p> <p><b>Example:</b> Router(config-if)# aps group 1</p>	Permits more than one APS protect and working interface to be supported on a router.
Step 11	<p><b>aps working</b> <i>circuit-number</i></p> <p><b>Example:</b> Router(config-if)# aps working 1</p>	Configures a POS interface as a working interface.
Step 12	<p><b>exit</b></p> <p><b>Example:</b> Router(config-if)# exit</p>	Exits interface configuration mode and returns the router to global configuration mode.
Step 13	Repeat Step 1 to Step 10.	<p>Repeat Step 1 to Step 10 on the second router to configure the protect interface. Substitute appropriate slot numbers, IP addresses, interface types, and interface numbers.</p> <ul style="list-style-type: none"> <li>After Step 10 is configured for the protect interface, proceed to Step 14.</li> </ul>
Step 14	<p><b>aps protect</b> <i>circuit-number ip-address</i></p> <p><b>Example:</b> Router(config-if)# aps protect 1 10.7.7.7</p>	<p>Configures a POS interface as a protect interface.</p> <ul style="list-style-type: none"> <li>Use the <i>ip-address</i> argument to specify the IP address of the router that has the working POS interface.</li> </ul>
Step 15	<p><b>exit</b></p> <p><b>Example:</b> Router(config-if)# exit</p>	Exits interface configuration mode and returns the router to global configuration mode.

## Troubleshooting Tips

Check the static route configurations and refer to the “[Troubleshooting Tips](#)” section for the previous task.



# Configuration Examples for Multirouter APS on the Cisco 10000 Series

This section contains the following configuration examples:

- [Multirouter APS: Example, page 9](#)
- [Two Multirouter APS Groups: Example, page 9](#)
- [Multirouter APS with Static Routes: Example, page 10](#)

## Multirouter APS: Example

Using the configuration shown in [Figure 1 on page 3](#), the following example shows the configuration of multirouter APS. Router A is configured with the working interface, and Router B is configured with the protect interface. If the working interface on Router A becomes unavailable, the connection will automatically switch over to the protect interface on Router B.

On Router A, which contains the working interface, use the following configuration:

```
configure terminal
interface pos 1/0/0
 ip address 10.7.7.7 255.255.255.0
!
redundancy
 associate slot 3 mr-aps
!
interface pos 2/0/0
 aps group 1
 aps working 1
```

On Router B, which contains the protect interface, use the following configuration:

```
configure terminal
interface pos 1/0/0
 ip address 10.7.7.6 255.255.255.0
!
redundancy
 associate slot 2 mr-aps
!
interface pos 3/0/0
 aps group 1
 aps protect 1 10.7.7.7
```

## Two Multirouter APS Groups: Example

The following example shows the configuration of two multirouter APS groups.

On Router A, which contains both a working interface and a protect interface, use the following configuration:

```
configure terminal
interface pos 1/0/0
 ip address 10.7.7.7 255.255.255.0
!
redundancy
 associate slot 2 mr-aps
 associate slot 3 mr-aps
```

```

!
interface pos 2/0/0
  aps group 1
  aps working 1
!
interface atm 3/0/0
  aps group 2
  aps protect 1 10.7.7.6

```

On Router B, which contains the protect interface and a working interface, use the following configuration:

```

configure terminal
interface pos 1/0/0
  ip address 10.7.7.6 255.255.255.0
!
redundancy
  associate slot 3 mr-aps
  associate slot 2 mr-aps
!
interface pos 3/0/0
  aps group 1
  aps protect 1 10.7.7.7
!
interface atm 2/0/0
  aps group 2
  aps working 1

```

## Multirouter APS with Static Routes: Example

Using the configuration shown in [Figure 1 on page 3](#), the following example shows the configuration of multirouter APS with static routes. Router A is configured with the working interface, and Router B is configured with the protect interface. If the working interface on Router A becomes unavailable, the connection will automatically switch over to the protect interface on Router B. Note that 172.17.1.0 is the address of the traffic destination network and that the route over the Peer Group Protocol (PGP) link has a higher distance metric number than the multirouter APS working interface.

On Router A, which contains the working interface, use the following configuration:

```

configure terminal
interface pos 1/0/0
  ip address 10.7.7.7 255.255.255.0
  ip route static update immediate
  carrier-delay msec 8
!
redundancy
  associate slot 2 mr-aps
!
interface pos 2/0/0
  aps group 1
  aps working 1
  ip route static update immediate
  carrier-delay msec 8
!
ip route 172.17.1.0 255.255.255.0 pos 2/0/0 10
ip route 172.17.1.0 255.255.255.0 pos 1/0/0 10.7.7.6 20

```

On Router B, which contains the protect interface, use the following configuration:

```

configure terminal
interface pos 1/0/0
  ip address 10.7.7.6 255.255.255.0

```

```

ip route static update immediate
carrier-delay msec 8
!
redundancy
associate slot 3 mr-aps
!
interface pos 3/0/0
aps group 1
aps protect 1 10.7.7.7
ip route static update immediate
carrier-delay msec 8
!
ip route 172.17.1.0 255.255.255.0 pos 3/0/0 10
ip route 172.17.1.0 255.255.255.0 pos 1/0/0 10.7.7.7 20

```

## Where to Go Next

For details on configuring more APS commands, refer to the *Automatic Protection Switching of Packet-over-SONET Circuits* feature document in Cisco IOS Release 11.2 P.

## Additional References

The following sections provide references related to multirouter APS.

## Related Documents

Related Topic	Document Title
APS and SONET commands: complete command syntax, command mode, defaults, usage guidelines, and examples	<i>Cisco IOS Interface Command Reference</i> , Release 12.0
APS and SONET configuration	<i>Cisco IOS Interface Configuration Guide</i> , Release 12.0
APS on the Cisco 7500 and Cisco 12000 series routers	<i>Automatic Protection Switching of Packet-over-SONET Circuits</i> feature document, Release 11.2 P

## Standards

Standards	Title
Bellcore SONET linear 1+1 architecture	TR-TSY-000253, SONET Transport Systems; Common Generic Criteria, Section 5.3.

## MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS 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
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—

## Technical Assistance

Description	Link
Technical Assistance Center (TAC) home page, containing 30,000 pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	<a href="http://www.cisco.com/public/support/tac/home.shtml">http://www.cisco.com/public/support/tac/home.shtml</a>

## Command Reference

This section documents new and modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.0 command reference publications.

- [associate slot](#)
- [ip route static update immediate](#)

# associate slot

To logically associate slots for automatic protection switching (APS) processor redundancy, use the **associate slot** command in redundancy configuration mode. To disable slot associations, use the **no** form of this command.

## Single Router APS

**associate slot** *slot-one slot-two*

**no associate slot** *slot-one slot-two*

## Multirouter APS

**associate slot** *slot-one mr-aps*

**no associate slot** *slot-one mr-aps*

Syntax Description		
	<i>slot-one</i>	First slot number to be associated for redundancy. Valid range is from 0 to 8.
	<i>slot-two</i>	Second slot number to be associated for redundancy. Valid range is from 0 to 8.
	<b>mr-aps</b>	Specifies that the slot association is between slots in different routers as part of a multirouter APS configuration.

**Defaults** No slots are associated.

**Command Modes** Redundancy configuration

Command History	Release	Modification
	12.1(5a)EY	This command was introduced.
	12.0(23)SX	The <b>mr-aps</b> keyword was added to support multirouter APS on the OC3ATM and OC12ATM line cards for the Cisco 10000 series.
	12.0(26)S	This command was integrated into Cisco IOS Release 12.0(26)S, and support was added for the CHOC12, CHSTM1, OC32POS, and OC12POS line cards for the Cisco 10000 series.

**Usage Guidelines** Use the **associate slot** command for single router APS or multirouter APS configurations on a Cisco 10000 series router. This command is specific to the Cisco 10000 series. The associated slots must use the same type of interface module and must be adjacent slots, for example slots 5 and 6.

Use the **mr-aps** keyword in a multirouter APS configuration to allow a protect interface on a second router to be a backup for a working interface on the first router.

**Examples**

The following example shows how to associate two slots in the same router in a single router APS configuration:

```
Router1(config)# redundancy
Router1(config-r)# associate slot 3 4
```

The following example shows how to associate two separate slots in different routers in a multirouter APS configuration:

```
Router1(config)# redundancy
Router1(config-r)# associate slot 3 mr-aps
!
Router2(config)# redundancy
Router2(config-r)# associate slot 2 mr-aps
```

**Related Commands**

<b>Command</b>	<b>Description</b>
<b>redundancy</b>	Enters redundancy configuration mode.

# ip route static update immediate

To add static routes to the routing table immediately after an interface becomes active, use the **ip route static update immediate** command in interface configuration mode. To restore the default condition of waiting for a route dampening delay interval before adding the static route, use the **no** form of this command.

**ip route static update immediate**

**no ip route static update immediate**

## Syntax Description

This command has no arguments or keywords.

## Defaults

Static routes are added after a route dampening delay interval.

## Command Modes

Interface configuration

## Command History

Release	Modification
12.0(26)S	This command was introduced on the Cisco 10000 series.

## Usage Guidelines

Use the **ip route static update immediate** command in a multirouter automatic protection switching (APS) configuration if there are a limited number of static routes. The command can be used on Gigabit Ethernet, ATM, channelized, and Packet-over-SONET (POS) interfaces that have static routes configured. This command is specific to the Cisco 10000 series.

## Examples

The following example shows how to configure static routes to be added to the routing table immediately after an interface becomes active:

```
Router(config)# interface pos 1/0/0
Router(config-if)# ip route static update immediate
Router(config-if)# exit
Router(config)# ip route 172.17.1.0 255.255.255.0 pos 2/0/0 10
Router(config)# ip route 172.17.1.0 255.255.255.0 pos 1/0/0 10.7.7.6 20
```

## Related Commands

Command	Description
<b>ip route</b>	Establishes a static route.

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