



Route Processor Redundancy Plus for the Cisco 12000 Series Internet Router

Feature History

Release	Modification
12.0(17)ST	This feature was introduced on the Cisco 12000 series Internet Router.
12.0(18)ST	Support added for Engine 4 line cards.
12.0(22)S	Support added for the Performance Route Processor (PRP).

This publication describes the Route Processor Redundancy Plus (RPR+) feature. It includes information on the benefits of the feature, supported platforms, prerequisites, configuration examples, and command reference.

This publication includes the following sections:

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Feature Overview

When two route processors (RPs) are installed in a Cisco 12000 series Internet Router chassis, one RP acts as the active RP, and the other acts as a backup, or standby, RP. If the active RP fails, or is removed from the system, the standby RP detects the failure and initiates a switchover. During a switchover, the standby RP assumes control of the router, connects with the network interfaces, and activates the local network management interface and system console.

Using the RPR+ feature, the standby RP is fully initialized and configured. This allows RPR+ to dramatically shorten the switchover time if the active RP fails, or if a manual switchover is performed. Because both the startup config and running config are continually synchronized from the active to the standby RP, line cards are not reset during a switchover. The interfaces remain up during this transfer, so neighboring routers do not detect a link flap (that is, the link does not go down and back up).

**Note**

RPR+ features are not supported when using a Gigabit Route Processor (GRP) and a Performance Route Processor (PRP). You must use the same cards in the chassis in order to use RPR+ features.

This section describes the switchover process with RPR+, including synchronization between the active and standby RPs and includes the following topics:

- [Synchronization](#)
- [Terminology Changes with Cisco IOS Release 12.0\(17\)ST](#)
- [Benefits](#)

Synchronization

To achieve the benefits of RPR+, the chassis and slot configuration information is synchronized from the active RP to the standby RP at startup and whenever changes to the active RP configuration occur. This synchronization occurs in two separate phases:

- When a standby RP first comes online, the configuration information is synced in bulk from the active RP to the standby RP.
- When configuration changes occur, an incremental sync from the active RP to the standby RP is conducted. Incremental syncs contain either the modifications to the shelf configuration or the trigger that caused the modification.

Synchronization During Initialization

When a system with RPR+ is initialized, the active RP performs a chassis discovery (discovery of the number and type of line cards and fabric cards in the system) and parses the startup configuration file.

The active RP then synchronizes this data to the standby RP and instructs the standby RP to complete its initialization. This method ensures that both RPs contain the same configuration information.

**Note**

Even though the standby RP is fully initialized, it interacts only with the active RP to receive incremental changes to the configuration files as they occur. CLI commands on the standby RP are not supported.

Synchronization of Startup Config

The startup config is a text file stored in the RP's NVRAM. During system startup, the startup config file is copied from the active RP to the standby RP. Any existing startup config file on the standby RP is overwritten.

The startup config file is also synced whenever you perform the following operations:

- CLI command: **copy system:running-config nvram:startup-config**
- CLI command: **copy running-config startup-config**

- CLI command: **write memory**
- CLI command: **copy filename nvram:startup-config**
- SNMP SET of MIB variable ccCopyEntry in CISCO_CONFIG_COPY MIB
- System Configuration Saved on **reload** command.
- System Configuration Saved on **redundancy force-failover** command.

**Note**

Synchronization of the startup config file is enabled by default in RPR+ mode. Because this is necessary for RPR+ functionality, the command **[no] auto-sync startup-config** is not available in RPR+ mode. This command is only available in standard RPR mode. For additional information on the use of **[no] auto-sync startup-config** with standard RPR, see the Cisco publication *GRP Redundant Processor Support*.

Incremental Synchronization of the Running Configuration

When both RPs are fully initialized, any further changes to the running config are synced to the standby RP as they occur.

CLI commands

CLI changes to the running config are synced from the active RP to the standby RP. In effect, the CLI command is run on both the active and the standby RP.

SNMP SET Commands

Configuration changes caused by an SNMP SET are also synced on a case-by-case basis. Currently only two SNMP configuration SETs are supported on the Cisco 12000 series Internet Router:

- **shut/no-shut** (of an interface)
- **link up/down trap enable/disable**

Changes to Chassis State

- Any changes to the chassis state because of line card insertion or removal are synced over to the standby RP.
- Changes to the chassis state because of switch card insertion or removal, or from configuration changes to the alarm or power supply cards, are *not* synced to the standby RP. The standby learns these configuration changes using a discovery and reconciliation process during a switchover.
- Information regarding line card states is not synced. Line cards that are not on line at the time of a switchover (that is, any cards not running the Cisco IOS and not communicating with the active RP) are reset and reloaded during a switchover. This process does not add downtime.

Terminology Changes with Cisco IOS Release 12.0(17)ST

In Cisco IOS release 12.0(17)ST and later, the terms for “Primary RP”, “Secondary RP”, and “failover” have been replaced by “Active RP”, “Standby RP”, and “switchover”, respectively.

Old Term	New Term
Primary RP	Active RP
Secondary RP	Standby RP
failover	switchover

RP Alphanumeric LED Message Changes

The following RP LED Messages are changed with Cisco IOS Release 12.0(17)ST.

Old LED Message	New Led Message	Description
PRI RP	ACTV RP	This RP is the active RP
SEC RP	STBY RP	This RP is the standby RP

CLI Changes

As a part of the terminology change, the following CLI commands have been changed with Cisco IOS release 12.0(17)ST. The functionality of these new commands is identical to the old commands:

Old CLI	New CLI
Router# show redundancy secondary	Router# show redundancy standby
Router# hw-module secondary reload	Router# hw-module standby reload
Router# redundancy force-failover	Router# redundancy force-switchover
Router(config-r-mc)# secondary aux	Router(config-r-mc)# standby aux
Router(config-r-mc)# failover timeout value	Router(config-r-mc)# switchover timeout value



Note

See the “[Command Reference](#)” section on page 11 for additional information on the CLI changes related to this change in RP terminology.

Benefits

RPR+ is part of an ongoing effort to improve high availability in Cisco 12000 series Internet Routers.

Standard RPR

In standard RPR, the system implemented Extended High System Availability (EHSA) redundancy, wherein the standby RP suspended its initialization midway through the startup process. To complete the initialization during a switchover, all line cards were reset and the switch fabric was reinitialized. Since initialization of the standby RP was suspended before configuration was parsed, chassis discovery and startup config parsing were conducted during the switchover.

Improved Switchover Time with RPR+

RPR+ provides a faster switchover by fully initializing and fully configuring the standby RP. The configuration data on the standby RP is fully synchronized with the active RP.

Neighboring Routers Do Not See a Link Flap

Because the interfaces remain up across a switchover, neighboring routers do not see a link flap (the link does not go down and back up).

Restrictions

Supported Line Cards

See the [Release Notes for Cisco IOS Release 12.0 S](#) for the list of supported line cards.



Note All other line cards are reset during a switchover.

General Restrictions

- With RPR+, both RPs must run the same Cisco IOS image. If the RPs are operating different Cisco IOS images, the system reverts to standard RPR mode even if RPR+ is configured.
- Any line cards that are not on line at the time of a switchover (line cards not in Cisco IOS running state) will be reset and reloaded on a switchover.
- The Forwarding InformationBase (FIB) tables are cleared on a switchover: transit traffic (routed traffic) will be interrupted until the route tables reconverge.
- RPR+ features are not supported when using a GRP and a PRP. You must use the same cards in the chassis in order to use these features.



Note Although FIB entries (including those generated by static IP routes) are cleared on a switchover, FIB entries corresponding to static routes are repopulated immediately after a switchover.



Note Static IP routes are maintained across a switchover, because they are configuration driven.

Dynamic States

Dynamic states information is maintained on the active RP. However, it is not synchronized to the standby RP, so dynamic states information is lost on a switchover. Some examples of this include:

- Frame Relay Switched Virtual Circuits (SVCs) are cleared on a switchover.



Note Frame Relay-switched DLCI information is maintained across a switchover (since Frame Relay switching is fully configuration driven).

- All terminated PPP sessions come down on a switchover (since PPP NCP/LCP state information is not synced from the active to the standby RP).
- All terminated TCP and other connection-oriented L3/L4 sessions come down on a switchover. Border Gateway Protocol (BGP) sessions also come down on a switchover since BGP uses TCP sockets for peer-to-peer communication.

- All automatic protection switching (APS) state information is lost on a switchover.

Config Mode Restrictions

- During the startup (bulk) synchronization, configuration changes are not allowed. The following message is generated:

```
Config mode locked out till standby initializes
```

- Simultaneous changes to the config from multiple CLI sessions are not allowed with RPR+. Only one config session is allowed to enter in config mode at a time; other sessions will not be able to enter in config mode. The following message is generated when an additional user attempts to enter config mode:

```
Simultaneous configs not allowed:locked from console *(or vty#)
```

- In the standard RPR, multiple config sessions are allowed. When redundancy mode is changed to RPR+, all the existing config sessions other than the session that changed the mode are forced out of config mode. The following message is displayed whenever a new command is entered on these sessions:

```
Simultaneous configs not allowed, forcing out of config mode:locked from console *(or vty#).
```

Switchover Process

- If any changes to the fabric configuration happen simultaneously with an RP switchover, the chassis is reset and all line cards are redownloaded. For example, if a Clock Scheduler Card or Switch Fabric Card (CSC/SFC) is removed or inserted in the chassis during switchover, the chassis is reset and all line cards redownloaded.
- If a switchover occurs before the standby RP is fully initialized, the switchover occurs in standard RPR mode (all line cards are reset).
- If a switchover occurs during any ongoing sync (running config sync or chassis slot state sync), the switchover occurs in standard RPR mode (all linecards are reset).

Related Documents

- *Cisco IOS Release 12.2 Configuration Fundamentals Configuration Guide*
- *Cisco IOS Release 12.2 Configuration Fundamentals Command Reference*
- *GRP Redundant Processor Support*, Release 11.2 (for information on standard RPR)

Supported Platforms

- Cisco 12000 series Internet Router when using two of the same RP cards.

See the [Release Notes for Cisco IOS Release 12.0 S](#) for the list of supported line cards.

**Note**

RPR+ features are not supported when using a GRP and a PRP. You must use the same cards in the chassis in order to use these features.

Supported Standards, MIBs, and RFCs

Standards

No new or modified standards are supported by this feature.

MIBs

No new or modified MIBs are supported by this feature.

To obtain lists of supported MIBs by platform and Cisco IOS release, and to download MIB modules, go to the Cisco MIB website on Cisco Connection Online (CCO) at <http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml>.

RFCs

No new or modified RFCs are supported by this feature.

Prerequisites

RPR+ is supported with the following hardware and software configuration:

- Two (redundant) RPs must be installed in the chassis
- The RPs must be of the same type (that is, two GRPs or two PRPs)
- Cisco IOS software version 12.0(17)ST or higher
- Cisco IOS Release 12.0(18)ST or higher with Engine 4 POS line cards (see the [“Supported Line Cards” section on page 5](#))
- Cisco IOS Release 12.0(22)S or higher with a PRP
- Both RPs must be running the same version of the Cisco IOS software

Configuration Tasks

See the following sections to configure RPR+ in the Cisco 12000 series Internet Router:

- [Configuring RPR+](#)
- [Verifying RPR+ Configuration](#)
- [Fast Software Upgrade](#)

Configuring RPR+

The default redundancy mode in the Cisco 12000 series Internet Router is standard RPR. To enable RPR+, both RPs must be running the same version of Cisco IOS software.


Note

See the [“Fast Software Upgrade” section on page 9](#) to upgrade or downgrade the router with a different image (without reinitializing the entire system).


Note

See the [“Benefits” section on page 4](#) for a description of the differences between standard RPR and RPR+.

	Command	Purpose
Step 1	Router> enable	Enters privileged EXEC mode.
Step 2	Router# config terminal	Enters configuration mode.
Step 3	Router(config)# redundancy	Enters redundancy configuration mode.
Step 4	Router(config)# mode rpr-plus	Configures the router with RPR+ functionality. When this command is entered, the standby RP will be reloaded and work in RPR+ mode.

Verifying RPR+ Configuration

To verify RPR+ configuration, follow these steps:

- Step 1** Enter the command **show running-config** to verify that RPR+ is enabled:

```
Router#show running-config
```

```
!
redundancy
mode rpr-plus
!
....
```

- Step 2** Enter the **show redundancy** command to display the operating redundancy mode:

```
Router#show redundancy
```

```
Active GRP in slot 7:
Preferred GRP: 7
Operating Redundancy Mode: RPR Plus
Auto synch: startup-config running-config
switchover timer 8 seconds
```

Fast Software Upgrade

The Fast Software Upgrade (FSU) procedure allows you to upgrade the Cisco IOS image on the RPs and line cards without reinitializing the system. To perform an FSU, the Cisco IOS software is upgraded on the standby RP, and a manual switchover is performed. The new IOS image can then be upgraded on the second RP.

	Command	Purpose
Step 1	Refer to the Cisco IOS Configuration Guide.	Copies the new Cisco IOS image to the bootflash/flash on both RPs.
Step 2	The commands in this step are an example of those used to boot from a new image. Refer to the Cisco IOS Configuration Guide for more details: Router# config terminal Router(config)# config-register 0x2 Router(config)# boot system flash slot0:gsr-p-mz.120-17.ST	Configures the RPs to boot the new image to be reloaded.
Step 3	Router# write memory	Saves the configuration.
Step 4	Router# hw-module standby reload	Resets the standby RP and brings it back online (running the new version of the Cisco IOS software).

Command	Purpose
Step 5 Router# redundancy force-switchover	<p>Conducts a manual switchover to the standby RP. The standby RP becomes the new active RP running the new IOS image. The line cards are reset and the line card software is downloaded from the new active RP.</p> <p>The old active RP reboots with the new image and becomes the standby RP.</p>
Note	If upgrading from a standard RPR system to RPR+, see the “Configuring RPR+” section on page 8 to complete the upgrade.
Note	If upgrading from a Cisco IOS image previously configured with RPR+ to a newer image with RPR+, the procedure is now complete. When the new active RP comes up, it will automatically configure RPR+ from the configuration information in the startup config (synced from old active RP).

Troubleshooting Tips

If RPR+ is not enabled after **mode rpr-plus** is run, verify that both the active and standby RPs are running the same Cisco IOS software release, 12.0(17)ST or higher. If the active RP detects a different version of the image on the standby RP, the system automatically reverts to standard RPR behavior.

Configuration Examples

This section provides an example of RPR+ configuration:

```

router# config terminal
Enter configuration commands, one per line. End with CNTL/Z.
router(config)#redundancy
router(config-r)#mode rpr-plus
router(config-r)#exit
router(config)#exit
router#
02:05:36: %SYS-5-CONFIG_I: Configured from console by vty0
router#show running-config
Building configuration...

.....
!
boot system flash slot0:gsr-p-mz.120-17.ST
!
....
!
redundancy
 mode rpr-plus

!
....
end

router#show redundancy
Active GRP in slot 15:
Standby GRP in slot 7:
Preferred GRP: 15
Operating Redundancy Mode: RPR Plus
Auto synch: startup-config running-config
switchover timer 8 seconds [default]

```

Command Reference

This section documents new and modified commands. All other commands used with this feature are documented in the Cisco IOS Release 12.2 command reference publications.

- [mode {rprlrpr-plus}](#)
- [show redundancy](#)

mode {rpr|rpr-plus}

This command allows you to chose between RPR or RPR+ mode.

To enable RPR+, use the **mode rpr-plus** config redundancy sub mode command. To disable RPR+ and enable standard RPR, use the **mode rpr** command.

```
mode {rpr|rpr-plus}
```

Syntax Description

<i>rpr-plus</i>	Enables RPR+, a redundancy method wherein the standby RP is fully initialized and synchronized with the running configuration.
<i>rpr</i>	Enables standard RPR, a redundancy method wherein the standby RP suspends its initialization midway through the startup process. RPR is also known as Enhanced High System Availability (EHSA).

Defaults

The default value is *rpr*.

Command Modes

Config redundancy submode.

Command History

Release	Modification
12.0(17)ST	This command was introduced.
12.0(22)S	This command was integrated into Cisco IOS Release 12.0(22)S.

Usage Guidelines

This command configures the redundancy mode as either RPR or RPR+. When a new configuration mode is configured, the standby RP is reloaded. Configuring the same mode again does not have any effect.

Examples

The following example configures the redundancy mode for RPR+:

```
mode rpr-plus
```

show redundancy

To display the redundancy status (either RPR or RPR+), use the **show redundancy** EXEC command. This command was modified to include information on RPR+.

show redundancy

Syntax Description	redundancy	Displays the redundancy status
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Defaults No default behavior or values.

Command Modes EXEC

Command History	Release	Modification
	11.2 GS	This command was introduced.
	12.0(17)ST	This command was modified to display information on RPR+.
	12.0(22)S	This command was integrated into Cisco IOS Release 12.0(22)S.

Usage Guidelines This command is available on the active RP only.

Examples The following example shows how to list redundancy information for a Cisco 12000 series Internet Router.

```
Router# show redundancy
Active GRP in slot 7:
Preferred GRP: 7
Operating Redundancy Mode: RPR Plus
Auto synch: startup-config running-config
switchover timer 8 seconds
```

Glossary

active RP—The RP that controls the system, runs the routing protocols, and presents the system management interface.

APS—Automatic Protection Switching. SONET switching mechanism that routes traffic from working lines to protect them in case of a line card failure or fiber cut.

BGP—Border Gateway Protocol. Interdomain routing protocol. BGP exchanges reachability information with other BGP systems.

CEF—Cisco Express Forwarding

CLI—command-line interface

CSC/SFC—Clock Scheduler Card and Switch Fabric Card

Cutover—See switchover.

dCEF—Distributed CEF

DLCI—Data Link Connection Identifier. Value that specifies a PVC or SVC in a Frame Relay network.

EHSA—Enhanced High System Availability. Redundancy method wherein the standby RP suspends its initialization midway through the startup process. See also RPR.

FIB—Forwarding Information Base. The FIB is conceptually similar to a routing table or information base. It maintains a mirror image of the forwarding information contained in the IP routing table. When routing or topology changes occur in the network, the IP routing table is updated and those changes are reflected in the FIB. The FIB maintains next-hop address information based on the information in the IP routing table and is maintained by the router.

FSU—Fast Software Upgrade. A mechanism to upgrade the Cisco IOS software images on the RPs and line cards without reinitializing the entire system.

HA—High Availability

Hot swap—The feature was formerly known as OIR.

HSU—Hitless Software Upgrade. Provides continued service for planned upgrade situations.

LC—Line card

NSF—Non-Stop Forwarding. The ability of a router to continue to forward traffic toward a router that may be recovering from a transient failure. Also, the ability of a router recovering from a transient failure in the control plane to continue correctly forwarding traffic sent to it by a peer.

OIR—Online Insertion and Removal. Feature that permits the addition, replacement, or removal of cards without interrupting the system power, entering console commands, or causing other software or interfaces to shut down. Also called “hot swapping” or “power-on servicing”.

POS—Packet-over-SONET interface. Enables core routers to send native IP packets directly over SONET/SDH frames.

Primary RP—Term previously used for active RP

PVC—Permanent Virtual Circuit

RP—Route Processor

RPR—Route Processor Redundancy. In RPR, linecards are reset on switchover and line card software is reloaded.

RPR+—Route Processor Redundancy Plus. An enhancement to RPR/EHSA in which the standby RP is fully initialized. An RPR+ switchover does not involve line card reset nor line card software reload.

Secondary RP—Term previously used for standby RP

SNMP—Simple Network Management Protocol

standby RP—The RP that waits for the active or primary RP to fail.

SVC—Switched Virtual Circuit

Switchover—An event in which system control and routing protocol execution is transferred from a failed processor to a standby RP.

