JunosE™ Software for E Series™ Broadband Services Routers

Service Availability Configuration Guide

Release

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JunosE™ Software for E Series™ Broadband Services Routers Service Availability Configuration Guide
Release 11.2.x

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About the Documentation

E Series and JunosE Documentation and Release Notes

For a list of related JunosE documentation, see http://www.juniper.net/techpubs/software/index.html .

If the information in the latest release notes differs from the information in the documentation, follow the *JunosE Release Notes.*

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at http://www.juniper.net/techpubs/.

Audience

This guide is intended for experienced system and network specialists working with Juniper Networks E Series Broadband Services Routers in an Internet access environment.

E Series and JunosE Text and Syntax Conventions

Table 1 on page xviii defines notice icons used in this documentation.

Table 1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.

Table 2 on page xviii defines text and syntax conventions that we use throughout the E Series and JunosE documentation.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents commands and keywords in text.	• Issue the **clock source** command. • Specify the keyword **exp-msg**.
Bold text like this	Represents text that the user must type.	**host1(config)#traffic class low-loss1**

`Fixed-width text like this`	Represents information as displayed on your terminal's screen.	**host1#show ip ospf 2**
		`Routing Process OSPF 2 with Router ID 5.5.0.250`
		`Router is an Area Border Router (ABR)`

Italic text like this	• Emphasizes words. • Identifies variables. • Identifies chapter, appendix, and book names.	• There are two levels of access: *user* and *privileged*. • *clusterId, ipAddress.* • *Appendix A, System Specifications*
Plus sign (+) linking key names	Indicates that you must press two or more keys simultaneously.	Press Ctrl + b.
Syntax Conventions in the Command Reference Guide		
Plain text like this	Represents keywords.	terminal length
Italic text like this	Represents variables.	*mask*, *accessListName*

Table 2: Text and Syntax Conventions *(continued)*

Convention	Description	Examples
| (pipe symbol)	Represents a choice to select one keyword or variable to the left or to the right of this symbol. (The keyword or variable can be either optional or required.)	diagnostic | line
[ ] (brackets)	Represent optional keywords or variables.	[internal | external]
[ ]* (brackets and asterisk)	Represent optional keywords or variables that can be entered more than once.	[level1 | level2 | l1]*
{ } (braces)	Represent required keywords or variables.	{ permit | deny } { in | out } { *clusterId* | *ipAddress* }

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- Document or topic name
- URL or page number
- Software release version

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- Find product documentation: http://www.juniper.net/techpubs/
- Find solutions and answer questions using our Knowledge Base: http://kb.juniper.net/
- Download the latest versions of software and review release notes: http://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://www.juniper.net/alerts/
- Join and participate in the Juniper Networks Community Forum: http://www.juniper.net/company/communities/
- Open a case online in the CSC Case Management tool: http://www.juniper.net/cm/

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: https://tools.juniper.net/SerialNumberEntitlementSearch/

Opening a Case with JTAC

You can open a case with JTAC on the Web or by telephone.

- Use the Case Management tool in the CSC at http://www.juniper.net/cm/ .
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see http://www.juniper.net/support/requesting-support.html .

PART 1

Chapters

CHAPTER 1

Service Availability

This chapter explains what service availability is and discusses the features of service availability. It also discusses Juniper Networks multi-layered service availability approach for uninterrupted delivery of services.

Service Availability Overview

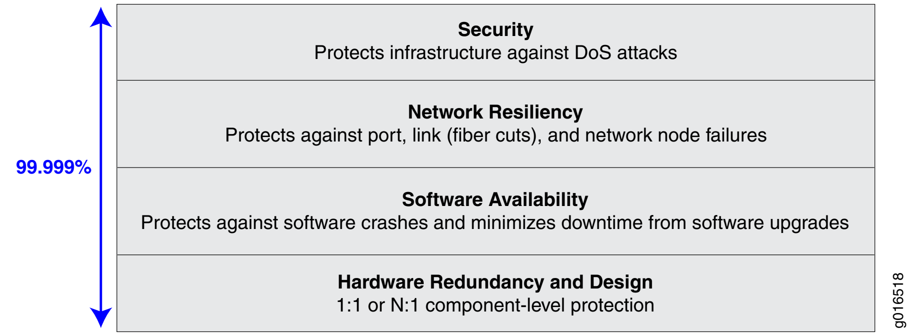
In a conventional network, router outages can occur because of denial of service (DoS) attacks, line module failure, switch route processor module failure, software defects, feature upgrades, or complete router failure. These outages result in subscriber downtime.

To reduce subscriber downtime, a network must have the following capabilities:

- *Reliability*—A network that does not crash often and recovers from failure very rapidly. During recovery, the network maintains user sessions and forwards data with little or no impact on the delivery of services.
- *Resiliency*—A network component or network that responds to failure, resists failure, and handles failure with little or no impact on the delivery of services.
- *Redundancy*—A network whose reliability is enhanced by the addition of a backup component.
- *High Availability*—A network that is both reliable and resilient.

JunosE Software uses a multi-layered service availability approach that enables you to provide uninterrupted delivery of services with the help of reliable, highly available, and redundant hardware and software components.

Figure 1 illustrates the multiple layers of JunosE Software service availability



The security layer protects the network from DoS attacks.

The network resiliency layer protects against port, link, and node failures. You can configure IEEE 802.3 ad link aggregation for Ethernet, and Virtual Router Redundancy Protocol (VRRP) to improve network resiliency.

The software availability layer protects against software failures by using hot-fixes or installing a higher-numbered software release. You can perform a unified in-service software upgrade (ISSU) instead of the conventional software upgrade to reduce outage. You can eliminate or reduce single points of failure by configuring stateful SRP switchover (high availability). Any network component with an uptime of 99.999 percent is considered *highly available* with a downtime of less than 5 minutes in a year.

The hardware redundancy and design layer introduces redundancy in the network in the form of multiple power supplies, cooling devices, line modules, and sometimes even a router. For instance, you can install a backup line module in your router to protect against line module failure. You can also configure a router as a backup router that accepts subscriber login requests when the master router fails.

Service Availability Versus High Availability

High availability is a measure of the uptime of a network or network component. A network component that has a downtime of 5 minutes is accessible or available 99 percent of the time. If a failure occurs, a backup component is available within 5 minutes. A highly available network is a network that has components that either have high reliability or have the ability to recover very quickly from a failure, or both.

Service availability refers to the ability to provide uninterrupted delivery of services. For example, from the time when a component fails to the time when the backup component is accessible, the delivery of services is interrupted. To provide uninterrupted delivery of services, highly available components must maintain session details and other data across failures. Service availability can thus be defined as the ability to provide uninterrupted delivery of services using a highly available network.

Related Topics

- Understanding Service Availability Features on page 5

Understanding Service Availability Features

Service availability refers to ability of a network or a network component to provide uninterrupted delivery of services using highly available, redundant, and reliable components. This topic provides brief overviews of the benefits of using the following service availability features:

- Module Redundancy on page 5
- Stateful SRP Switchover on page 5
- Unified ISSU on page 5
- VRRP on page 6
- Interchassis Redundancy on page 6

Module Redundancy

For hardware components, Juniper Networks provides redundancy solutions to ensure that the router continues to operate in the event of a hardware fault. Redundancy also enables you to hot-swap various components within your E Series router.

Stateful SRP Switchover

Stateful SRP switchover (high availability) enables you to reduce or eliminate single points of failure in your network. Stateful SRP switchover provides both hardware-specific and software-specific methods to ensure minimal downtime and ultimately improve the performance of your network.

Stateful SRP switchover minimizes the impact to the router of a stateful switchover from the active SRP module to the standby SRP module. Stateful SRP switchover maintains user sessions and data forwarding through the router during the switchover, thus improving the overall availability of the router.

Unified ISSU

A conventional software upgrade—one that does not use the unified in-service software upgrade (ISSU) process—causes a router-wide outage for all users. Only static configurations (stored on the flash card) are maintained across the upgrade; all dynamic configurations are lost. A conventional upgrade can take 30-40 minutes to complete, with additional time required to bring all users back online.

Unified ISSU enables you to upgrade the router to a higher-numbered software release without disconnecting user sessions or disrupting forwarding through the chassis.

When an application supports unified ISSU, you can configure the application on the router and proceed with the unified in-service software upgrade with no adverse effect on the upgrade.

When you perform a unified ISSU on a router that has one or more modules that do not support unified ISSU, these modules are upgraded by means of the legacy, conventional upgrade process. The unsupported modules undergo a cold reboot at the beginning of the unified ISSU process, and are held down until the ISSU process is completed.

VRRP

Virtual Router Redundancy Protocol (VRRP) prevents loss of network connectivity to end hosts when the static default IP gateway fails. By implementing VRRP, you can designate a number of routers as backup routers in the event that the default master router fails. In case of a failure, VRRP dynamically shifts the packet-forwarding responsibility to a backup router. VRRP creates a redundancy scheme that enables hosts to keep a single IP address for the default gateway but maps the IP address to a well-known virtual MAC address. You can take advantage of the redundancy provided by VRRP without performing any special configuration on the end host systems.

Routers running VRRP dynamically elect master and backup routers. You can also force assignment of master and backup routers using priorities in the range 1–255, with 255 being the highest priority.

VRRP supports virtual local area networks (VLANs), stacked VLANs (S-VLANs), and creation of interchassis redundancy (ICR) partitions.

Interchassis Redundancy

ICR enables you to minimize subscriber downtime when the router or access interface on the edge router fails. ICR accomplishes this by re-creating subscriber sessions on the backup router that were originally terminated on the failed router. It also enables you to track the failure of uplink interfaces. In this way, ICR enables you to completely recover from router failure. ICR uses Virtual Router Redundancy Protocol (VRRP) to detect failures. ICR also enables you to track the failure of uplink interfaces. ICR currently supports only PPPoE subscribers.

Related Topics

- Managing Module Redundancy on page 7
- Managing Stateful SRP Switchover on page 23
- Configuring a Unified In-Service Software Upgrade on page 55
- Configuring VRRP on page 101
- Managing Interchassis Redundancy on page 121
- Service Availability Overview on page 3

CHAPTER 2

Managing Module Redundancy

This chapter describes how to manage redundancy in line modules, switch route processor (SRP) modules, switch fabric modules (SFMs), I/O modules, and I/O adapters (IOAs) in E Series routers.

This chapter contains the following sections:

Line Module Redundancy Overview

You can install an extra line module in a group of identical line modules to provide redundancy if one of the modules fails.

The process by which the router switches to the spare line module is called *switchover*. During switchover, the line, circuit, and IP interfaces on the I/O module or one or more IOAs appear to go down temporarily. The duration of the downtime depends on the number of interfaces and the size of the routing table, because the router must reload the interface configuration and the routing table from the SRP module.

If the line module software is not compatible with the running SRP module software release, a warning message appears on the console.

Module Requirements

The requirements for line module redundancy depend on the type of router that you have.

NOTE: The information in this section does not apply to the ERX310 Broadband Services Router, which does not support line module redundancy.

ERX7xx Models and ERX14xx Models

To use this feature on ERX7xx models and ERX14xx models, you must also install a redundancy midplane and a redundancy I/O module. For a detailed explanation of how the router provides redundancy for line modules and procedures for installing the modules, see the *ERX Hardware Guide*.

E120 and E320 Routers

To configure line module redundancy on the E120 or E320 Broadband Services router, you must also install an ES2-S1 Redund IOA in either slot 0 or slot 11. The ES2-S1 Redund IOA is a full-height IOA. For a detailed explanation of how the router provides redundancy for line modules and procedures for installing the modules, see the *E120 and E320 Hardware Guide*.

On E120 and E320 routers, each side of the chassis is treated as a redundancy group. The lowest numbered slot for each side acts as the spare line module, providing backup functionality when an ES2-S1 Redund IOA is located directly behind it. When the line module does not contain an ES2-S1 Redund IOA, it is considered a primary line module.

The router accepts the following redundancy groups:

- ES2 4G LM as backup and ES2 4G LM as primary
- ES2 10G Uplink LM and ES2 10G Uplink LM as primary
- ES2 10G LM as backup and ES2 10G LM
- ES2 10G ADV LM as backup and ES2 10G ADV LM as primary
- ES2 10G ADV LM as backup and ES2 10G LM as primary

Also, you cannot configure redundancy for the ES2-S1 Service IOA.

IOA Behavior When the Router Reboots

On E120 and E320 routers, switchover is based on the combined states of the line module and the IOAs that are installed in the affected slot.

When the router reboots and the formerly configured primary line module is not present, or is present and fails diagnostics, it switches to a spare line module and takes inventory of the IOAs. If the IOA is present and new, the router reverts back to the primary line module so that the spare line module can service other active primary line modules.

When the router reboots and a slot contains a line module and one active and one inactive IOA, the inactive IOA remains in that state.

Line Module Behavior When Disabling or Enabling IOAs

On E120 and E320 routers, a line module reboots when you issue the **adapter disable** or **adapter enable** commands for an associated IOA.

When you issue the **adapter disable** or **adapter enable** commands, the line module (primary or spare) currently associated with that IOA reboots. If the IOA is protected by a line module redundancy group, an automatic line module redundancy switchover or revert can be triggered by the line module reboot. To prevent undesired line module redundancy actions, issue the **redundancy lockout** command for the primary line module slot before issuing the **adapter disable** or **adapter enable** commands.

Automatic Switchover

Provided you have not issued the **redundancy lockout** command for the primary line module, the router switches over to the spare line module automatically if it detects any of the following failures on the primary line module:

- Power-on self-test (POST) failure
- Software-detected unrecoverable error
- Software watchdog timer expiration
- Primary line module failure to respond to keepalive polling from the SRP module
- Removal, disabling, or reloading of the primary line module
- Missing or disabled primary line modules when the router reboots
- Resetting the primary line module using the concealed push button

Limitations of Automatic Switchover

If automatic switchover is enabled on a slot (the default configuration) and a spare line module is available, issuing some CLI commands for the primary line module causes a switchover (Table 3 on page 9).

You can also disable automatic switchover on individual slots. For more information, see “Configuring Line Module Redundancy” on page 9.

Table 3: Commands That Can Cause Automatic Switchover

Command	Reason for Automatic Switchover
slot disable *primary-line-module-slot*	The command disables the primary line module but not the primary I/O module or IOAs.
reload slot *primary-line-module-slot*	The command is equivalent to pushing the reset button on the primary line module.

Reversion After Switchover

You can install only one spare line module in the group of slots covered by the redundancy midplane or redundancy group. If the router is using the spare line module, no redundancy is available. Reverting to the primary module as soon as possible is desirable. By default, the router does not automatically revert to the primary module after switchover; however, you can configure it to do so. (See “Configuring Line Module Redundancy” on page 9.) Before reversion can take place, the primary line module must complete the POST diagnostics.

Configuring Line Module Redundancy

You can modify the default redundancy operations on the router as follows:

- Disable automatic switchover on a slot.

- Enable automatic reversion after switchover.

redundancy lockout

- Use to prevent the router from switching automatically to a spare line module if the primary module in the specified slot fails.
- The **redundancy force-switchover** command overrides the **redundancy lockout** command.
- Example

  host1(config)#**redundancy lockout 5**

- Use the **no** version to restart redundancy protection for the slot.
- See redundancy lockout.

redundancy revertive

- Use to enable the router to revert from all spare line modules to the associated primary line modules automatically.
- Reversion takes place when the primary line module is again available unless you specify a time of day. In that case, reversion takes place only when the primary module is available and after the specified time.
- Example

  host1(config)#**redundancy revertive 23:00:00**

- Use the **no** version to disable automatic reversion.
- See redundancy revertive.

Managing Line Module Redundancy

When the router is running and a redundancy group is installed, you can manage the redundancy situation as follows:

- Force switchover manually.
- Force reversion manually.

redundancy force-switchover

- Use to force the router to switch from the primary line module in the specified slot or the primary SRP module to the spare line module or SRP module.
- The command causes a single switchover. When you reboot, the router reverts to the configured setting for this slot.
- The **redundancy force-switchover** command overrides the **redundancy lockout** command.
- Example

  host1#**redundancy force-switchover 5**

- There is no **no** version.
- See redundancy force-switchover.

redundancy revert

- Use to force the router to revert to the primary line module in the specified slot.
- The router acts on this command immediately unless you specify a time or a time and date that the action is to take place.
- The command causes a single reversion. When you reboot, the router uses the configured setting for this slot.
- Example

  host1#**redundancy revert 4 23:00:00 5 September 200X**
- There is no **no** version.
- See redundancy revert.

SRP Module Redundancy

This section covers general issues of SRP module redundancy. It does not cover NVS cards or the behavior on systems running high availability features such as hitless SRP switchover. For information about managing NVS in a router that contains two SRP modules, see *Managing Flash Cards on SRP Modules* in the *JunosE System Basics Configuration Guide*. For information about managing high availability in a router, see “Managing Module Redundancy” on page 7.

The information in this section does not apply to the ERX310 router, which does not support SRP module redundancy. For this reason, any references to synchronization that may appear in command output or system messages do not apply to the ERX310 router.

SRP Module Behavior

The SRP module uses a 1:1 redundancy scheme. When two SRP modules are installed in the router, one acts as a primary and the second as a redundant module. On ERX7xx models, ERX14xx models, and the ERX310 router, both SRP modules share a single SRP I/O module located in the rear of the chassis. On the E120 and E320 routers, both SRP modules share an SRP IOA located in the rear of the chassis.

After you install two SRP modules, the modules negotiate for the primary role. A number of factors determine which module becomes the primary; however, preference is given to the module in the lower slot. The SRP modules record their latest roles and retain them the next time you switch on the router.

With the default software settings, if the primary SRP module fails, the redundant SRP module assumes control without rebooting itself. For information about preventing the redundant SRP module from assuming control, see “Managing SRP Module Redundancy” on page 16.

On E120 and E320 routers, the switch fabric is distributed between the SFMs and the SRP modules. If the primary SRP module fails a diagnostic test on its resident slice of switch fabric, then it abdicates control to the redundant SRP module if both of the following are true:

- The standby SRP module does not indicate any error.
- The standby SRP module passes diagnostics on its attached fabric slice.

When the redundant SRP module assumes control, the following sequence of events occurs:

1. The original primary SRP module reboots and assumes the redundant role.
2. The redundant SRP module restarts and assumes the primary role without reloading new code. (When upgrading software, you must reload the software on the redundant SRP module. See *Installing JunosE Software* in the *JunosE System Basics Configuration Guide*.)
3. All line modules reboot.

The following actions activate the redundant SRP module:

- Failure of the primary SRP module (hardware or software)
- Pushing the recessed reset button on the primary SRP module (See Figure 1 on page 13 and Figure 2 on page 14.)
- Issuing the **srp switch** command
- Issuing the **redundancy force-switchover** command

Figure 1: SRP Module on ERX7xx Models and ERX14xx Models

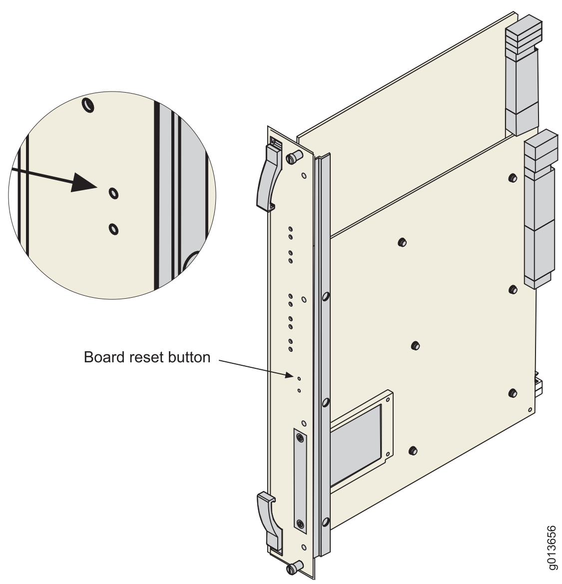
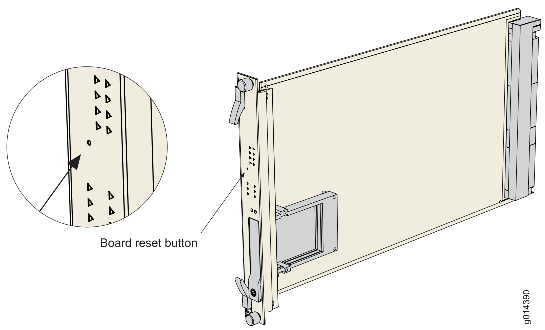


Figure 2: SRP Module on the E120 and E320 Routers



Specifying the Configuration for Redundant SRP Modules

On a router with redundant SRP modules, you can specify the configuration that both the primary and redundant modules load in the event of a reload or switchover. A switchover can result from an error on the primary SRP module or from an **srp switch** command. The following behavior takes place only in the event of a cold restart; it does not take place in the event of a warm restart.

When you arm a configuration (.cnf) file by issuing the **boot config** *cnfFilename* command, a subsequent SRP switchover causes the redundant SRP module to take the role of primary SRP module with the configuration specified by the .cnf file. The new primary SRP module does not use the running configuration.

If you want the redundant SRP module to instead use the running configuration when it takes the primary role, then you must first arm a configuration file with the **boot config** *cnfFilename* **once** command. To exhaust the **once** option, you must then cause the redundant SRP module to reload for some reason, such as by issuing a **reload** command or by arming a new JunosE Software release or a hotfix file.

When a switchover subsequently occurs, the redundant SRP module reloads with the running configuration and takes the primary role. For more information about the **boot config** command, see *Booting the System* in the *JunosE System Basics Configuration Guide*.

Installing a Redundant SRP Module

You can install a redundant SRP module into a running router, provided that the redundant SRP module has a valid, armed software release on its NVS card. Access to a software release in NVS ensures that the redundant SRP module can boot; the release need not be the same as that on the primary SRP module.

WARNING: Do not insert any metal object, such as a screwdriver, or place your hand into an open slot or the backplane when the router is on. Remove jewelry (including rings, necklaces, and watches) before working on equipment that is connected to power lines. These actions prevent electric shock and serious burns.

CAUTION: When handling modules, use an antistatic wrist strap connected to the router's ESD grounding jack, and hold modules by their edges. Do not touch the components, pins, leads, or solder connections. These actions help to protect modules from damage by electrostatic discharge.

To install a redundant SRP module into a running router, follow these steps:

1. Install the redundant SRP module into the open SRP slot (slot 6 or 7 for ERX14xx models, the E120 router, and the E320 router; slot 0 or 1 for ERX7xx models).

   For detailed information about installing the SRP module, see the *ERX Hardware Guide* or the *E120 and E320 Hardware Guide*.

2. Wait for the redundant SRP module to boot, initialize, and reach the standby state.

   When the module is in standby state, the REDUNDANT LED is on and the ONLINE LED is off. If you issue the **show version** command, the state field for the slot that contains the redundant SRP module is standby.

3. Synchronize the NVS file system of the redundant SRP module to that of the primary SRP module.

NOTE: The SRP module reboots after synchronization is complete.

reload slot

- Use to reboot a selected slot on the router.
- If you specify a slot on the E120 or E320 router that contains an SRP module, you reboot the SC subsystem on that slot by default. You do not, however, reboot the fabric slice that resides on the slot.

- Use the **srp** keyword to reboot the portion of the SC subsystem that resides on a specified SRP module.
- Use the **fabric** keyword to reboot the fabric slice that resides on the specified SRP module.

- Example 1—Reboots the module in slot 7

  host1#**reload slot 7**

- Example 2—Reboots the SC on the SRP module in slot 7 (applies only to E120 and E320 routers)

  host1#**reload slot 7 srp**

- There is no **no** version.
- See reload slot.

synchronize

- Use to force the file system of the redundant SRP module to synchronize with the NVS file system of the primary SRP module.
- If you synchronize the redundant SRP module with the primary SRP module and the redundant module is armed with a release different from the one it is currently running, the redundant SRP module is automatically rebooted to load the armed release.
- Optionally, you can use the **low-level-check** keyword to force the router to validate all files or only configuration files in NVS, and to synchronize all files that failed the checksum test during the **flash-disk-compare** command as well as any other files that are unsynchronized. See *Managing Flash Cards on SRP Modules* in the *JunosE System Basics Configuration Guide* for details.
- Examples

  host1#**synchronize**
  host1#**synchronize low-level-check all**
  host1#**synchronize low-level-check configuration**

- There is no **no** version.
- See synchronize.

Managing SRP Module Redundancy

You can prevent the redundant SRP module from taking over when:

- The primary SRP module experiences a software failure.
- You push the reset button on the primary SRP module.

NOTE: If you do not configure this option, when troubleshooting an SRP module, disconnect the other SRP module from the router. This action prevents the redundant SRP module from taking over if you push the reset button on the primary SRP module.

To configure this option:

1. Issue the **disable-switch-on-error** command.
2. Synchronize the NVS file system of the redundant SRP module to that of the primary SRP module.

disable-switch-on-error

- Use to prevent the redundant SRP module from taking over if the primary SRP module experiences a software failure or if you push the reset button on the primary SRP module.
- Issue the **synchronize** command immediately before you issue this command.
- If you issue the **disable-switch-on-error** command, and later issue the **srp switch** command, the redundant SRP module waits about 30 seconds before it takes over from the primary SRP module.
- Example

  host1(config)#**disable-switch-on-error**

- Use the **no** version to revert to the default situation, in which the redundant SRP module takes over if the primary SRP module experiences a software failure.
- See disable-switch-on-error.

synchronize

- Use to force the NVS file system of the redundant SRP module to synchronize with the NVS file system of the primary SRP module.
- If you synchronize the redundant SRP module with the primary SRP module and the redundant module is armed with a release different from the one it is currently running, the redundant SRP module is automatically rebooted to load the armed release.
- Optionally, you can use the **low-level-check** keyword to force the router to validate all files or only configuration files in NVS, and to synchronize all files that failed the checksum test during the **flash-disk-compare** command as well as any other files that are unsynchronized. See *Managing Flash Cards on SRP Modules* in the *JunosE System Basics Configuration Guide* for details.
- Examples

  host1#**synchronize**
  host1#**synchronize low-level-check all**
  host1#**synchronize low-level-check configuration**

- There is no **no** version.
- See synchronize.

Switching to the Redundant SRP Module

To switch immediately from the primary SRP module to the redundant SRP module, issue the **redundancy force-switchover** command or the **srp switch** command. You can configure the router to prompt you if the modules are in a state that could lead to loss of configuration data or NVS corruption.

redundancy force-switchover

- Use to force the router to switch from the primary line module in the specified slot or the primary SRP module to the spare line module or SRP module.
- The command causes a single switchover. When you reboot, the router reverts to the configured setting for this slot.
- With the **srp** option, the command is equivalent to the **srp switch** command.
- The **redundancy force-switchover** command overrides the **redundancy lockout** command.
- Example

  host1#**redundancy force-switchover 5**
- There is no **no** version.
- See redundancy force-switchover.

srp switch

- Use to switch from the primary SRP module to the redundant SRP module.
- When the high availability state is active, this command delays until all transaction data, up to when you issue the command, has been mirrored to the standby SRP module. This preserves legacy behavior requiring that SRP modules be synchronized before the switchover.
- If you specify the **force** keyword, the procedure fails if the SRP modules are in certain states, such as during a synchronization. In these cases, the router displays a message that indicates that the procedure cannot currently be performed and the reason why. However, if the SRP modules are in other states that could lead to a loss of configuration data or an NVS corruption, the router displays a message that explains the state of the SRP modules, and prompts you to confirm (enter yes or no) whether you want to proceed.
- If you do not specify the **force** keyword, the procedure fails if the SRP modules are in any state that could lead to a loss of configuration data or an NVS corruption, and the router displays a message explaining the command failure.
- When you issue this command, the router prompts you for a confirmation before the command takes effect.
- If you issue the **disable-switch-on-error** command and later issue the **srp switch** command, the redundant SRP module waits about 30 seconds before it takes over from the primary SRP module.
- If the router does not contain a redundant SRP module, this command has no effect.
- Example

  host1#**srp switch**
  host1#**srp switch force**

- There is no **no** version.
- See srp switch.

Upgrading Software on a Redundant SRP Module

For information about upgrading software on SRP modules on ERX7xx models, ERX14xx models, or the ERX310 router, see *Installing JunosE Software* in the *JunosE System Basics Configuration Guide*.

Monitoring the Status LEDs

You can determine the redundancy state of line modules and SRP modules by examining their status LEDs. See Table 4 on page 19 for a description of the LEDs functions. In addition, if you issue the **show version** command, the state field for the slot that contains the redundant SRP module indicates standby.

Table 4: Function of the Online and Redundant LEDs

Online LED	Redundant LED	State of the Module
Off	Off	Module is booting or is an inactive primary line module.
On	Off	Module is active, but no redundant module is available.
Off	On	Module is in standby state.
On	On	Module is active, and a redundant module is available.

Monitoring Line Module and SRP Module Redundancy

You can use **show** commands to monitor the status of redundancy groups, line modules, and SRP modules.

NOTE: For more information about monitoring high availability, see “Managing Module Redundancy” on page 7.

show environment

- Use to display information about the hardware installed for redundancy.
- See *Managing the System* in the *JunosE System Basics Configuration Guide* for details and examples.
- See show environment.

show hardware

- Use to display detailed information about the line modules and SRP modules.
- See *Monitoring Modules* in the *JunosE System Basics Configuration Guide* for details and examples.

- See show hardware.

show redundancy

- Use to display the configuration for line module redundancy and SRP redundancy.
- Field descriptions
  - SRP
    - high-availability state—State of the high availability mode (disabled, active, or pending)
    - current redundancy mode—Redundancy mode currently being used by this router (high-availability or file-system-synchronization)
    - last activation type—Last type of activation that occurred on this router (that is, the method by which the SRP last booted [cold-start or warm-start])
  - Criteria Preventing High Availability from being Active—Criteria required for high availability to be active.
  - slot—Slot in which the line module resides
  - hardware role—Function of the line module: primary or spare
  - lockout config—Status of redundancy on this line module
    - protected—Line module redundancy is enabled
    - locked out—Line module redundancy is disabled
  - backed up by slot—Slot that contains the line module that is a spare for this primary line module
  - sparing for slot—Slot that contains the primary line module for which this line module is a spare
  - revert at—Time at which you want the line module to revert
  - midplane type—Identifier for the type of midplane
  - midplane rev—Hardware revision number of the redundancy midplane
  - fabric slice redundancy—Status of the fabric slice on the SRP modules or SFMs on the E120 and E320 routers
    - slot—Slot in which the fabric slice resides
    - state—State of the fabric slice (online, not present)
    - type—Identifier for the type of hardware (SRP module or SFM)
- Example 1

  In the following example, the user issues a **show redundancy** command, and then a **redundancy force switchover** command. Finally, the user issues the **show redundancy**

line-card command to display information specific to the line modules. The two displays show how the states of the primary and spare line modules change.

```
host1#show redundancy

SRP
---

high-availability state:  disabled
current redundancy mode:  file-system-synchronization
last activation type:     cold-start

Criteria Preventing High Availability from being Active
-------------------------------------------------------
            criterion               met
---------------------------------   ---
High Availability mode configured?  No
Mirroring Subsystem present?        No

Line Card
---------

automatic reverting is off

                              backed
                                up    sparing
       hardware    lockout      by      for     revert
slot     role      config      slot    slot       at
----   --------   ---------   ------  -------   ------
 0      spare        ---       ---      ---      ---
 2     primary    protected    ---      ---      ---
 12      ---         ---       ---      ---      ---

        midplane   midplane
slots     type       rev
-----   --------   --------
0 - 5      6          0

host1#redundancy force-switchover 2
host1#show redundancy line-card

automatic reverting is off

                              backed
                                up    sparing
       hardware    lockout      by      for     revert
slot     role      config      slot    slot       at
----   --------   ---------   ------  -------   ------
 0      spare        ---       ---       2       ---
 2     primary    protected     0       ---      ---
 12      ---         ---       ---      ---      ---

        midplane   midplane
slots     type       rev
-----   --------   --------
0 - 5      6          0
```

- Example 2—Displays the redundancy status on an E320 router

```
host1#show redundancy
```

```
SRP
---

high-availability state:  active
current redundancy mode:  high-availability
last activation type:     cold-start

Line Card
---------

automatic reverting is off

                                    backed
                                      up    sparing
       hardware    lockout            by      for     revert
slot     role      config            slot    slot       at
----   --------   ---------         ------  -------   ------
 0      spare        ---             ---      ---      ---
 2     primary    protected          ---      ---      ---
 4     primary    protected          ---      ---      ---


fabric slice redundancy: none
slot   state     type
----   ------   -------
6      online   SFM-100
7      online   SFM-100
8       ---       ---
9       ---       ---
10      ---       ---
```

- See show redundancy.

show version

- Use to display information about each module in the router.

  See *Managing the System* in the *JunosE System Basics Configuration Guide*, for details and examples.

- See show version.

Managing Port Redundancy

For information on port redundancy, see the *JunosE Physical Layer Configuration Guide*. For information on managing port redundancy on Gigabit Ethernet I/O modules, see *Managing Port Redundancy on Gigabit Ethernet I/O Modules* in the *JunosE Physical Layer Configuration Guide*.

For information on redundancy and interface distribution of tunnel-service interfaces see *Redundancy and Interface Distribution of Tunnel-Service Interfaces* in the *JunosE Physical Layer Configuration Guide*.

CHAPTER 3

Managing Stateful SRP Switchover

This chapter describes how to manage Juniper Networks Stateful SRP Switchover (also referred to as high availability or HA) software features for the E Series router. Use this chapter with "Managing Module Redundancy" on page 7 to fully manage the SRP features.

This chapter contains the following sections:

Stateful SRP Switchover Overview

Stateful SRP switchover is the idea of reducing or eliminating single points of failure. When applied to the E Series router, stateful SRP switchover provides both hardware-specific and software-specific methods to ensure minimal downtime and ultimately improve the performance of your network.

For hardware components, Juniper Networks provides redundancy solutions to ensure that the router continues to operate in the event of a hardware fault. This redundancy can exist on various router models in the form of multiple power supplies, cooling fans, switching planes, routing engines and, in some cases, interfaces. Redundancy also allows for hot-swapping various components within your Juniper Networks router.

NOTE: For information about E Series hardware redundancy features, see the *ERX Hardware Guide* or the *E120 and E320 Hardware Guide*.

Related Topics

- Stateful SRP Switchover Redundancy Modes on page 25
- Stateful SRP Switchover States on page 26
- Application Support for Stateful SRP Switchover on page 30

Stateful SRP Switchover Platform Considerations

Stateful SRP switchover is supported on all E Series routers except for the ERX310 Broadband Services Router.

For information about the modules supported on E Series routers:

- See the *ERX Module Guide* for modules supported on ERX7xx models and ERX14xx models.
- See the *E120 and E320 Module Guide* for modules supported on the E120 and E320 Broadband Services Routers.

Module Requirements

The following table lists which SRPs support or do not support the high availability mode (stateful SRP switchover) feature.

SRP Model	Supported
SRP-5G	No
SRP-5G+	Yes
SRP-10G	Yes
SRP-40G	No
SRP-40G PLUS	Yes
SRP-100	Yes

NOTE: Stateful SRP switchover requires two SRP modules with 1 GB of memory or more.

Related Topics

- Monitoring the Redundancy Status on page 43
- Monitoring the Redundancy Status of SRP Modules on page 51
- show redundancy
- show redundancy srp

Stateful SRP Switchover Redundancy Modes

The switch route processor (SRP) modules can operate in one of two redundancy modes—file system synchronization and high availability.

File System Synchronization Mode

File system synchronization is the default behavior mode for E Series routers that contain redundant SRPs. Available only to SRP modules, this mode has been available since the JunosE Software 2.x release. In this mode:

- Files and data (for example, configuration files and releases) in nonvolatile storage (NVS) remain synchronized between the primary and standby SRP modules.
- SRP modules reload all line modules and restart from saved configuration files.
- If the active SRP module switches over to the standby SRP, the router cold-restarts as follows:
  - All line modules are reloaded.
  - User connections are lost, and forwarding through the chassis stops until the router SRP module recovers.
  - The standby SRP module boots from the last known good configuration from NVS.

For additional information about the default SRP functionality, see "Managing Module Redundancy" on page 7.

High Availability Mode

Currently applicable to the SRP module, Juniper Networks high availability mode uses an initial bulk file transfer and subsequent, transaction-based mirroring to ensure rapid SRP module recovery after a switchover. This process is referred to in this chapter as *stateful SRP switchover*.

In addition to keeping the contents of NVS, high availability mode keeps state and dynamic configuration data from the SRP memory synchronized between the primary and standby SRP modules.

When stateful SRP switchover is enabled, an SRP switchover keeps line modules up and forwarding data, and the newly active SRP module continues from the point of switchover.

By using transaction-based mirroring instead of file synchronization, high availability mode keeps the standby SRP module synchronized with the active SRP module. Mirroring occurs from memory on the active SRP module to memory on the standby SRP module by way of transactions. When a transaction is committed on the active SRP module, the data associated with the transaction is sent to the standby SRP module.

In high availability mode:

- The contents of the NVS in the primary and standby SRP modules remain synchronized.

NOTE: Configuration files are always synchronized. Nonconfiguration files are synchronized when the **disable-autosync** command has not been configured; this is the default case. When the **disable-autosync** command has been configured, nonconfiguration files are not synchronized.

- If a switchover occurs:
  - The standby SRP module warm-restarts using the mirrored data to restore itself to the state of the system before the switchover.
  - During the warm restart:
    - User connections remain active, and forwarding continues through the chassis.
    - New user connection attempts during switchover are denied until switchover is complete.
    - New configuration changes are prevented until switchover is complete (or after 5 minutes).

NOTE: If the switchover does not finish within 5 minutes, the SRP module cancels the operation and reenables CLI configuration.

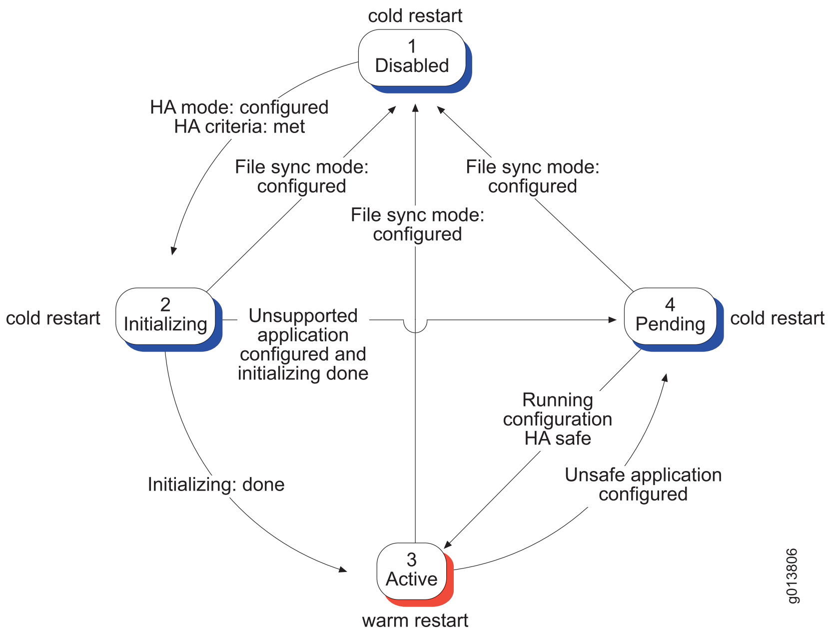
Related Topics

- Stateful SRP Switchover States on page 26
- disable-autosync
- redundancy
- mode

Stateful SRP Switchover States

The SRP progresses through various high availability states. These states are illustrated in Figure 3 on page 27.

Figure 3: High Availability States



Disabled State

The initial, default state for high availability mode is disabled. While in this state, the router continues to use file system synchronization. If a switchover occurs while the router is in this state, the standby SRP module performs a cold restart.

The router enters this state when you power up the router or when the router warm-restarts from an SRP switchover.

After you enable high availability, the system must meet the following criteria before it can enter the initializing state:

- High availability mode is configured.
- Active SRP hardware supports high availability.
- Network core dump feature is disabled.
- Running configuration allows high availability to operate (that is, no unsupported applications are configured).
- Standby SRP hardware supports high availability.
- Standby SRP module is online and capable of mirroring.
- Standby SRP module is running the same release.

During the disabled state:

- If any one criterion is not met, the system remains in the disabled state, until the criterion is met.
- If a switchover occurs while the system is in the disabled state, the system cold-restarts.

While in the disabled state, the system operates as if it were configured for file system synchronization (for example, NVS is synchronized every 5 minutes, if autosynchronization is enabled).

If all criteria are met, high availability mode transitions to the initialization state.

Initializing State

After the SRP module transitions into the initializing state, bulk synchronization of the memory and NVS occurs. This includes the following:

- File synchronization of the primary NVS with the standby NVS
- Mirroring of appropriate state and dynamic configuration information from the active SRP (memory) to the standby SRP (memory)

NOTE: Depending on the size of the configuration, this process can take several minutes.

During the initializing state:

- If an unsupported application is configured during initialization, the system completes initializing and enters the pending state.
- If any other criterion becomes false (or is no longer met), the system enters the disabled state.
- If a switchover occurs while the system is in this state, the system cold-restarts.

After initialization is completed, the system enters the active state.

Active State

During the active state, the data that was synchronized from the active SRP module to the standby SRP module during initialization remains synchronized through mirroring updates.

Mirroring updates occur as follows:

1. When making changes or updates, applications create individual transactions, perform the updates on the active SRP module, and post the transactions.
2. Following the updates, the active SRP module sends the changes to the standby SRP module.
3. The standby SRP module replays the updates (in the order in which they were committed on the active SRP module) and makes the appropriate changes for each changed application.
4. Updates that need to be stored in NVS (that is, for static configurations) are updated in NVS.

NOTE: While in the active and pending states, the CLI **synchronize** command does not update configuration files; these files are updated by the mirroring process.

During the active state:

- If a switchover occurs while the router is in the active state, the standby SRP module performs a warm restart (that is, stateful SRP switchover is in effect); the standby SRP module uses the configuration located in NVS.
- If an unsupported application is configured, the system transitions to the pending state.
- If any other criterion changes (is no longer met), the system transitions to the disabled state.

NOTE: Changes made in manual commit mode are maintained, uncommitted, in the standby SRP memory until a trigger to commit occurs; if a switchover occurs while in this mode, the standby SRP module uses the configuration in memory.

Pending State

The system transitions to the pending state if an unsupported application is configured. When a transition to the pending state occurs, the system generates SNMP traps and log messages.

How the router behaves depends on which HA state the application is in when it shifts to a pending state:

- From disabled state—The router remains in the disabled state.
- From initializing state—The router completes the initializing state and transitions to the pending state after initialization is complete.
- Active State—The router transitions to the pending state.

The system remains in the pending state until the configuration of the unsupported application is removed. However, even though it is in the pending state, the system continues mirroring updates from the primary SRP module to the standby SRP module.

NOTE: You can use the **show redundancy srp** command to display the name of any unsupported applications that are configured.

If a switchover occurs while the system is in the pending state, the system cold-restarts.

Related Topics

- Monitoring the Redundancy Status on page 43
- Monitoring the Redundancy Status of SRP Modules on page 51
- show redundancy
- show redundancy srp

- synchronize

Application Support for Stateful SRP Switchover

Applications are either supported or unsupported by stateful SRP switchover.

- Supported—You can configure supported applications without having any adverse impact to stateful SRP switchover. When a switchover occurs, supported applications can react to switchovers in one of two different ways:
  - Gracefully recover using mirrored static and dynamic information (for example, IP, PPP, and PPPoE)
  - Recover using static configuration only; that is, no runtime state is restored after a switchover. Dynamic configuration and state information are lost. (For example, CLI sessions are restarted, telnet sessions are dropped, multicast routes must be rebuilt, and so on.)
- Unsupported—We recommend that you not configure unsupported applications on a chassis running in high availability mode. Although configured unsupported applications suspend high availability or prevent high availability from becoming active, they do not cause any problems with the function of the router.

Table 5 on page 30 indicates which applications support or do not support stateful SRP switchover.

Application Support

Table 5: Application Support for Stateful SRP Switchover

Application	Supported	Unsupported	Notes
Physical Layer Protocols			
DS1	✓	–	–
DS3	✓	–	–
HDLC	✓	–	–
SONET/SDH	✓	–	–
SONET/SDH VT	✓	–	–
Link-Layer Protocols			

Table 5: Application Support for Stateful SRP Switchover *(continued)*

Application	Supported	Unsupported	Notes
ATM	✓	–	Static and dynamic interfaces, with the exception of ATM subscribers, are supported. In this case, *ATM subscribers* refers to a technology on the E Series router where the ATM layer does authentication (that is, not PPP or IP subscriber manager).
ATM 1483 bulk configuration of dynamic interfaces	✓	–	–
Bridged Ethernet	✓	–	–
Cisco HDLC	✓	–	–
Ethernet (with and without VLANs)	✓	–	–
Frame Relay	✓	–	–
PPP	✓	–	–
PPPoE	✓	–	–
Transparent bridging	✓	–	–
Unicast Routing			
Access Routes	✓	–	–
BFD	✓	–	During a stateful SRP switchover, the BFD transmit interval is set to 1000 ms with a detection multiplier of 3. These values result in a liveness detection interval of 3000 ms. This longer interval helps prevent a BFD timeout during the switchover. BFD negotiates the interval with the remote peer before applying the temporary change. The BFD timers revert back to the configured values after 15 minutes (the maximum duration for graceful restart completion).
BGP	✓	–	Supported for IPv4 only when the graceful restart extension is enabled. Does not support graceful restart for IPv6 address families.
FTP	✓	–	Static recovery support only.

Table 5: Application Support for Stateful SRP Switchover *(continued)*

Application	Supported	Unsupported	Notes
IP	✓	–	–
IPv6	✓	–	–
IPv6 neighbor discovery	✓	–	IPv6 neighbor discovery characteristics are replayed during switchover. Line modules do not flush neighbor discovery information during the switchover.
IPSec Transport	–	✓	–
IPSec Tunnels	✓	–	Completed IKE phase 1 and phase 2 negotiations supported only.
IS-IS	✓	–	Supported only when the graceful restart extension is enabled.
IS-ISv6	✓	–	Supported only when the graceful restart extension is enabled.
OSPFv2		–	Supported only when the graceful restart extension is enabled.
OSPFv3	✓	–	Supported only when the graceful restart extension is enabled.
RIP	✓	–	Static recovery support only.
Static Routes (IP and IPv6)	✓	–	After all high-priority interfaces have been replayed from NVS and mirrored storage, static routes are replayed from NVS, followed by replay of low-priority interfaces from NVS and mirrored storage. This behavior enables static routes that are dependent on high-priority interfaces to be resolved quickly and installed in the IP routing table.
Telnet	✓	–	Static recovery support only.
IPv4 Multicast Routing			

Table 5: Application Support for Stateful SRP Switchover *(continued)*

Application	Supported	Unsupported	Notes
Multicast Routing	✓	–	Stateful SRP switchover. During switchover, the system mirrors the multicast queue so that IP can use the same queue without needing to recreate a different connection. The multicast queues are also preserved during the switchover and graceful restart period to ensure that multicast data continues to be forwarded using the previously learned multicast forwarding state.
DVMRP	✓	–	Static recovery support only. DVMRP gives the restart complete indication to the IP routing table after getting a peer update (60-second timeout).
IGMP	✓	–	IC IGMP deletes its interface and membership state on SRP failover (controller down). As part of SRP warm start, IGMP interfaces are reconfigured from NVS and dynamic IGMP interfaces are reconfigured from mirrored storage. IGMP hosts are queried as IP interfaces come back up, the join state is re-established, and SC IGMP state is created. After the maximum query response time (across all interfaces) expires to allow hosts to re-establish join state, IGMP notifies MGTM that graceful restart is complete.

Table 5: Application Support for Stateful SRP Switchover *(continued)*

Application	Supported	Unsupported	Notes
MGTM	✓	–	On SRP failover, old mroutes are retained on the line module to preserve multicast forwarding; cache-misses to the SRP are disabled. When MGTM warm starts on the SRP, it reads the NVS configuration and enables multicast routing. When IGMP, DVMRP, and PIM have completed graceful restart and the IP route table multicast-view has completed graceful restart, old mroutes are deleted from the line module and cache-misses to the SRP are enabled. This triggers re-creation of mroutes and establishes the current multicast forwarding state. Although cache-misses to the SRP module are disabled, forwarding is preserved for old multicast joins to downstream routers and hosts. However, forwarding for new multicast joins requested by downstream routers and hosts after SRP module switchover is not provided until cache-misses are re-enabled.
PIM	✓	–	Static recovery support only. For warm start, PIM interfaces are reconfigured from NVS. A Hello message with a new Generation ID is issued as IP interfaces come up. A neighbor that receives this Hello determines that the upstream neighbor has lost state and needs to be refreshed. A VR-global configurable graceful restart timer is required for PIM to time out the re-establishment of the join state for sparse-mode interfaces. After this timer expires, PIM notifies MGTM that graceful restart is complete.
IPv6 Multicast Routing			
Multicast Routing	✓	–	Stateful SRP switchover. During switchover, the system mirrors the multicast queue so that IP can use the same queue without needing to recreate a different connection. The multicast queues are also preserved during the switchover and graceful restart period to ensure that multicast data continues to be forwarded using the previously learned multicast forwarding state.

Table 5: Application Support for Stateful SRP Switchover *(continued)*

Application	Supported	Unsupported	Notes
MGTM	✓	–	On SRP failover, old mroutes are retained on the line module to preserve multicast forwarding; cache-misses to the SRP are disabled. When MGTM warm starts on the SRP, it reads the NVS configuration and enables multicast routing. When MLD and PIM have completed graceful restart and the IPv6 route table multicast-view has completed graceful restart, old mroutes are deleted from the line module and cache-misses to the SRP are enabled. This triggers re-creation of mroutes and establishes the current multicast forwarding state. Although cache-misses to the SRP module are disabled, forwarding is preserved for old multicast joins to downstream routers and hosts. However, forwarding for new multicast joins requested by downstream routers and hosts after SRP module switchover is not provided until cache-misses are re-enabled.
MLD	✓	–	IC MLD deletes its interface and membership state on SRP failover (controller down). As part of SRP warm start, MLD interfaces are reconfigured from NVS and dynamic IMLD interfaces are reconfigured from mirrored storage. MLD hosts are queried as IPv6 interfaces come back, the join state is re-established, and SC MLD state is created. After the maximum query response time (across all interfaces) expires to allow hosts to re-establish join state, MLD notifies MGTMv6 that graceful restart is complete.
PIM	✓	–	Static recovery support only. For warm start, PIM interfaces are reconfigured from NVS and a Hello message with a new Generation ID is issued as IPv6 interfaces come up. A neighbor that receives this Hello determines that the upstream neighbor has lost state and needs to be refreshed. A VR-global configurable graceful restart timer is required for PIM to time out the re-establishment of the join state for sparse-mode interfaces. After this timer expires, PIM notifies MGTM that graceful restart is complete.

Table 5: Application Support for Stateful SRP Switchover *(continued)*

Application	Supported	Unsupported	Notes
Multiprotocol Label Switching			
MPLS	✓	–	MPLS is HA-unsafe during a graceful restart. It is HA-unsafe until all the configured MPLS signaling protocols have completed their graceful restart procedures and any stale forwarding elements have been flushed from the line modules. If you force an SRP switchover while MPLS is HA-unsafe, the SRP module switches but the SRP module and the line modules undergo a cold restart. If the primary SRP module resets while MPLS is HA-unsafe, the router undergoes a cold restart. MPLS over IPv6 supports HA. This functionality enables BGP to support graceful restart for IPv6 labeled addresses.
BGP signaling	✓	–	—
LDP signaling	✓	–	To provide uninterrupted service during an SRP switchover in a scaled configuration, such as one with 32,000 Martini circuits, set the LDP graceful restart reconnect time to the maximum 300 seconds and set the LDP graceful restart recovery timer to the maximum 600 seconds. This requirement is true for all SRP switchovers, including those in the context of a unified in-service software upgrade. LDP signaling does not support HA for IPv6.
RSVP signaling	✓	–	—
Local cross-connects between layer 2 interfaces using MPLS	✓	–	–
Policies and QoS			
Policies	✓	–	–
QoS	✓	–	Static recovery support only.

Table 5: Application Support for Stateful SRP Switchover *(continued)*

Application	Supported	Unsupported	Notes
Remote Access			
AAA	✓	–	–
DHCP External Server and Packet Trigger	✓	–	Following a switchover, the DHCP lease (that is, time remaining) is recalculated based on when the lease started. When the release timer for a client expires, the client is deleted and the access route is removed, along with the dynamic subscriber interface if it was created. If the client requests a new lease, DHCP external server resynchronizes with the new lease time.
DHCP Packet Capture	✓	–	–
DHCP Proxy Client	–	✓	–
DHCP Relay Proxy		–	–
DHCP Relay Server	✓	–	Before HA support, clients identified by the DHCP relay server were maintained on a switchover (their state was stored to NVS); DHCP relay server always had some level of HA support. Currently, following a switchover, the DHCP lease (that is, time remaining) is reset. When the release timer for a client expires, the client requests a new lease. The E Series router DHCP relay server then synchronizes with the new state.
DHCPv4 Local Server	✓	–	–
DHCPv6 Local Server	✓	–	DHCPv6 now supports stateful SRP switchover (high availability). After SRP warm switchover, the router restores the client bindings from the mirrored DHCPv6 information as it does for other applications that support stateful SRP switchover.
L2TP	✓	–	—
L2TP Dialout	–	✓	–

Table 5: Application Support for Stateful SRP Switchover *(continued)*

Application	Supported	Unsupported	Notes
IPv4 Local Address Pools	✓	–	The internal local address server state supports only static recovery. However, the AAA application reallocates active addresses on a switchover. The resulting effect is the IPv4 local address server having full HA support.
IPv6 Local Address Pools	✓	–	When the IPv6 local pools are configured, you can perform an HA switchover without cold booting the router because the configuration is now HA safe. The prefix assigned to the subscriber, before and after the warm restart, remains the same. The In Use prefix count also remains the same before and after the warm restart.
RADIUS Client	✓	–	Similar to local address server, AAA recovers disrupted RADIUS communication on a switchover. The resulting effect is the RADIUS client having full HA support.
RADIUS Dynamic-Request Server	✓	–	Static recovery support only.
RADIUS Initiated Disconnect	✓		–
RADIUS Relay Server	✓	–	–
RADIUS Route-Download Server	✓	–	–
Service Manager	✓	–	–
SRC Client	✓	–	–
TACACS+	✓	–	Static recovery support only.
Miscellaneous			
DNS	✓	–	—
DNSv6	–	✓	If DNSv6 is configured, no warning or error is displayed during a warm start. DNSv6 is subsequently configured from NVS as it is after a cold reboot.

Table 5: Application Support for Stateful SRP Switchover *(continued)*

Application	Supported	Unsupported	Notes
J-Flow (IP flow statistics)	✓	–	–
Line Module Redundancy	✓	–	–
Network Address Translation	✓	–	–
NTP	✓	–	–
Resource Threshold Monitor	✓	–	–
Response Time Reporter	✓	–	–
Route Policy	✓	–	Static recovery support only.
Subscriber Interfaces	✓	–	IPv4 only. Subscriber interfaces are not applicable to IPv6.
Tunnels (GRE and DVMRP)	✓	–	–
VRRP	✓	–	Static recovery support only.

CAUTION: When IP tunnels are configured on an HA-enabled router and the Service Module (SM) carrying these tunnels is reloaded, HA transitions to the pending state. HA remains in the pending state for 5 minutes after the successful reloading of the SM. This amount of time allows for IP tunnel relocation and for the tunnels to become operational again on the SM. If an SRP switchover occurs while HA is in the pending state, the router performs a cold restart.

Related Topics

- Monitoring the Redundancy Status of Applications on page 47
- show redundancy clients

Guidelines for Activating High Availability

Before you activate high availability on the SRP modules, you must be aware of any high availability–related changes to SRP management commands. For information on high availability-related changes to SRP, see "Managing Stateful SRP Switchover" on page 23.

You activate high availability (stateful SRP switchover) by launching Redundancy Configuration mode and issuing the **mode high-availability** command. The **high-availability** keyword enables high availability mode for stateful SRP switchover. In this mode, the router uses mirroring to keep the configuration and state of the standby SRP module coordinated with the configuration and state of the active SRP module.

When activating high availability, keep the following in mind:

- In an E Series router that supports stateful SRP switchover, both SRP modules must be running the same software release version in order to activate high availability mode.
- If high availability mode cannot become active because of different releases on the active and standby SRP modules, the system reverts to its default mode (file system synchronization).
- When active or pending, the router configuration files are mirrored from the active SRP module to the standby SRP module. All other files shared between the active and standby SRP modules are automatically synchronized using legacy synchronization methods.

Related Topics

- Stateful SRP Switchover Redundancy Modes on page 25
- Activating High Availability on page 40

- redundancy
- mode

Activating High Availability

The switch route processor (SRP) module can operate in one of the two redundancy modes—file system synchronization and high availability. When you activate high availability, the router uses mirroring to keep the configuration and state of the standby SRP module coordinated with the configuration and state of the active SRP module.

To activate high availability:

1. From Global Configuration mode, launch Redundancy Configuration mode.

   host1(config)#**redundancy**

2. In Redundancy Configuration mode, specify high availability as the redundancy mode.

   host1(config-redundancy)#**mode high-availability**

Related Topics

- Stateful SRP Switchover Redundancy Modes on page 25
- Guidelines for Activating High Availability on page 39

- redundancy
- mode

Guidelines for Deactivating High Availability

You can disable high availability (stateful SRP switchover) by launching Redundancy Configuration mode and issuing the **mode file-system-synchronization** command or specifying the **no mode** command.

In the **file-system-synchronization** mode, the router synchronizes the files and data such as configuration files and releases that are stored in NVS (nonvolatile storage) between the primary and standby SRP modules. This is the default behavior mode for E Series routers that contain redundant SRPs.

Because this mode uses file synchronization instead of transaction-based mirroring, when the active SRP module switches to the standby SRP, the router cold-starts.

Related Topics

- Stateful SRP Switchover Redundancy Modes on page 25
- Deactivating High Availability on page 41

- redundancy
- mode

Deactivating High Availability

The switch route processor (SRP) module can operate in one of the two redundancy modes—file system synchronization and high availability. When you disable high availability, the router uses file system synchronization mode which is the default behavior mode for E Series routers that use redundant SRPs. The router synchronizes the contents of the NVS (nonvolatile storage) in the primary and standby SRP modules.

To disable high availability support:

1. From Global Configuration mode, launch Redundancy Configuration mode.

   host1(config)#**redundancy**

2. In Redundancy Configuration mode, you can disable high availability by doing one of the following:

   - Specify file system synchronization mode as the redundancy mode.

     host1(config-redundancy)#**mode file-system-synchronization**

   - Specify the **no** version to disable high availability.

     host1(config-redundancy)#**no mode**

Related Topics

- Stateful SRP Switchover Redundancy Modes on page 25
- Guidelines for Deactivating High Availability on page 41

- redundancy
- mode

Guidelines for Setting the IP Interface Priority

During the warm restart after an SRP switchover, IP and IPv6 interfaces are replayed from NVS and from mirrored storage. High-priority IP and IPv6 interfaces are replayed first, followed by static routes, and then by low-priority IP and IPv6 interfaces. This scheme enables static routes that are dependent on high-priority interfaces to be resolved and routing protocols to exchange information with peers over high-priority interfaces before the low-priority interfaces are replayed.

You can designate an IP or IPv6 interface as high priority either implicitly or explicitly:

- Implicit designation—Configure an IGP or PIM protocol on the interface.
- Explicit designation—Issue the **ip initial-sequence-preference 1** command on the IP subinterface, or the **ipv6 initial-sequence-preference 1** command on the IPv6 subinterface.

An IP or IPv6 interface can be designated as high priority by more than one protocol, the CLI command, or both. You can change an IP or IPv6 interface from high priority to low priority only by one of the following methods:

- Delete the IP or IPv6 interface.
- Remove all high-priority configuration from the IP or IPv6 interface, then reload the router.

Related Topics

- Setting the IP Interface Priority on page 42
- ip initial-sequence-preference
- ipv6 initial-sequence-preference

Setting the IP Interface Priority

Use the **ip initial-sequence-preference** command to set the preference value on an IP or IPv6 interface at the subinterface level. To configure the interface as high-priority, specify the value of the initial sequence preference as 1. To configure the interface as low-priority, specify the value as 0.

To set the priority for the IPv4 or IPv6 interface, you can do one of the following:

- From Subinterface Configuration mode, explicitly configure the IPv4 interface as high-priority:

  host1(config-subif)#**ip initial-sequence-preference 1**

- From Subinterface Configuration mode, explicitly configure the IPv6 interface as low-priority:

  host1(config-subif)#**ipv6 initial-sequence-preference 0**

Related Topics

- Guidelines for Setting the IP Interface Priority on page 42

- ip initial-sequence-preference
- ipv6 initial-sequence-preference

Guidelines for Upgrading Software

You cannot activate stateful SRP switchover when a different release of software is running on the standby SRP module. The router determines whether a release is the same by viewing the build date, the release filename, and the internal version number for the software on each SRP module.

The most efficient way to upgrade the software is to ensure that the standby SRP module is armed with the new release and then reload the standby SRP module. This reload occurs automatically after you download and arm a new release onto the active SRP module and the active SRP module subsequently synchronizes with the standby SRP module.

After reloading, and even though high availability mode is configured, the active SRP module reverts to using the file-system-synchronization operational mode for synchronizing updates. To complete the upgrade and place the system back in high-availability operational mode, you must execute the **srp switch** command to force the standby SRP module to take over as the active SRP module.

NOTE: Executing the **srp switch** command results in a cold restart of the router.

After the switchover is initiated, the formerly active SRP module reloads the software and starts running the same release as the newly active SRP module. When the formerly active SRP module becomes operational as the standby SRP module, the newly active SRP module detects that the release it is running is the same as that on the standby SRP module and allows the originally active SRP module to resume the high-availability operational mode.

If a fault occurs when the active SRP module is in file-system-synchronization operational mode, the standby SRP module detects the fault and takes over, and the router cold-restarts. For this reason, you must arm the new release *only* when you can accept the resulting window of vulnerability where high availability is disabled (that is, until the active and standby SRP modules are again running the same release).

Related Topics

- Stateful SRP Switchover Redundancy Modes on page 25
- Stateful SRP Switchover States on page 26
- srp switch

Monitoring the Redundancy Status

Purpose Display the redundancy modes and other information about stateful SRP switchover.

Action To display summary redundancy status information.

```
host1#show redundancy
SRP
---

high-availability state:  disabled
current redundancy mode:  high-availability
last activation type:     cold-switch

Criteria Preventing High Availability from being Active
-------------------------------------------------------
                   criterion                      met
----------------------------------------------   ---
Standby SRP is online and capable of mirroring?   No

Line Card
---------

automatic reverting is off

                              backed
                                up     sparing
       hardware    lockout      by       for     revert
slot     role       config     slot     slot       at
----   --------   ---------   ------   -------   ------
 3       ---         ---        ---      ---      ---
 8      spare        ---        ---      ---      ---
 12    primary    protected     ---      ---      ---

         midplane   midplane
slots      type       rev
------   --------   --------
8 - 13      6          0
```

To display detailed redundancy status information:

```
host1#show redundancy detail
SRP
---
high-availability state:  disabled
current redundancy mode:  file-system-synchronization
last activation type:     cold-start
   Criteria Required for High Availability to be Active
   ----------------------------------------------------
                     criterion                           met
-----------------------------------------------------   ---
Active SRP hardware supports High Availability?         Yes
High Availability mode configured?                      No
Mirroring Subsystem present?                            Yes
Mirroring activity levels within limits?                Yes
Network Core Dumps disabled?                            Yes
Running configuration is safe for High Availability?    Yes
Standby SRP hardware supports High Availability?        Yes
Standby SRP is online and capable of mirroring?         Yes
Standby SRP is running the same release?                Yes
Line Card
---------
automatic reverting is off
                              backed
                                up     sparing
       hardware    lockout      by       for     revert
slot     role       config     slot     slot       at
----   --------   ---------   ------   -------   ------
```



```
 3       ---         ---       ---       ---      ---
 8      spare        ---       ---       ---      ---
 12    primary    protected    ---       ---      ---
         midplane   midplane
slots      type        rev
------   --------   --------
8 - 13      6           0
```

Meaning Table 6 on page 45 lists the **show redundancy** command output fields.

Table 6: show redundancy Output Fields

Field Name	Field Description
SRP	
high-availability state	State of high availability mode: • disabled—Initial, default state for high-availability mode. The router continues to use file system synchronization. • active—Data synchronized from the active SRP module to the standby SRP module during initialization remains synchronized through mirroring updates. • pending—If an unsupported application is configured, the router transitions to this state. • initializing—If SRP module is in initializing state, bulk synchronization of memory and NVS occurs.
current redundancy mode	Redundancy mode currently used by the router: • high-availability—Ensures rapid SRP module recovery after a switchover by using initial bulk file transfer and subsequent, transaction-based mirroring. • file-system-synchronization—Default redundancy mode of the router. SRP modules reload all line modules and restart form saved configuration files.
last activation type	Last type of activation that occurred on the router. The method using which the SRP last booted: • cold-switch—When the router is in pending state and switchover occurs, the router undergoes a cold-switch or cold re-start. • warm-switch—When the router is in active state and switchover occurs, the router undergoes a warm-switch or warm re-start.
Criteria Preventing High Availability from being Active	Criteria preventing the router from being in the active state of high availability mode. NOTE: For the router to be in the Active state, all criteria for this option must be “yes”.

Table 6: show redundancy Output Fields *(continued)*

Field Name	Field Description
Criteria Required for High Availability to be Active	Criteria required for the router to be in the active state of high availability mode. NOTE: For the router to be in the Active state, all criteria for this option must be "yes".
Line Card	
automatic reverting	State of automatic reverting. Possible states: on or off.
slots	Slots in which the line modules reside.
hardware role	Function of the line module. Possible values: primary or spare.
lockout config	Status of redundancy on the line module: • protected—Line module redundancy is enabled • locked out—Line module redundancy is disabled
backed up by slot	Slot that contains the line module that is a spare for this primary line module.
sparing for slot	Slot that contains the primary line module for which this module is a spare.
revert at	Time at which you want the line module to revert.
midplane type	Identifier for the type of midplane.
midplane rev	Hardware revision number of the redundancy midplane.
fabric slice redundancy	Status of the fabric slice on the SRP modules or SFMs on the E120 and E320 routers.
slot	Slot in which the fabric slice resides.
slice state	State of the fabric slice. Possible values: online or not present.
type	Identifier for the type of hardware. Possible values: SRP modules or SFM modules.

Related Topics

- show redundancy

Monitoring the Redundancy Status of Applications

Purpose Display the redundancy status of the applications.

Action To display the applications that do not support high availability.

```
host1#show redundancy clients

Unsupported High Availability Clients
 -------------------------------------
       client           configuration
---------------------   -------------
DHCP Proxy Client           safe
Global Ipv6                 safe
IPsec Transport (ITM)       safe
l2tpDialoutGenerator        safe
DHCPv6 Local Server         safe
Radius Relay Server         safe
```

You can also display the redundancy status information of all clients. Specifies whether the client supports high availability and also the safety level of configuration. For instance, if an unsupported client is configured on a router with high availability enabled, the configuration reads “unsafe”.

```
host1#show redundancy clients all
High Availability Client Information
         ------------------------------------
       client              mode      configuration
---------------------   -----------  -------------
atm1483DataService       supported       safe
AA83                     supported       safe
aaaServer                supported       safe
atmAal5                  supported       safe
AAQS                     supported       safe
atm                      supported       safe
Bridged Ethernet         supported       safe
Transparent Bridging     supported       safe
dcm                      supported       safe
dhcpExternal             supported       safe
DHCP Proxy Client       unsupported      safe
DS1                      supported       safe
DS3                      supported       safe
ethernet                 supported       safe
Flow Inspection          supported       safe
frameRelay               supported       safe
FT1                      supported       safe
Global Ipv6             unsupported      safe
Global Ip                supported       safe
HDLC                     supported       safe
IKEP                     supported       safe
ipflowstats              supported       safe
IpSubscriberManager      supported       safe
IPTU                     supported       safe
IPVR                     supported       safe
IPsec Transport (ITM)   unsupported      safe
l2tpDialoutGenerator    unsupported      safe
l2tp                     supported       safe
LMGR                     supported       safe
DHCPv4 Local Server      supported       safe
DHCPv6 Local Server     unsupported      safe
```

```
MPLS                     supported      safe
PMGR                     supported      safe
pppoe                    supported      safe
ppp                      supported      safe
qos                      supported      safe
Radius Relay Server    unsupported      safe
RSVP                     supported      safe
SCM                      supported      safe
slotHelper               supported      safe
Cisco HDLC               supported      safe
ServiceManager           supported      safe
Sonet                    supported      safe
SonetPath                supported      safe
SonetVT                  supported      safe
IPsec Tunnel (ST)        supported      safe
```

Meaning Table 7 on page 48 lists the **show redundancy clients** command output fields.

Table 7: show redundancy clients Output Fields

Field Name	Field Description
client	High availability client.
mode	High availability status of the client. Possible values: supported or unsupported.
Configuration	Safety level of the configuration based on whether or not the client is supported or unsupported and in case of those unsupported, whether or not the client has been configured. For example, if an unsupported client has been configured on a router with high availability enabled, the configuration reads “unsafe”.

Related Topics

- show redundancy clients

Monitoring the Redundancy History

Purpose Display information about dates, times, and the number of occurrences for starts and switchovers.

Action To display information about the number of occurrences for starts and switchovers.

```
host1#show redundancy history
system up time:        0 00:08:01
last cold start:       2004-07-26 10:44:25
last cold switchover:  2004-07-25 18:51:56
last warm switchover:  2004-07-25 20:58:57
activation statistics:
    cold starts:           92
    switchovers:
        cold:              21
        warm:              147
        consecutive warm:  0
```

To display the additional redundancy history information:

```
host1#show redundancy history detail
system up time:        0 00:08:01
last cold start:       2004-07-26 10:44:25
last cold switchover:  2004-07-25 18:51:56
last warm switchover:  2004-07-25 20:58:57
activation statistics:
    cold starts:           92
    switchovers:
        cold:              21
        warm:              147
        consecutive warm:  0
                                              system
SRP activation time      type       slot   uptime    running release
-------------------   ----------    ----   ------   -----------------
2004-09-08 15:10:40   cold-start     00     ---     erx_6-0-0b1-8.rel
2004-09-08 14:39:10   cold-start     00     ---     erx_6-0-0b1-1.rel
```

Meaning Table 8 on page 49 lists the **show redundancy history** command output fields.

Table 8: show redundancy history Output Fields

Field Name	Field Description
system up time	Amount of time elapsed since the last cold boot.
last cold start	Date and time the router experienced the last cold start.
last cold switchover	Date and time the router experienced the last cold switchover.
last warm switchover	Date and time the router experienced the last warm switchover.
cold starts	Total number of cold starts the router has experienced.
switchovers	Number of cold, warm, and consecutive warm switchovers the router has experienced.
SRP activation time	Amount of time the SRP module has been active.
type	Last type of activation that occurred on this router.
slot	Slot in which the line module resides.
system uptime	Amount of time the chassis has been operational.
running release	Release running on the SRP module at the time.

Related Topics

- show redundancy history

Monitoring the Redundancy Status of Line Modules

Purpose Display redundancy information specific to line modules.

Action To display the redundancy status of the line modules.

```
host1#show redundancy line-card
automatic reverting is off
                              backed
                                up     sparing
       hardware    lockout      by       for      revert
slot     role      config      slot     slot        at
----   --------  ---------   ------   -------   ------
 3       ---        ---       ---       ---       ---
 8      spare       ---       ---       ---       ---
 12    primary   protected    ---       ---       ---
         midplane   midplane
slots      type       rev
------   --------   --------
8 - 13      6          0
```

Meaning Table 9 on page 50 lists the **show redundancy line-card** command output fields.

Table 9: show redundancy line-card Output Fields

Field Name	Field Description
automatic reverting	State of automatic reverting (on or off).
slots	Slots in which the line modules reside.
hardware role	Function of the line module: primary or spare.
lockout config	Status of redundancy on this line module: • protected—Line module redundancy is enabled • locked out—Line module redundancy is disabled
backed up by slot	Slot that contains the line module that is a spare for this primary line module.
sparing for slot	Slot that contains the primary line module for which this line module is a spare.
revert at	Time at which you want line module to revert.
midplane type	Identifier for the type of midplane.
midplane rev	Hardware revision number of the redundancy midplane.

Related Topics

- show redundancy line-card

Monitoring the Redundancy Status of SRP Modules

Purpose Display redundancy information specific to SRP modules.

Action To display the redundancy status of the SRP modules.

```
host1#show redundancy srp
high-availability state:  active
current redundancy mode:  high-availability
last activation type:     warm-switch
```

To display the redundancy status of the SRP modules in detail.

```
host1#show redundancy srp detail
high-availability state:  disabled
current redundancy mode:  file-system-synchronization
last activation type:     cold-start
   Criteria Required for High Availability to be Active
   ----------------------------------------------------
                     criterion                          met
----------------------------------------------------   ---
Active SRP hardware supports High Availability?        Yes
High Availability mode configured?                     No
Mirroring Subsystem present?                           Yes
Mirroring activity levels within limits?               Yes
Network Core Dumps disabled?                           Yes
Running configuration is safe for High Availability?   Yes
Standby SRP hardware supports High Availability?       Yes
Standby SRP is online and capable of mirroring?        Yes
Standby SRP is running the same release?               Yes
```

Meaning Table 10 on page 51 lists the **show redundancy srp** command output fields.

Table 10: show redundancy srp Output Fields

Field Name	Field Description
high-availability state	State of high availability mode: • disabled—Initial, default state for high-availability mode. The router continues to use file system synchronization. • active—Data synchronized from the active SRP module to the standby SRP module during initialization remains synchronized through mirroring updates. • pending—If an unsupported application is configured, the router transitions to this state. • initializing—If SRP module is in initializing state, bulk synchronization of memory and NVS occurs.

Table 10: show redundancy srp Output Fields *(continued)*

Field Name	Field Description
current redundancy mode	Redundancy mode currently being used by this router: • high-availability—Ensures rapid SRP module recovery after a switchover by using initial bulk file transfer and subsequent, transaction-based mirroring. • file-system-synchronization—Default redundancy mode of the router. SRP modules reload all line modules and restart form saved configuration files.
last activation type	Last type of activation that occurred on the router. The method using which the SRP last booted: • cold-switch—When the router is in pending state and switchover occurs, the router undergoes a cold-switch or cold re-start. • warm-switch—When the router is in active state and switchover occurs, the router undergoes a warm-switch or warm re-start.
Criteria Required for High Availability to be Active	Criteria required for high availability to be active. NOTE: All criteria must be “yes” for high availability to be active.

Related Topics

- show redundancy srp

Monitoring the Redundancy Switchover History

Purpose Display information about stateful SRP switchover history for the chassis.

Action

```
host1# show redundancy switchover-history
                                                  system
SRP activation time      type         slot      uptime          running release
-------------------   -----------   ----    ----------    -------------------------
2004-07-26 10:44:25   cold-start     07        ---         L-07-25-60b1mrg-e.rel
2004-07-25 20:58:57   warm-switch    06     0 00:15:08     L-07-25-60b1mrg-e.rel
2004-07-25 20:53:41   warm-switch    07     0 00:09:51     L-07-25-60b1mrg-e.rel
2004-07-25 20:44:43   cold-start     06        ---         L-07-25-60b1mrg-e.rel
2004-07-25 19:32:01   cold-start     06        ---         L-07-25-60b1mrg-d.rel
2004-07-25 18:58:01   warm-switch    06     0 00:12:01     L-07-25-60b1mrg-c.rel
2004-07-25 18:51:56   cold-switch    07     0 00:05:56     L-07-25-60b1mrg-c.rel
2004-07-25 18:46:54   cold-start     06        ---         L-07-25-60b1mrg-c.rel
2004-07-25 17:44:48   warm-switch    06     0 00:14:32     L-07-25-60b1mrg-b.rel
2004-07-25 17:31:07   cold-start     07        ---         L-07-25-60b1mrg-b.rel
2004-07-25 16:05:08   cold-start     07        ---         L-07-25-60b1mrg-a.rel
2004-07-24 23:25:09   warm-switch    07     0 16:27:03     L-07-24-60b1mrg-b.rel
2004-07-24 23:18:23   cold-switch    06     0 16:20:17     L-07-24-60b1mrg-b.rel
```

Meaning Table 11 on page 53 lists the **show redundancy switchover-history** command output fields.

Table 11: show redundancy switchover-history Output Fields

Field Name	Field Description
SRP activation time	Amount of time the SRP module has been active.
type	Type of switchover.
slot	Slot in which the SRP module resides.
system uptime	Amount of time the chassis has been operational.
running release	Release running on the SRP module at the time of the switchover.

Related Topics

- show redundancy switchover-history

Clearing the Redundancy History

To clear the stateful SRP switchover history for the router:

- Issue the **clear redundancy history** command:

  host1#**clear redundancy history**

There is no **no** version.

Related Topics

- Monitoring the Redundancy History on page 48
- Monitoring the Redundancy Switchover History on page 52
- clear redundancy history
- show redundancy history
- show redundancy switchover-history

CHAPTER 4

Configuring a Unified In-Service Software Upgrade

This chapter describes how to prepare for and perform a unified in-service software upgrade (unified ISSU) of JunosE Software on E120 and E320 Broadband Services Routers. A unified in-service software upgrade provides a way to upgrade to a higher-numbered release while minimizing the effect of the upgrade on traffic forwarded through the router.

Unified ISSU Overview

In software releases numbered lower than Release 6.0, all line modules are reloaded when an SRP switchover occurs. This reload disconnects user sessions and disrupts forwarding through the chassis. Stateful SRP switchover was introduced in JunosE Release 6.0 to minimize the impact to the router of a stateful switchover from the active SRP module to the standby SRP module. Stateful SRP switchover (high availability) maintains user sessions during the switchover and data forwarding through the router continues to flow with little impact, thus improving the overall availability of the router.

The unified in-service software upgrade (unified ISSU) feature further extends router availability. Unified ISSU enables you to upgrade the router to a higher-numbered software release without disconnecting user sessions or disrupting forwarding through the chassis.

A conventional software upgrade—one that does not use the unified ISSU process—causes a router-wide outage for all users. Only static configurations (stored on the flash card) are maintained across the upgrade; all dynamic configurations are lost. A conventional upgrade takes 30-40 minutes to complete, with additional time required to bring all users back online.

When you perform a unified in-service software upgrade on a router that has one or more modules that do not support unified ISSU, these modules alone are upgraded by means of the legacy, conventional upgrade process. The unsupported modules undergo a cold reboot at the beginning of the unified ISSU process, and are held down until the in-service software upgrade is completed. Connections that pass through the unsupported modules are lost. The interfaces on these modules pass into a down state, which causes the physical layer and link layer to go down during the unified in-service software upgrade for those modules.

Applications that do not support unified ISSU applications cannot maintain state and configuration with minimal traffic loss across the upgrade to a higher-numbered release. When you attempt a unified in-service software upgrade on a router on which a unified ISSU-challenged application is configured, the unified in-service software upgrade cannot proceed. You must unconfigure the unified ISSU-challenged application to successfully perform the unified ISSU.

Router Behavior During a Unified In-Service Software Upgrade

The following behaviors are characteristic of a unified in-service software upgrade.

- Connections that were established before you begin the unified ISSU are maintained across the upgrade. Any such connection that was forwarding data continues to do so during and after the upgrade.
- New connections are denied until the upgrade is completed.
- Packet loss during the upgrade is limited. Bandwidth through the modules is reduced, but the impact is minimal.
- Graceful restart protocols do not time out during the unified ISSU.
- The unified in-service software upgrade has a minimal effect on the control and data planes. During the SRP module upgrade phase, forwarding through the fabric is interrupted for about 1 second on the E120 and E320 routers and about 4 seconds on the ERX1440 Broadband Services Router. During the line module upgrade phase, forwarding through the chassis is interrupted for about 15 seconds on the E120 and E320 routers and for about 50 seconds on the ERX1440 router.
- Diagnostic software is not run on any modules during a unified in-service software upgrade.
- The router undergoes a cold restart if you attempt to upgrade the software to a lower-numbered version with unified ISSU. The unified in-service software upgrade must be to a higher-numbered release than the running release.
- Additional memory is consumed during a unified in-service software upgrade. Available memory on a line module might not be sufficient due to the module's configuration. Unified ISSU can detect this limitation during the upgrade procedure and exit the process, gracefully.

Related Topics

- Unified ISSU Phases Overview on page 61
- Application Support for Unified ISSU on page 68
- Hardware and Software Requirements Before Beginning a Unified ISSU on page 58
- Upgrading Router Software with Unified ISSU on page 93

Unified ISSU Platform Considerations

Unified ISSU is supported on E120 and E320 routers. Unified ISSU is also supported on the ERX1440 router with the SRP-40G PLUS with 2GB of memory. Unified ISSU on the ERX1440 requires a license key.

For information about modules supported on E120 and E320 routers:

- See *E120 and E320 Module Guide, Table 1, Modules and IOAs* for detailed module specifications.

- See *E120 and E320 Module Guide, Appendix A, IOA Protocol Support* for information about the modules that support unified ISSU.

For information about modules supported on the ERX1440 router:

- See *ERX Module Guide, Table 1, ERX Module Combinations* for detailed module specifications.
- See *ERX Module Guide, Appendix A, Module Protocol Support* for information about the modules that support unified ISSU.

Redundant SRP modules are required for unified ISSU support.

Unified ISSU is not supported on the ERX7xx models, the ERX1410 router, and the ERX310 router.

Hardware and Software Requirements Before Beginning a Unified ISSU

The following hardware and software prerequisites must be met for the successful completion of unified ISSU. You can issue the **show issu** command to determine whether the routers meets these requirements.

Hardware Requirements for Unified ISSU

- The router must support unified ISSU. Therefore the router must be an E120, E320, or ERX1440 router.
- Two SRP modules must be installed in the router.
- All installed combinations of line modules and IOAs must support unified ISSU. Unsupported modules that are online are reloaded during the unified ISSU, with consequent loss of connections and traffic forwarding.

  Do not install IOAs in the chassis while the unified ISSU operation is in process.
- The redundant SRP module must have at least 300 MB of free memory. Depending on their configuration, line modules require up to 75 MB of free memory.

On the ERX1440 router, certain hardware updates might require a module to be cold restarted. Unified ISSU cannot be successfully accomplished with such modules. In this case, the behavior is the same as for unsupported line modules. The unified ISSU process reboots these modules and holds them down until the supported modules on the router complete the unified ISSU process.

When hardware updates are required for modules that you have installed in an ERX1440 router, contact your Juniper Networks representative to determine whether the update affects unified ISSU.

Software Requirements for Unified ISSU

- The running JunosE Software release must support unified ISSU.

  You can upgrade to a software version that supports unified ISSU from a software version that does not support unified ISSU only by means of a conventional upgrade. During the conventional upgrade, all line modules are reloaded, all subscribers are dropped, and traffic forwarding is interrupted until the upgrade is completed.

- The armed (upgrade) release must be capable of being upgraded to from the currently running release; it must be higher-numbered than the running release.

- All applications that are configured on the router must support unified ISSU and stateful SRP switchover.

  If one or more unified ISSU-challenged applications are configured and you proceed with a unified in-service software upgrade, the unified ISSU process forces a conventional upgrade on the router. All line modules are reloaded, all subscribers are dropped, and traffic forwarding is interrupted until the upgrade is completed.

  You can avoid this circumstance by removing the configuration for the unified ISSU-challenged applications from the router before you begin the in-service software upgrade.

- Stateful SRP switchover must be configured on the router. Use the following commands to configure high availability:

  host1(config)#**redundancy**
  host1(config-redundancy)#**mode high-availability**

  See "Managing Stateful SRP Switchover" on page 23 for information about high availability.

The following requirements must be met for traffic forwarding to continue. However, failing to meet these requirements does not halt the unified ISSU operation. The unified ISSU process offers the option to override or ignore these forwarding requirements.

- Graceful restart must be enabled for all configured routing protocols. The unified ISSU operation relies on graceful restart to keep the routing protocols alive through the various stages of the upgrade.

- All connected peers must be configured with graceful restart. Because some protocols cannot themselves confirm peer configuration for graceful restart, you must ensure that the peers are properly configured.

- For applications that exchange keepalive messages with peers, you must ensure that the poll times are adequate to maintain the peering session across any forwarding interruption caused by the unified ISSU operation.

- On the ERX1440 router, you must enter the key provided with your license in order to make the unified ISSU CLI commands available. Unified ISSU is licensed on only the ERX1440 router; no license is required or available on the E120 and E320 routers.

  The **license issu** command is available only on the ERX1440 CLI.

Related Topics

- Application Support for Unified ISSU on page 68
- Application Support for Stateful SRP Switchover on page 30
- Activating High Availability on page 40
- license issu
- show issu

Unified ISSU Terms

Table 12 on page 60 defines terms relevant to module behavior during a unified in-service software upgrade.

Table 12: Unified ISSU-Related Terms

Term	Meaning
Cold boot	The SRP module or line module loads diagnostics from the flash file system and runs them. When the diagnostics successfully complete, the operational image is loaded from the flash file system and then cold started.
Cold start	The SRP module or line module is initialized from the loaded operational image. The line modules are reloaded and the configuration is read from flash memory. When the line modules are operational, their configuration data is bulk downloaded and their interfaces become operational.
Cold restart	If the active SRP module fails, the standby SRP module takes the role of active SRP module. When high availability is not configured, the cold restart is similar to the cold start, except that the applications are already loaded into memory on the standby SRP module and ready to be started. The line modules are reloaded.
Warm restart	If the active SRP module fails, the standby SRP module takes the role of active SRP module. Mirrored configuration data as well as any mirrored volatile data are already resident in memory. The line modules continue to forward data (with a small loss of packets when the fabric is switched from the formerly active SRP module to the newly active SRP module). The protocols and other applications re-initialize from the mirrored data and resynchronize communications with the line modules. When resynchronization is completed, the router resumes normal operations, including updates of any routing tables that result from changes that occurred during the warm restart.

Unified ISSU References

For more information about stateful SRP switchovers, see “Managing Stateful SRP Switchover” on page 23.

For more information about SRP module redundancy, see “Managing Module Redundancy” on page 7.

Unified ISSU Phases Overview

The JunosE Software includes software modules that operate the following hardware components:

- SRP module
- Line module control plane
- Line module forwarding plane

A unified in-service software upgrade replaces the currently operating software on each of these components with a higher-numbered release. The unified ISSU also upgrades or re-creates the state and configuration data of the configured applications.

Before you begin the unified in-service software upgrade, you must first prepare the router for the upgrade. See “Hardware and Software Requirements Before Beginning a Unified ISSU” on page 58 for more information.

The unified in-service software upgrade takes place in three phases:

1. Initialization Phase—When you issue the **issu initialize** command, unified ISSU verifies whether all prerequisites for the upgrade have been met. The router is prepared for the upgrade. The configuration that has been mirrored to the standby SRP module is upgraded according to the upgrade release. This phase can last from a few minutes up to 40 minutes depending on the number of software releases across which the router is being upgraded.
2. Upgrade Phase—When you issue the **issu start** command, unified ISSU again verifies whether all prerequisites for the upgrade have been met. During this phase the line module control plane and forwarding plane are upgraded and all three hardware components are resynchronized.
3. Service Restoration Phase—This phase automatically begins without user intervention when the upgrade phase has completed. During this final phase, the router is returned to a normal, runtime state.

Related Topics

- Unified ISSU Initialization Phase Overview on page 61
- Unified ISSU Upgrade Phase Overview on page 63
- Unified ISSU Service Restoration Phase Overview on page 68
- Halting Unified ISSU During Initialization Phase on page 95
- Halting Unified ISSU During Upgrade Phase on page 96

Unified ISSU Initialization Phase Overview

When you issue the **issu initialize** command, unified ISSU first verifies whether all requirements for the upgrade are met. The verification process examines the running release, the SRP modules, the line modules, line module redundancy, and the router configuration.

The **issu initialize** command does not interrupt or disrupt any of the runtime operations of the router. The command has no effect on changes of authorization, forwarding, or subscribers (except perhaps, rate of logins). You cannot manually change the file system redundancy mode from high availability to file synchronization until the unified in-service software upgrade is completed.

NOTE: We recommend that you make no configuration changes after you have issued the **issu initialization** command. As a best practice, ensure that your configuration is complete before you start the software upgrade.

During the initialization phase, you can halt the unified in-service software upgrade at any time and revert either to a normal SRP module switchover or to the previous state of the router. To stop the unified ISSU process, you must issue the **issu stop** command. If instead you simply exit the CLI session, the unified ISSU initialization phase continues.

The action taken when a requirement is not met depends on the requirement. For some failed verifications, the CLI warns you of the issue and prompts you to proceed or quit the upgrade process. More serious failures cause the CLI to exit the command and provide a message describing the issue.

NOTE: We recommend that you issue the **show issu** command before beginning the unified in-service software upgrade. The output of the command lists any necessary conditions that are not currently met on the router. You can therefore correct these failures before entering into the upgrade. You can issue the **show issu** command at any time.

NOTE: On E120 and E320 routers, you can hot swap an IOA during the initialization phase without affecting the in-service software upgrade. However, we strongly recommend that you perform any necessary hot swaps before you issue the **issu initialize** command.

If the standby SRP module reloads during the initialization phase, unified ISSU is halted. You must begin again by issuing the **issu initialize** command.

Application Data Upgrade on the Standby SRP Module

Synchronized modules can become unsynchronized because you can change the router configuration at any time until you issue the **issu start** command. When the verification process is completed, unified ISSU starts up the stateful SRP switchover process to maintain synchronization between the active SRP module and the standby SRP module during the SRP module upgrade phase.

NOTE: An SRP switchover from the active SRP module to the standby SRP module at this point in the unified in-service software upgrade causes a cold restart of the router because the SRP modules are running two different releases. The current release is on the active SRP module and the upgrade release is on the standby SRP module.

The application and configuration data that has been mirrored to the standby SRP module is upgraded as required by the new software release. The CLI displays the progress of the SRP module upgrade.

While data on the standby SRP module is upgraded, any new changes that are mirrored from the primary SRP module to the standby SRP module are also upgraded to the version required by the armed release.

NOTE: This process consumes significant CPU resources on the redundant SRP module and can take a considerable amount of time to complete. Performance of the active SRP module might be affected during the SRP module upgrade.

When the upgrade release has been synchronized to the standby SRP module, stateful SRP switchover is disabled until the unified in-service software upgrade is completed.

If you configure an application that does not support unified ISSU during the initialization phase, the initialization phase completes, but the **issu start** command subsequently fails.

SNMP Traps

When you issue the **issu initialization** command, the SNMP agent generates a juniSystemIssuStateChange trap with juniSystemIssuState set to initializing. When the unified ISSU initialization is completed, the SNMP agent generates a juniSystemIssuStateChange trap with juniSystemIssuState set to initialized.

Related Topics

- Unified ISSU Phases Overview on page 61
- Halt of Unified ISSU During Initialization Phase Overview on page 95
- Halting Unified ISSU During Initialization Phase on page 95

- issu initialize
- issu start
- issu stop
- show issu

Unified ISSU Upgrade Phase Overview

During the upgrade phase, the CLI supports only a reduced set of administrative commands. You cannot interrupt the upgrade phase. The upgrade phase cannot commence if any CLI commands outside of this set are executing when you issue the **issu start** command.

NOTE: Although you can use any CLI session to issue the **issu start** command, we recommend that you issue the command from a session to the management console port. When the standby SRP module switchover takes place, all management network connections through the Ethernet management port are dropped, and you can access the router only through a console port until the service restoration phase is completed.

When you issue the **issu start** command, unified ISSU performs the following operations:

1. Verifies that the unified ISSU requirements on the router are still met.
2. Verifies that the active and standby SRP modules are synchronized. If they are not synchronized, forces a synchronization to ensure that all configuration and file system changes are propagated to the standby SRP module before proceeding with the upgrade.
3. Copies the NVS configuration from a backup memory area to the flash card on the standby SRP module. During the initialization phase, this configuration data was mirrored from NVS on the active SRP module and upgraded as required by the armed release.
4. Upgrades the control plane on each line module at the same time.
5. Switches control from the primary SRP module (running the current release) to the standby SRP module (running the armed upgrade release).
6. Upgrades the forwarding plane on each line module at the same time. The fabric is switched and upgraded.

You can view the status of the router and the progress of the upgrade at any time by issuing the **show issu** command from another terminal session to the router.

NOTE: While a unified ISSU operation is in progress, do not remove the SRP modules or attempt to reset them. Removing the SRP modules anytime during unified ISSU has an adverse impact.

After the unified ISSU operation is completed, issue the **show version** command. The output from a successful upgrade indicates the following:

- The formerly active SRP module has rebooted and come up as the new standby SRP module.
- The newly active SRP module indicates that the formerly active SRP has rebooted and has come up as standby SRP module

You can then remove an SRP module after issuing the **halt** command.

Exceptions During the Upgrade Phase

Table 13 on page 65 describes the behavior of the router during the upgrade phase when certain exceptional events take place outside the context of the unified in-service software upgrade.

Table 13: Router Response to Undesirable Events During the Upgrade Phase

Event	Router Action
The router reloads.	• The unified ISSU operation halts. • The router undergoes a cold restart. • The router boots with the armed upgrade release. • The line modules reboot.
The primary SRP module switches over to the standby SRP module.	• The unified ISSU operation halts. • The router undergoes a cold restart. • The router boots with the armed upgrade release. • The line modules reboot.
The standby SRP module reloads.	• The unified ISSU operation halts. • The router undergoes a cold restart. • The router boots with the armed upgrade release. • The line modules reboot.
A line module reloads.	• The line module is held down and prevented from rebooting until the service restoration phase is completed. The line module then undergoes a cold reboot to the running (post-upgrade) release.
An IOA is hotswapped.	• Hot swapping is disabled during the upgrade phase. The line module undergoes a cold reboot and hot swapping is reenabled when the service restoration phase is completed,
An application that does not support unified ISSU is configured.	• This event can take place only before the **issu start** command is issued, because that command disables CLI configuration commands. When you issue the **issu start** command, after configuring such an application, the command exits and generates an error message.

Verifications of Requirements

Because some time may have passed since unified ISSU verified the requirements for the upgrade during the initialization phase, unified ISSU reverifies all the same conditions.

Unified ISSU also verifies that no CLI configuration sessions are open, that no scripts or macros are running, and that any SNMP requests or CLI commands in progress complete within 5 seconds.

If any of the required conditions are not met, the CLI either exits the command with an error message or provides an informative message and prompts you to proceed or halt.

When all the conditions are met, the CLI prompts you to proceed. If you continue, then you can subsequently halt the upgrade only by reloading the router. If you exit the command, the router remains in the unified ISSU initialized state.

Upgrade Setup

At this stage all the preconditions have been met. The unified ISSU process shuts down all management interfaces to the router in order to prevent changes in the configuration.

Final preparation for the upgrade phase includes the following actions:

- SNMP—The SNMP agent generates a juniSystemIssuStateChange trap with juniSystemIssuState set to upgrading to indicate that the final phase of the operation has begun. When the trap is issued with this state value, the SNMP agent stops accepting any new SNMP gets or sets and does not issue any further traps.
- CLI—Most CLI commands are disabled. Only **reload**, **show issu**, and **show version** commands are available to you until the service restoration phase completes. These commands are available on the console and are not available to Telnet sessions.
- External events—Externally created events from sources other than the CLI are ignored. These events typically come from user connections, RADIUS servers, SRC software and SDX software, and SNMP, and include login requests, COA requests, multicast join requests, packet mirroring requests, and so on. Logout requests are cached and processed at a later stage.
- Routing protocols—The unified ISSU process prompts you to consider raising the link costs for each routing protocol that is configured on the router. Raising the link cost for routes through the upgrading router enables neighbors to recompute better routes to those destinations. If you choose to raise the link cost, the higher costs can take some time to propagate through the network. Because the router is unable to determine when this has completed, it waits for 2 minutes before proceeding to the next step in the upgrade.

  The reason for raising the link cost is that when the upgrade of the line module control plane begins, routing protocol updates cannot be installed in the line modules until that upgrade completes. That period can be in the range 2–15 minutes. During the control plane upgrade, the routing protocols can still accept new routes and communicate with their neighbors but cannot install the routes.
- Unsupported line modules—Any unsupported line modules that are present are held down after the start of this phase when you can no longer gracefully exit from the unified ISSU process. The modules are held down for the duration of the unified in-service software upgrade and then undergo a cold boot to the original running release.
- IGMP requests—The router cannot handle IGMP requests for channel changing for IPTV implementations.

Line Module Arming

When the upgrade of the application data on the standby SRP upgrade is completed, unified ISSU temporarily arms the line modules with the upgrade release in a backup region of the memory.

Line Module Control Plane Upgrade

At this point, the upgrade release is preserved on each line module in some backup region. When signaled by the active SRP module, all supported line modules simultaneously reload and restart with the new release. Forwarding through the forwarding subsystem on the line modules—through the fabric of the system—is not affected by the reload.

The line modules then simultaneously recover any application data preserved in memory on the line module and upgrade that data into a format that the applications running on the new release can interpret. This operation can take in the range of 1–10 minutes depending on the size of the data and the upgrade path of the data. Each line module restores its operational state, running the new release with all data upgraded to a version acceptable to the new software.

If the upgrade process fails for any line module, that module undergoes a cold restart, but none of the other line modules is affected.

SRP Module Switchover

At this stage the primary SRP module is running the current release, the redundant SRP module is running the armed release, and the control plane on each supported line module is running the armed release.

When the primary SRP module has verified that all line modules are up, the redundant SRP module takes over control of the router by becoming the active SRP module. The primary, and formerly active, SRP module reboots to the armed release and serves as the standby SRP module.

All applications on the newly active SRP module are restarted. Each application reconstructs itself from the mirrored data, restoring its state and configuration as it was before the switchover. Forwarding through the fabric is interrupted for about 1 second on the E120 and E320 routers and about 4 seconds on the ERX1440 router.

The SRP switchover restarts the routing protocols and triggers a graceful restart because the routes need to be recomputed. This recalculation can take up to 90 seconds. Data continues to be forwarded through routes that were learned before the upgrade of the line module control planes.

Line Module Forwarding Plane Upgrade

While the applications on the SRP module and the line modules reconstruct themselves, they also begin to build up the new state for the forwarding subsystem. All applications on the line module signal the system when they are ready to start the forwarding upgrade.

Because upgrading the forwarding plane affects forwarding through the chassis for up to 30 seconds on the E120 and E320 routers and about 50 seconds on the ERX1440 router, unified ISSU does not proceed until the routing protocols have signaled that route reconvergence has completed. Unified ISSU then instructs all line modules to simultaneously upgrade their forwarding subsystems.

The line modules then perform the following steps:

1. Halt forwarding through the line modules. Although any links to external devices remain up, incoming data is dropped.
2. Update any changed programmable hardware devices.
3. Update the forwarding subsystem with the new release and upgraded configuration data.

4. Update the routing tables with the reconverged routes.
5. Resume forwarding.

Related Topics

- Unified ISSU Phases Overview on page 61
- Halt of Unified ISSU During Upgrade Phase Overview on page 96
- Halting Unified ISSU During Upgrade Phase on page 96
- issu start
- show issu
- halt
- reload

Unified ISSU Service Restoration Phase Overview

This is the final unified ISSU phase. At this point, all three major components of the router—the SRP modules, the line module control planes, and the line module forwarding planes—have been upgraded and forwarding has resumed through the chassis. The following actions take place during this phase:

- The CLI is re-enabled. All commands are made available to users.
- The SNMP agent is restarted and bulk statistics are collected and available for review. (The first interval of bulk statistics collection starts when unified ISSU is still in process. Therefore, the system performs bulk statistics collection after the first interval.)
- New login requests and logout requests are processed. The router begins to accept externally created events from sources other than the CLI and SNMP. These events typically come from user connections, RADIUS servers, and SRC software and SDX software, and include login requests, COA requests, multicast join requests, and so on.
- Logout requests that were cached at the start of the unified in-service software upgrade are processed.
- After the flash memory on the newly active SRP module is updated, stateful SRP switchover is available to the router.

At this point the unified in-service software upgrade is completed, and the router is restored to normal operation. Any line modules that reloaded during the upgrade phase and were therefore held down are now rebooted to the original running release.

Related Topics

- Unified ISSU Phases Overview on page 61

Application Support for Unified ISSU

When an application supports unified ISSU, you can configure the application on the router and proceed with the unified in-service software upgrade with no adverse impact to the upgrade.

Applications that do not support unified ISSU cannot maintain state and configuration with minimal traffic loss across the upgrade. When you attempt the unified in-service software upgrade on a router that is configured with an ISSU-challenged application, the unified in-service software upgrade is halted and cannot proceed unless you remove the configuration. An application that does not support high availability cannot support unified ISSU.

Table 14 on page 69 indicates which applications support or do not support a unified in-service software upgrade, as well as limitations on their behavior.

Table 14: Application Support for Unified In-Service Software Upgrades

Application	Supported	Unsupported	Notes
Physical Layer Protocols			
DS1 (E120 and E320)	–	–	–
DS1 (ERX1440)	–	–	–
DS3	✓	–	–
HDLC	✓	–	–
SONET/SDH	✓	–	Unified ISSU support is provided only for non-channelized APS IOAs. Also, unified ISSU can proceed only if you have not configured APS on the OCx/STMx ATM or OCx/STMx POS line modules. If you have configured APS, a warning message is displayed and the router cannot proceed with the unified ISSU. The unified ISSU process for channelized line modules remains unchanged. E120 and E320 routers do not support APS.
SONET/SDH VT	–	✓	–
Link-Layer Protocols			

Table 14: Application Support for Unified In-Service Software Upgrades *(continued)*

Application	Supported	Unsupported	Notes
ARP	✓	–	ARP entries in the ARP cache do not time out because no ARP aging occurs during unified ISSU. When the unified ISSU is completed, the ARP cache contains the same entries as it had before the unified ISSU began.
ATM	✓	–	–
ATM 1483 bulk configuration of dynamic interfaces	✓	–	–
ATM bulk configuration of static interfaces	✓	–	–
Bridged Ethernet	✓	–	–
Cisco HDLC	✓	–	–
Ethernet (with and without VLANs)	✓	–	–
Frame Relay	–	–	–
PPP	✓	–	–
PPPoE	✓	–	–
Transparent bridging	✓	–	–
Unicast Routing			
Access Routes	✓	–	–
BGP	✓	–	–

Table 14: Application Support for Unified In-Service Software Upgrades *(continued)*

Application	Supported	Unsupported	Notes
FTP	✓	–	Although unified ISSU supports FTP in active state, no file transfer operation can be in progress while performing unified ISSU.
IP	✓	–	–
IPv6	–	✓	Unified ISSU does not support IPv6.
IPSec Transport (E120 and E320)	–	✓	E120 and E320 routers do not support IPSec.
IPSec Transport (ERX1440)	–	–	–
IPSec Tunnels (E120 and E320)	–	✓	E120 and E320 routers do not support IPSec.
IPSec Tunnels (ERX1440)	–	–	–
IS-IS	✓	–	Support only when graceful restart is configured.
OSPF	✓	–	Support only when graceful restart is configured.
RIP	✓	–	–
Static Routes	✓	–	–
Telnet	✓	–	Authentication and command authorizations on Telnet sessions fail during the upgrade phase and Telnet sessions are dropped.
IPv4 Multicast Routing			
Multicast Routing	✓	–	–

Table 14: Application Support for Unified In-Service Software Upgrades *(continued)*

Application	Supported	Unsupported	Notes
ANCP (L2C)	✓	–	Unified ISSU can proceed if ANCP is configured. However, ANCP has no graceful restart extensions and therefore it cannot maintain its dynamic state across the upgrade. Consequently, all ANCP sessions are brought down and then restored when the upgrade is completed.
DVMRP (E120 and E320)	✓	–	–
DVMRP (ERX1440)	–	–	–
IGMP	✓	–	–
PIM	✓	–	–
IPv6 Multicast Routing			
Multicast Routing	–	✓	Unified ISSU does not support IPv6.
MLD	–	✓	Unified ISSU does not support IPv6.
PIM	–	✓	Unified ISSU does not support IPv6.
Multiprotocol Label Switching			
MPLS	✓	–	–
BGP signaling	✓	–	–
LDP signaling	✓	–	–
RSVP-TE signaling	✓	–	–

Table 14: Application Support for Unified In-Service Software Upgrades *(continued)*

Application	Supported	Unsupported	Notes
Local cross-connects between layer 2 interfaces using MPLS	✓	–	–
Policies and QoS			
Policies	✓	–	–
QoS	✓	–	–
Remote Access			
AAA	✓	–	The following configuration is not supported: The subscriber username and password are on an ATM circuit in Bridged Ethernet over ATM or IP over ATM configurations.
DHCP External Server and Packet Trigger	✓	–	–
DHCP Packet Capture	✓	–	Configuration of DHCP packet capture does not prevent unified ISSU from proceeding. However, the capturing of packets on the line modules is halted when the unified ISSU upgrade phase commences. Packet capture resumes automatically during the unified ISSU service restoration phase.
DHCP Proxy Client	–	✓	–

Table 14: Application Support for Unified In-Service Software Upgrades *(continued)*

Application	Supported	Unsupported	Notes
DHCP Relay Proxy	✓	–	DHCP relay proxy continues processing of DHCP release requests during the unified ISSU to maintain server-client synchronization. State is preserved across the upgrade; statistics are not preserved.
DHCP Relay Server	✓	–	–
DHCPv4 Local Server	✓	–	Forwarding outages that take place during a unified ISSU can affect DHCP lease renewal. Before you begin unified ISSU, we recommend that you configure the DHCP local server address pools with a minimum lease time of 120 minutes to ensure that leases do not expire during the upgrade.
DHCPv6 Local Server	–	✓	Unified ISSU does not support IPv6.
L2TP	✓	–	Unified ISSU forces an L2TP failover for all established tunnels. L2TP failover resynchronization is required for successful recovery of a tunnel and its sessions following the upgrade.
L2TP Dialout	–	✓	–
Local Address Pools	✓	–	–
Local Authentication Server	✓	–	–
RADIUS Client	✓	–	–

Table 14: Application Support for Unified In-Service Software Upgrades *(continued)*

Application	Supported	Unsupported	Notes
RADIUS Dynamic-Request Server	✓	–	–
RADIUS Initiated Disconnect	✓	–	–
RADIUS Relay Server	–	✓	–
RADIUS Route-Download Server	✓	–	–
SRC Client	✓	–	–
Service Manager	✓	–	–
Subscriber Manager	✓	–	–
TACACS+	✓	–	–
Miscellaneous			
Bulk statistics	✓	–	–
Denial of Service (DoS) protection	✓	–	–
HTTP server	✓	–	–
IOA hot swap	–	✓	–
J-Flow (IP flow statistics)	✓	–	–

Table 14: Application Support for Unified In-Service Software Upgrades *(continued)*

Application	Supported	Unsupported	Notes

Line Module Redundancy	✓	–	You can use the active spare line module for unified ISSU operations. You do not have to revert to the primary line module. The following sets of line modules and IOAs are supported:
			• ATM: OC3-4A, OC3/OC12/DS3-ATM
			• POS: OC3-4P
			• Line Modules
			  ◦ ES2 4G LM
			  ◦ ES2 10G Uplink LM
			  ◦ ES2 10G LM
			  ◦ ES2 10G ADV LM
			• IOAs
			  ◦ ES2-S1 GE-4 IOA
			  ◦ ES2-S1 GE-8 IOA
			  ◦ ES2-S3 GE-20 IOA
			  ◦ ES2-S1 10GE IOA
			  ◦ ES2-S2 10GE PR IOA
			  ◦ ES2-S1 OC3-8 STM1 ATM IOA
			  ◦ ES2-S1 OC12-2 STM4 ATM IOA
			  ◦ ES2-S1 OC12-2 STM4 POS IOA
			  ◦ ES2-S1 OC48 STM16 POS IOA

Mobile IP Home Agent	–	✓	–
Network Address Translation (NAT)	–	✓	You must remove the NAT license configuration as well as the NAT configuration from the router.
NTP	✓	–	–

Table 14: Application Support for Unified In-Service Software Upgrades *(continued)*

Application	Supported	Unsupported	Notes
Resource Threshold Monitor	✓	–	–
Response Time Reporter	✓	–	–
Route Policy	✓	–	–
SNMP	✓	–	–
Subscriber Interfaces	✓	–	–
Tunnels (GRE and DVMRP)	✓	–	–
VRRP	✓	–	–

Related Topics

- Unexpected AAA Authentication and Authorization Behavior During Unified ISSU on page 78
- Unexpected ATM Behavior During Unified ISSU on page 78
- Unexpected DHCP Behavior During Unified ISSU on page 79
- Unexpected Denial-of-Service Protection Behavior During Unified ISSU on page 79
- Unexpected Ethernet Behavior During Unified ISSU on page 80
- Unexpected File Transfer Protocol Server Behavior During Unified ISSU on page 80
- IS-IS Effects on Graceful Restart and Network Stability During Unified ISSU on page 83
- Unexpected L2TP Failover of Established Tunnels During Unified ISSU on page 84
- Interruption in Traffic Forwarding for Layer 3 Routing Protocols During Unified ISSU on page 89
- OSPF Effects on Graceful Restart and Network Stability During Unified ISSU on page 85
- Unexpected Suspension of PIM During Unified ISSU on page 87
- Unexpected SONET and SDH Behavior During Unified ISSU on page 88
- Unexpected T3 Behavior During Unified ISSU on page 88
- Unexpected Suspension of Subscriber Login and Logouts During Unified ISSU on page 87
- Unavailability of TACACS+ Services During Unified ISSU on page 89
- Recommended Settings for Routing Protocol Timers During Unified ISSU on page 91

Unexpected AAA Authentication and Authorization Behavior During Unified ISSU

Authentication and command authorization are temporarily disabled on the serial console connection during the upgrade phase. You can connect to the serial console and issue the **reload**, **show issu**, and **show version** commands without the action of authentication and authorization servers, such as RADIUS or TACACS+.

Related Topics

• Application Support for Unified ISSU on page 68

Unexpected ATM Behavior During Unified ISSU

The following aspects of ATM behavior during unified ISSU are different than the behavior during normal router operations.

ILMI Sessions Not Maintained

The router does not maintain ILMI sessions during a unified in-service software upgrade. The router terminates all ILMI sessions and restarts them during the upgrade. If the ILMI protocol is enabled on any port, you are warned during the initialization phase when unified ISSU is verifying the prerequisites for the upgrade. You can choose to continue the upgrade—and bring down the sessions—or to halt the unified in-service software upgrade.

OAM CC Effects on VCC

When an ATM VC is configured as an OAM CC source, periodic OAM cells are generated for about 15 seconds. The device configured as the OAM CC sink is likely to declare the VCC down during this time. Unified ISSU generates a warning when it detects an OAM CC source configuration during the initialization phase while unified ISSU is verifying the prerequisites for the upgrade. You can choose to continue or halt the unified in-service software upgrade

When an ATM VC is configured as OAM CC sink, it cannot receive OAM CC cells generated by the source for about 15 seconds. The OAM CC does not time out and the VCC is not declared down. OAM CC cell generation resumes when the unified ISSU operation is completed.

OAM VC Integrity Verification Cessation

During the unified ISSU operation, verification of OAM VC integrity stops. This verification resumes when the unified ISSU operation is completed.

ATM does not respond to incoming OAM loopback cells during the upgrade for a period of less than 30 seconds. The lack of response might cause ATM peers to declare VCC (VPC) down.

Port Data Rate Monitoring Cessation

The monitoring of ATM port data rates is halted during a unified in-service software upgrade. Monitoring resumes immediately after the unified ISSU operation is completed.

The data rates reported by the **show atm interface** command are inaccurate for the period of one configured load interval after unified ISSU is completed.

VC and VP Statistics Monitoring Halts Unified ISSU Progress

A unified in-service software upgrade cannot proceed if VC or VP statistics monitoring is in progress.

Related Topics

- Application Support for Unified ISSU on page 68

Unexpected DHCP Behavior During Unified ISSU

The following aspects of DHCP behavior during unified ISSU are different than the behavior during normal router operations.

DHCP Packet Capture Halted on Line Modules

The DHCP packet capture application supports unified ISSU in that its configuration does not halt a unified in-service software upgrade. However, packet capture on line modules is halted during the upgrade phase. Packets are not captured and buffered for later forwarding to the SRP module during this phase. Capture resumes automatically during the service restoration phase.

Related Topics

- Application Support for Unified ISSU on page 68

Unexpected Denial-of-Service Protection Behavior During Unified ISSU

The denial-of-service (DoS) protection application freezes its state when the in-service software upgrade is initiated. Any suspicious control flow, protocol, or priority remains suspicious until unified ISSU completes.

Freezing the DoS protection state prevents any active control flows from interfering with the system while the unified ISSU is in progress. However, no new control flows, protocols, or priorities are monitored for suspicious activity, and no suspicious activity can be detected until the upgrade is completed.

NOTE: Because of this limitation on DoS functionality, we recommend that you do not initiate unified ISSU until all suspicious control flows, protocols, and priorities have been resolved.

When the unified in-service software upgrade is completed, the DoS protection application resumes attending to all dynamic state that was frozen at the beginning of the unified ISSU process.

Some suspicious control flows might remain in a suspicious list based on your configuration, if the upgrade software version has DoS protection classification algorithms that are better or different than in the previous version. Because flows are discovered and monitored at 1-second intervals, the new conditions might cause these flows to be removed. You do not need to explicitly clear the flows when unified ISSU is completed.

Related Topics
- Application Support for Unified ISSU on page 68

Unexpected Ethernet Behavior During Unified ISSU

The following aspects of Ethernet behavior during a unified in-service software upgrade are different than during normal router operations.

ARP Packets Briefly Not Sent or Received

There is a brief period at the end of the upgrade phase when ARP packets are not sent or received. This event can affect ARP entries on attached devices that were in the process of being aged out.

Link Aggregation Interruption

During the unified in-service software upgrade, LACP PDUs are not generated or received for about 15 seconds on Ethernet ports configured with LACP.

This interruption has no effect on the local side of the link because JunosE Software generates LAC PDU packets every 30 seconds. The link is not declared down unless packets are missed three times. LACP packet generation continues when the unified ISSU operation is completed.

If a device on the other end of the link is configured with the short timeout, then the device is likely to declare the link to be down and remove the link from the LAG bundle.

Port Data Rate Monitoring Halted

The monitoring of Ethernet port data rate is halted during a unified in-service software upgrade. Monitoring resumes immediately after the unified ISSU operation is completed. The data rates reported by the **show interface** command are inaccurate for the period of one configured load interval after unified ISSU is completed.

VLAN Statistics Monitoring Halts Unified ISSU Progress

A unified in-service software upgrade cannot proceed if VLAN statistics monitoring is in progress.

Related Topics
- Application Support for Unified ISSU on page 68

Unexpected File Transfer Protocol Server Behavior During Unified ISSU

You can perform the unified ISSU operation even when the FTP server is enabled on the router. However, no file transfer process, such as uploading or downloading of files, creating of directories, or removing of files, can be in progress to enable the unified ISSU operation to complete successfully.

When you issue the **issu initialize** command, unified ISSU checks for open FTP connections or active file transfer sessions. At this stage, existing connections are not terminated and new connections can also be established. When you issue the **issu start** command, all FTP connections, including data and control connections, are disconnected. Although the listening port is still available at this stage, any attempt to create a new connection and incomplete file operations on existing connections fail with an appropriate error message from the FTP server.

The **issu start** command is not executed if file transfer operations are in progress. You must issue the **ftp-server flush** command to forcibly terminate the file transfer process. When you are prompted to confirm, type **y** to confirm to close all active file transfer jobs.

CAUTION: Because using the **ftp-server flush** command causes a forced and ungraceful termination of all file transfer jobs that are in progress to start the unified ISSU process, use it only when it is absolutely necessary. We recommend that you wait for file transfer operations that are in progress to complete gracefully before you perform unified ISSU, if your situation enables you to do so.

The following example shows the output of the **show ftp-server** command in a scenario where FTP server is enabled, but no open file transfer connections exist.

```
host1#show ftp-server

FTP Server state: enabled, 0 open connections
Statistics since server was last started:
        attempts: 3
        failed hosts: 0
        failed users: 0
Statistics since last system reload:
        attempts: 3
        failed hosts: 0
        failed users: 0
```

To display detailed information about unified ISSU status and warnings in addition to criteria required for unified ISSU and whether the router hardware and software meet the required criteria, issue the **show issu detail** command.

```
host1#show issu detail
ISSU state:       idle
ISSU description: ISSU is currently idle
criteria met:     No, upgrade error(s) found
running release:  dtnguyen.rel
armed release:    dtnguyen.rel
#                       ISSU Criteria Summary                           Met
--   ------------------------------------------------------------   -----------
1    In-Service Software Upgrade ready?                             Yes
2    High-Availability ready?                                       No
3    Line modules ready?                                            Conditional
4    Configuration conversion support ready?                        Yes
5    CLI sessions ready?                                            Yes
6    Routing applications ready?                                    Yes
7    Protocol timers ready?                                         Yes
```

The following example shows a case when a few clients are connected to the FTP server, and the FTP ISSU state becomes conditional. However, unified ISSU begins without any error. All existing connections are dropped when you issue the **issu start** command and the upgrade runs.


```
host1#show ftp-server
FTP Server state: enabled, 1 open connections
Statistics since server was last started:
        attempts: 3
        failed hosts: 0
        failed users: 0
Statistics since last system reload:
        attempts: 3
        failed hosts: 0
        failed users: 0

host1#show issu detail
ISSU state:       idle
ISSU description: ISSU is currently idle
criteria met:     No, upgrade error(s) found
running release:  dtnguyen.rel
armed release:    dtnguyen.rel
#                      ISSU Criteria Summary                            Met
--   ------------------------------------------------------------   -----------
1    In-Service Software Upgrade ready?                             Yes
2    High-Availability ready?                                       No
3    Line modules ready?                                            Conditional
4    Configuration conversion support ready?                        Yes
5    CLI sessions ready?                                            Yes
6    Routing applications ready?                                    Conditional
->   Criteria: There are open FTP connections                       Conditional
     Impact: Open connections will be disconnected during ISSU
     process
     Remedy: Close all FTP sessions
     Reporting slot: 7
7    Protocol timers ready?                                         Yes
```

The following example shows when an ongoing file transfer operation is detected during the initialization phase or validation phase. In this case, the prerequisite verification that unified ISSU performs fails. Unified ISSU does not proceed until the active file transfer operations are terminated. Issue the **ftp-server flush** command to forcibly terminate all FTP sessions.

```
host1#show ftp-server
FTP Server state: enabled, 1 open connections
Statistics since server was last started:
        attempts: 3
        failed hosts: 0
        failed users: 0
Statistics since last system reload:
        attempts: 3
        failed hosts: 0
        failed users: 0


host1#show issu detail
ISSU state:       idle
ISSU description: ISSU is currently idle
criteria met:     No, upgrade error(s) found
running release:  dtnguyen.rel
armed release:    dtnguyen.rel
#                      ISSU Criteria Summary                            Met
--   ------------------------------------------------------------   -----------
1    In-Service Software Upgrade ready?                             Yes
```



```
2     High-Availability ready?                                  No
3     Line modules ready?                                       Conditional
4     Configuration conversion support ready?                   Yes
5     CLI sessions ready?                                       Yes
6     Routing applications ready?                               No
->    Criteria: FTP file transfer is in progress                No
      Impact: ISSU cannot be performed when file transfer is in pr
      ogress
      Remedy: Abort transfer with "ftp-server flush" or wait until
      transfer is done
      Reporting slot: 7
7     Protocol timers ready?                                    Yes
```

```
host1#ftp-server flush
This command will terminate all FTP sessions, continue? [confirm]
host1#
```

New FTP connections are not allowed and all existing FTP connections are dropped after the unified ISSU process begins. Also, no remote file operations are allowed while unified ISSU is in progress. If unified ISSU is aborted, FTP server is returned to the state in which it was before unified ISSU was started.

Related Topics

- Application Support for Unified ISSU on page 68

IS-IS Effects on Graceful Restart and Network Stability During Unified ISSU

IS-IS has the following issues to consider before you begin a unified in-service software upgrade:

- Graceful restart—Required
- Routing around the upgrading router—Optional

Configuring Graceful Restart Before Unified ISSU Begins

You must configure IS-IS graceful restart on the router and on all IS-IS neighbors before you begin the unified in-service software upgrade. When the unified ISSU process verifies the upgrade requirements during the initialization phase, it detects whether graceful restart is configured. If it is not configured, the CLI displays a warning message and prompts you to proceed or halt. You can stop at this point to configure graceful restart.

If instead you proceed, the unified in-service software upgrade can complete successfully, but the IS-IS neighbors are likely to break the adjacencies with the upgrading router and consider that routes formerly reached through this router are now unreachable. When the unified in-service software upgrade completes and the routing protocols restart, the IS-IS neighbors can relearn the routes through the router.

When you issue the **issu start** command, IS-IS lengthens its hello timer values and sends LSPs with the new values. The upgrade proceeds when the IS-IS neighbors have acknowledged the new values.

Configuring Graceful Restart When BGP and LDP Are Configured

When BGP, IS-IS, and LDP are all configured on a router on which you want to perform a unified in-service software upgrade, ensure that the IS-IS graceful restart timeout is longer than the LDP graceful restart timeout. The IS-IS graceful restart does not complete when the LDP graceful restart timeout is longer than the IS-IS graceful restart timeout. Configure IS-IS graceful timeout with the **nsf t3** command. Configure LDP graceful restart timeout with the **mpls ldp graceful-restart timers max-recovery** command.

Routing Around the Restarting Router to Minimize Network Instability

NOTE: The situation described in this section is very uncommon. This rare circumstance arises when you have redundant uplinks to the core and network topology changes cause routes to go through the upgrading router. In a typical network design, this is not an issue and you do not need to route peers around the upgrading router.

During the unified ISSU upgrade phase, network instability can result if the restarting router goes into an unstable state after the unified ISSU process fails. Some IS-IS traffic loss occurs during the resulting line module resets. For those reasons, you might want IS-IS peers to route around the router that is being upgraded.

You can use the **overload advertise-high-metric issu** command to cause the router to advertise a high metric to its neighbors so that they route around the upgrading router. When you issue the **issu start** command, the router raises the metric to the maximum link cost on all interfaces running IS-IS. The maximum value depends on the metric type. IS-IS neighbors then choose a path with lower metrics to reach any destination that was previously reached through the upgrading router. When unified ISSU is completed, IS-IS reverts the metrics back to the values that were configured before the unified in-service software upgrade.

When traffic engineering has been configured, the traffic engineering metrics are also increased. New tunnels are not established through the upgrading router and any tunnels undergoing re-optimization in other routers go around the upgrading router.

IS-IS support for unified ISSU does not depend on this configuration. If you do not issue the **overload advertise-high-metric issu** command, the unified in-service software upgrade can still proceed to successful completion without disrupting IS-IS functionality.

Related Topics

- Application Support for Unified ISSU on page 68

Unexpected L2TP Failover of Established Tunnels During Unified ISSU

L2TP never declares itself as unified ISSU unsafe. However, unified ISSU forces an L2TP failover for all established tunnels. Successful recovery of a tunnel and its sessions following the unified in-service software upgrade requires a successful L2TP failover resynchronization, either by the L2TP silent failover method or the L2TP failover protocol.

When the L2TP silent failover method is configured on ERX1440 router, use the **l2tp retransmission** command to set the retransmission retry count to 8 for the remote peers.

A value of more than 7 helps ensure that the remote peers keep retransmitting control messages for the duration of the unified ISSU warm restart and the tunnels are not disconnected.

See Specifying the Number of Retransmission Attempts.

When the unified ISSU operation attempts to verify the upgrade prerequisites, a warning message is generated if any tunnels are present for which failover resynchronization is disabled.

You can use the **show l2tp tunnel failover-resync disable** command to identify the tunnels referred to by the warning message. The command enables filtering based upon the effective failover resynchronization mechanism:

```
host1#show l2tp tunnel failover-resync disable
L2TP tunnel 2/1 is Up with 1 active session
1 L2TP tunnel found
```

If a successful failover resynchronization cannot be performed for a tunnel following the upgrade, then the tunnel and all of its sessions are subject to disconnection.

L2TP automatically detects a peer L2TP disconnect after the unified in-service software upgrade is completed by detecting a control channel failure.

When peer LNSs are not configured with PPP keepalives or inactivity timeouts, you must configure an inactivity timeout for L2TP on the LAC. This timeout enables the router to detect a PPP disconnect when signaling has been dropped during the unified ISSU forwarding interruption. In the absence of this configuration, the connection at the LAC and LNS is left as logged in for an extended period of time following the upgrade.

Related Topics

- Application Support for Unified ISSU on page 68

OSPF Effects on Graceful Restart and Network Stability During Unified ISSU

OSPF has the following issues to consider before you begin a unified in-service software upgrade:

- Graceful restart—Required
- Dead interval—Required
- Routing around the upgrading router—Optional

Configuring Graceful Restart Before Unified ISSU Begins

You must configure OSPF graceful restart before you begin the unified in-service software upgrade. When the unified ISSU process verifies the upgrade requirements during the initialization phase, it detects whether graceful restart is configured. If it is not configured, the CLI displays a warning message and prompts you to proceed or halt. You can stop at this point to configure graceful restart.

If instead you proceed, the unified in-service software upgrade can complete successfully, but the OSPF neighbors are likely to break the adjacencies with the upgrading router and consider that routes formerly reached through this router are now unreachable. When the unified in-service software upgrade completes and the routing protocols restart, the IS-IS neighbors can relearn the routes through the router.

You must also ensure that the OSPF neighbors have been configured as graceful restart helper routers. During the unified ISSU initialization phase, OSPF graceful restart on the upgrading router cannot verify whether its neighbors are helper routers, and reports that fact by means of the CLI.

Configuring Graceful Restart When BGP and LDP Are Configured

When BGP, LDP, and OSPF are all configured on a router on which you want to perform a unified in-service software upgrade, ensure that the OSPF graceful restart timeout is longer than the LDP graceful restart timeout. The OSPF graceful restart does not complete when the LDP graceful restart timeout is longer than the OSPF graceful restart timeout. Configure OSPF graceful restart timeout with the **graceful-restart restart-time** command. Configure LDP graceful restart timeout with the **mpls ldp graceful-restart timers max-recovery** command.

Configuring a Longer Dead Interval Than Normal

To prevent OSPF from timing out to the OSPF neighbors, you must configure a dead interval that is longer than the expected forwarding outage for the platform. During the initialization phase, unified ISSU displays the recommended dead interval in a warning message. For information about the expected forwarding outage, see “Interruption in Traffic Forwarding for Layer 3 Routing Protocols During Unified ISSU” on page 89

Routing Around the Restarting Router to Minimize Network Instability

NOTE: The situation described in this section is very uncommon. This rare circumstance arises when you have redundant uplinks to the core and network topology changes cause routes to go through the upgrading router. In a typical network design, this is not an issue and you do not need to route peers around the upgrading router.

During the unified ISSU upgrade phase, network instability can result if the restarting router goes into an unstable state after the unified ISSU process fails. Some OSPF traffic loss occurs during the resulting line module resets. For those reasons, you might want OSPF peers to route around the router that is being upgraded.

You can use the **overload advertise-high-metric issu** command to cause the router to advertise a high link cost to its neighbors so that they route around the upgrading router. When you issue the **issu start** command, the router raises the link cost to the maximum link cost on all interfaces running OSPF. The higher cost is advertised in the OSPF LSAs. OSPF neighbors then choose a path with lower metrics to reach any destination that was previously reached through the upgrading router. When unified ISSU is completed, OSPF reverts the link costs back to the values that were configured before the unified in-service software upgrade.

When traffic engineering has been configured, the traffic engineering metrics are also increased. New tunnels are not established through the upgrading router and any tunnels undergoing re-optimization in other routers go around the upgrading router.

OSPF support for unified ISSU does not depend on this configuration. If you do not issue the **overload advertise-high-metric issu** command, the unified in-service software upgrade can still proceed to successful completion without disrupting OSPF functionality.

Related Topics

- Application Support for Unified ISSU on page 68
- overload advertise-high-metric issu
- issu start

Unexpected Suspension of PIM During Unified ISSU

You can minimize PIM traffic loss during the unified in-service software upgrade by issuing the **ip pim dr-priority** command to set a priority so that PIM neighbors do not forward traffic through the upgrading router. By default, a PIM interface has a priority of one. If you set the priority to one, the lowest possible priority, then the upgrading router is not selected to be a designated router in the PIM network if an interface on another router in that network has a higher priority.

Related Topics

- Application Support for Unified ISSU on page 68
- ip pim dr-priority

Unexpected Suspension of Subscriber Login and Logouts During Unified ISSU

All new subscriber logins are ignored during the upgrade phase. New subscriber logouts are cached and processed after the unified ISSU operation is completed.

Subscriber Statistics Accumulation or Deletion

All subscriber statistics present in the line modules are cleared when the line module forwarding planes are upgraded. For this reason, the router has to read the statistics from the forwarding plane before it is upgraded.

However, forwarding through the line modules continues after that point, until the line module forwarding plane is upgraded. Some statistics can therefore accumulate in the forwarding plane in the interval between these two events. These statistics are not preserved across the upgrade.

Statistics for subscribers that log out during the forwarding plane upgrade are collected and reported before the forwarding plane is reloaded. Statistics are not collected for any subscribers who are connected before you issue the **issu start** command but who log out before the forwarding plane upgrade is completed.

The following subscriber statistics are preserved across the upgrade:

- All policy statistics
- Accounting statistics reported by IP: in bytes, out bytes, in packets, out packets
- Accounting statistics reported by L2TP: in octets, out octets, in packets, out packets
- Accounting statistics reported by PPP: in octets, out octets, in packets, out packets

All other statistics are set to zero, including all statistics belonging to the SNMP generic interface MIB for every interface layer.

Related Topics

- Application Support for Unified ISSU on page 68

Unexpected SONET and SDH Behavior During Unified ISSU

During a unified in-service software upgrade, several aspects of SONET behavior differ from normal operation.

- SONET APS is supported only for non-channelized APS IOAs.

  During a unified in-service software upgrade, if you have configured APS functionality on the non-channelized APS IOAs, the unified ISSU process fails and a warning message is displayed. If you have not configured APS functionality, the unified ISSU process succeeds and the line modules (OC3/OC12) do not get rebooted.

NOTE: The unified ISSU process for the channelized APS IOAs has not been modified. The channelized APS IOAs are rebooted during a unified in-service software upgrade.

- During a conventional software upgrade, a SONET loss-of-signal defect lasts more than 2.5 seconds, causing the router to declare an LOS failure. Devices on the remote end of SONET links detect the failure and bring down the link and the dynamic interface stacks built on the link.

  During a unified in-service software upgrade, the LOS does not last more than 2.5 seconds. The remote device detect a momentary LOS but does not perceive this short LOS as a link failure and does not bring the link down,

Related Topics

- Application Support for Unified ISSU on page 68

Unexpected T3 Behavior During Unified ISSU

Local T3 (DS3) devices are reprogrammed during a unified in-service software upgrade, generating a defect. The router completes the reprogramming within 2.5 seconds. Because JunosE DS3 applications declare an alarm and bring down the link only if the defect persists for more than 2.5 seconds, unified ISSU does not cause the links to be brought down. However, the remote T3 devices must also wait 2.5 seconds before declaring an alarm. If the equipment on the far end of the T3 connection generates an alarm immediately rather than waiting, the link goes down, causing the higher layers to also go down for the remote equipment.

Related Topics
- Application Support for Unified ISSU on page 68

Unavailability of TACACS+ Services During Unified ISSU

During the upgrade phase of unified ISSU, TACACS+ services are unavailable. If you have configured AAA authentication for Telnet (with the **aaa new-model command**) this lack of availability affects CLI authentication, authorization, and accounting activities.

CLI login and privilege authentication cannot succeed during a unified ISSU unless you configure at least one of the alternate authentication methods with the **aaa authentication login** command: **enable**, **line**, or **none**.

Similarly, CLI exec and command authorization cannot succeed during a unified ISSU unless you configure one of the alternate authorization methods with the **aaa authorization** command: **if-authenticated** or **none**.

Because there is no alternate method of accounting other than TACACS, CLI exec and command accounting does not work during this phase.

Related Topics
- Application Support for Unified ISSU on page 68

Interruption in Traffic Forwarding for Layer 3 Routing Protocols During Unified ISSU

The routing protocols are affected by two interruptions in traffic forwarding caused by the unified in-service software upgrade during the upgrade phase.

- Switchover from active to standby SRP module—When the active SRP module running the current release switches over to the standby SRP module running the upgrade release, the routing protocols and all other applications restart. A control plane outage of 30–40 seconds prevents the protocols from sending hellos or keepalive messages.

  The protocols must gracefully restart to come back online, recover their routing state on the newly active SRP module, and respond to their peers. Therefore, you must enable graceful restart for all protocols before you begin the unified in-service software upgrade. All neighbors of the routing protocols must also be configured to support graceful restart.

  A data plane outage of about 1 second for the E120 and E320 routers and about 4 seconds for the ERX1440 router also takes place during the switchover of the fabric from the active primary SRP module to the standby SRP module.

- Upgrade of the forwarding plane for each line module—After the routing protocols reconverge with their peers and rebuild their routing tables, unified ISSU upgrades the forwarding plane on all line modules simultaneously. This upgrade halts forwarding through the chassis. This forwarding outage lasts about 15 seconds for the E120 and E320 routers and about 50 seconds for the ERX1440 router.

If capable, routing protocols temporarily lengthen their timers to survive the outages. During the initialization phase, unified ISSU checks for timers that are set too short and whether the protocol enables timer renegotiation. If these checks fail, unified ISSU generates a warning and enables you to reconfigure the protocols before you issue the **issu start** command.

We recommend that you configure timers to be longer than usual for the routing protocols that cannot renegotiate timers. You can use bidirectional forwarding detection (BFD) to quickly detect forwarding interruptions.

Table 15 on page 90 describes how individual routing protocols behave during a unified in-service software upgrade.

Table 15: Behavior of Routing Protocols During a Unified In-Service Software Upgrade

Protocol	Behavior
BFD	BFD renegotiates its timers as needed. Typically, the timers are lengthened until the SRP module switchover takes place, then shortened for the forwarding plane upgrade, and finally shortened to the original configured values.
BGP	The configured BGP timers are typically long enough to survive the forwarding outages. If, not, unified ISSU generates a warning message with a recommended timer interval. BGP sends out keepalive messages immediately before and immediately after both the SRP module switchover and the forwarding plane restart, independent of the interval since it last sent them.
IS-IS	If necessary, temporarily lengthens the hello timers.
LDP	Unified ISSU warns you if the hello timers or the keepalive timers are not long enough to survive the forwarding plane upgrade. LDP sends out hello messages and keepalive messages immediately before and immediately after both the SRP module switchover and the forwarding plane restart, independent of the interval since it last sent them.
OSPF	OSPF timers are not negotiable between peers. Unified ISSU generates a warning if the hello timers or the keepalive timers are not long enough to survive the forwarding plane upgrade. OSPF begins a graceful restart before the SRP module switchover. When you configure graceful restart before the unified in-service software upgrade, you must ensure that the graceful restart times are long enough to allow recovery. OSPF sends out hello messages and keepalive messages immediately before and immediately after forwarding plane restart, independent of the interval since it last sent them.
PIM	If necessary, temporarily lengthens the hold times in hello messages. PIM guarantees that at least one hello message with a lengthened hold time is sent to each neighbor. If necessary, increases the join-prune hold time. PIM guarantees that at least one join-prune message with a lengthened hold time is sent to each neighbor.

Table 15: Behavior of Routing Protocols During a Unified In-Service Software Upgrade *(continued)*

Protocol	Behavior
RIP	RIP timers do not affect unified ISSU.
RSVP-TE	If necessary, temporarily lengthens the graceful restart timers to survive the SRP module switchover. If necessary, lengthens the hello timers to survive the forwarding plane upgrade.

You might want some or all traffic to be routed around the upgrading router rather than accept a forwarding loss during the forwarding interruption. To do so, you must configure your routing protocols appropriately. For example, you might raise the link cost in IS-IS and OSPF, causing their neighbors to seek alternate routes that have lower link costs. In PIM, you can set the priority for the router interface to zero to ensure that the upgrading router is not selected as a designated router.

Related Topics

- Application Support for Unified ISSU on page 68

Recommended Settings for Routing Protocol Timers During Unified ISSU

You can use the default values for many of the routing protocol timers with no adverse effect on a unified in-service software upgrade. For other timers, we recommend particular values, as described in Table 16 on page 91.

Table 16: Recommended Routing Protocol Timer Settings

Protocol	Timers
BFD	Use the default timers.
BGP	Use the default timers, including graceful restart default timers. If the expected forwarding outage for the platform is beyond what the BGP session's graceful restart mechanism can survive, the unified ISSU initialization process generates a warning message accordingly. In this event, adjust the timer intervals as advised by the message. For information about the expected forwarding outage, see "Interruption in Traffic Forwarding for Layer 3 Routing Protocols During Unified ISSU" on page 89.
DVMRP	Use the default timers.
IGMP	Use the default timers.
IS-IS	Use the default timers, including graceful restart default timers.

Table 16: Recommended Routing Protocol Timer Settings *(continued)*

Protocol	Timers
LDP	Use the default timers, including graceful restart default timers, except for the following: • Set the hello hold time to at least 901 seconds for a helper or a restarter configuration for a link-level adjacency or for LDP targeted sessions.
OSPF	Use the default timers, including graceful restart default timers, except for the dead interval. If the expected forwarding outage for the platform is longer than the configured dead interval, the unified ISSU initialization process generates a warning message accordingly. In this event, adjust the timer interval as advised by the message. For information about the expected forwarding outage, see "Interruption in Traffic Forwarding for Layer 3 Routing Protocols During Unified ISSU" on page 89.
PIM	Set the query interval to at least 210 seconds. Unified ISSU generates a warning for any of the following conditions, but you can ignore the warning without causing a higher FC outage: • The current router is a DR. • The current router is configured as an Auto RP mapping agent and is chosen as the RP for any group. • The current router is an elected or candidate BSR, or if BSR candidate RPs are configured. • The graceful restart timer is less than the default value, 30 seconds.
RIP	Use the default timers; graceful restart is not supported. For scaled configurations, such as for 2000 RIP interfaces, use the following values: • Flush interval: 600 seconds • Holddown time: 260 seconds • Invalid interval: 260 seconds • Update interval: 60 seconds

RSVP-TE	Use the default timers, including graceful restart default timers, except for the following:
	• For graceful restart, the hello timeout interval is the product of hello misses multiplied by the hello refresh interval. Determine which period is longer, the IC upgrade time or the forwarding upgrade time. Configure the hello refresh and hello miss values so that the hello timeout is greater than the longer of those two periods.
	• For node hellos, the product of the refresh misses multiplied by the hello refresh interval must be great than the FC outage time. For an outage time of less than 30 seconds, for example, configure the following values:
	  ◦ Set the node hello refresh interval to 8000.
	  ◦ Set the node hello refresh misses to 4.

Related Topics

- Application Support for Unified ISSU on page 68

Upgrading Router Software with Unified ISSU

To upgrade your router software by means of unified ISSU, perform the following steps.

1. Disable autosynchronization.

   host1(config)#**disable-autosync**

2. Copy the new release to the router.

   NOTE: Be sure to specify the correct software release (.rel) filename for the router you are using, as described in the section *Identifying the Software Release File* in the *JunosE System Basics Configuration Guide*.

   host1#**copy /incoming/releases/ftpserver/quebec2.rel R2.rel**

3. Save the current configuration.

   host1#**copy running-configuration** system2.cnf

4. Determine whether the router hardware and the software release meet the criteria required for unified ISSU to operate successfully by using one of the following commands:

   host1#**show issu**
   host1#**show issu brief**
   host1#**show issu detail**

5. Arm the primary SRP module with the upgrade release.

   host1#**boot system R2.rel**

   NOTE: You must arm any hotfixes that need to be loaded with the new release after you have armed the new release. The hotfixes are supplied when the modules to which they apply are rebooted.

6. Synchronize the NVS file system of the redundant SRP module with that of the primary SRP module.

   host1#**synchronize**

   Because the redundant SRP module is running a different release than the armed release, the module automatically reboots and runs the armed (upgrade) release, R2.rel.

   Wait for the redundant SRP module to boot, initialize, and reach the standby state. At this point, the REDUNDANT LED on the module is illuminated and the ONLINE LED is off. The State field in the **show version** display indicates that the redundant module is in the standby state.

7. Synchronize the file system of the primary module with that of the redundant module.

The NVS file systems of the two SRP modules are unsynchronized because the redundant SRP module rebooted.

host1#**synchronize**

8. Reenable autosynchronization.

   host1(config)#**no disable-autosync**

9. (ERX1440 only) Configure the ERX1440 license key.

   host(config)#**license issu xyz123abc**
   License for ISSU configured.

10. Determine whether unified ISSU is in the Idle state and whether all upgrade requirements have been met.

    host1#**show issu**

NOTE: If the results indicate that some requirements are not met, you must correct this situation before proceeding.

11. Ensure that stateful SRP switchover is configured on the router.

    host1#**show redundancy srp**

    If it is not already configured, do so now.

    host1(config)#**redundancy**
    host1(config-redundancy)#**mode high-availability**

12. For each configured protocol on the router and its neighbors, ensure that graceful restart is configured. See the relevant protocol configuration chapters in the JunosE document set for information about configuring graceful restart.

13. Begin the initialization phase of the unified in-service software upgrade.

    host1#**issu initialize**

    The CLI displays the status of the initialization as it proceeds.

14. (Optional) From a different CLI session, display the progress of the initialization.

    host1#**show issu**

    Unified ISSU must be in the Initialized state before you proceed to the next step. The time required for initialization varies with the system load and the complexity of the router configuration.

15. Start the upgrade phase.

    host1#**issu start**

    The router switches to the redundant SRP module running the upgrade release, R2.rel. Significant upgrade milestones are displayed as they occur.

16. When the console indicates that the upgrade is completed, you can verify that the router is back in the idle state and running the upgrade release, R2.rel.

    host1#**show issu**

You can also verify the status of the SRP modules and line modules, as well as the running and armed releases.

host1#**show version**

Related Topics

- issu initialize
- issu start
- issu stop
- license issu

Halt of Unified ISSU During Initialization Phase Overview

The options that are available to halt the unified in-service software upgrade depend on the phase that the upgrade is in when you attempt to halt it. The phase also affects the state of the router after the upgrade is halted.

During the initialization phase, you can halt the unified ISSU process by issuing the **issu stop** command. This action reloads the redundant SRP module with the armed upgrade release. As a result, unified ISSU is placed in the idle state and the following releases are present on the router:

- Primary SRP module—Running (original) release
- Redundant SRP module—Upgrade release
- Line modules—Running (original) release

Related Topics

- issu stop
- Halting Unified ISSU During Initialization Phase on page 95
- Halt of Unified ISSU During Upgrade Phase Overview on page 96
- Halting Unified ISSU During Upgrade Phase on page 96

Halting Unified ISSU During Initialization Phase

After you stop unified ISSU, you can return the router to the state it was in when you began the unified in-service software upgrade. To roll the router back to its beginning state with the redundant SRP module running the original release, you must perform the following steps to arm the redundant SRP module with the running release:

1. Turn off auto synchronization.

   host1(config)#**disable-autosync**

2. Specify that the router use the running release when it reboots.

   host1(config)#**boot system** erx_x-y-z.rel

3. Synchronize the NVS file system of the redundant module with that of the primary module.

host1#**synchronize**

The redundant SRP module automatically reboots because the armed release (the original release) now differs from the software release it is currently running (the upgrade release).

4. Verify that stateful SRP switchover is enabled.

   host1#**show redundancy**

Related Topics

- Halt of Unified ISSU During Initialization Phase Overview on page 95
- disable-autosync
- boot system
- synchronize
- show redundancy

Halt of Unified ISSU During Upgrade Phase Overview

During the upgrade phase—before the line module and control plane software is upgraded—the unified ISSU process provides an opportunity to cancel the upgrade. If you choose to cancel, the router remains in the unified ISSU initialized state. The CLI command set becomes fully accessible.

If you do not cancel at this point, then the process continues and any line modules that do not support unified ISSU are reloaded. Application sessions are brought down and traffic forwarding is interrupted for the unsupported modules.

If you do cancel in response to the CLI prompt, unified ISSU returns to the initialized state, and the following releases are present on the router:

- Primary SRP module—Running (original) release
- Redundant SRP module—Upgrade release; the module is in the unified ISSU initialized state
- Line modules—Running (original) release

To roll back from the unified ISSU initialized state, you must issue the **issu stop** command. The command reloads the redundant SRP module with the armed release and places unified ISSU in the idle state. As a result, the following releases are present on the router:

- Primary SRP module—Running (original) release
- Redundant SRP—Upgrade release
- Line modules—Running (original) release

Halting Unified ISSU During Upgrade Phase

After you stop unified ISSU, you can return the router to the state it was in when you began the unified in-service software upgrade. To roll the router back to its beginning state with the redundant SRP module running the original release, you must perform the following steps to arm the redundant SRP module with the running release:

1. Turn off auto synchronization.

   host1(config)#**disable-autosync**

2. Specify that the router use the running release when it reboots.

   host1(config)#**boot system** erx_x-y-z.rel

3. Synchronize the NVS file system of the redundant module with that of the primary module.

   host1#**synchronize**

   The redundant SRP module automatically reboots because the software release that it is configured to run now differs from the software release it is running.

Related Topics

- disable-autosync
- boot system
- synchronize
- Unified ISSU Phases Overview on page 61
- Halt of Unified ISSU During Upgrade Phase Overview on page 96

Monitoring the Status of the Router During Unified ISSU

Purpose Display information about the current status of the router relative to a unified in-service software upgrade and of the upgrade itself.

Action To display the current unified ISSU state and identify the active and armed releases in brief:

```
host1#show issu brief
ISSU state:       initializing
ISSU description: ISSU initialize is in-progress, 5% complete
criteria met:     No, upgrade error(s) found
running release:  release1.rel
armed release:    release2.rel
```

To the information displayed by **show issu brief**, the **show issu** command adds a summary table of unified ISSU verification criteria:

```
host1# show issu
ISSU state:       idle
ISSU description: ISSU is currently idle
criteria met:     No, upgrade error(s) found
running release:  release1.rel
armed release:    release2.rel
#                  ISSU Activation Criteria Summary                Met
--   -----------------------------------------------------   -----------
1    In-Service Software Upgrade ready?                         Yes
2    High-Availability ready?                                   No
3    Line modules ready?                                      Conditional
4    Configuration conversion support ready?                    Yes
5    CLI sessions ready?                                        Yes
```

```
6    Routing applications ready?                                  Yes
7    Protocol timers ready?                                       Yes
```

To the information displayed by **show issu**, the **show issu detail** command adds a detailed table of unified ISSU verification criteria that lists mandatory and conditional criteria that have not been met, the impact of this status, and the remedy as reported by router applications and system components that participate in the in-service software upgrade:

```
host1# show issu detail
ISSU state:       idle
ISSU description: ISSU is currently idle
criteria met:     No, upgrade error(s) found
running release:  release1.rel
armed release:    release2.rel
#                  ISSU Activation Criteria Summary               Met
--   ------------------------------------------------------   -----------
1    In-Service Software Upgrade ready?                           Yes
2    High-Availability ready?                                     No
3    Line modules ready?                                      Conditional
4    Configuration conversion support ready?                      Yes
5    CLI sessions ready?                                          Yes
6    Routing applications ready?                                  Yes
7    Protocol timers ready?                                       Yes
#                 ISSU Criterion Detail                           Met
--   ------------------------------------------------------   -----------
1    In-Service Software Upgrade ready?                           Yes
2    High-Availability ready?                                      No
->  Problem: The standby SRP must not be running the same release  No

     Reporting Slot: 6
     Impact: ISSU cannot be performed
     Remedy: boot a release compatible with ISSU on the standby SRP

3    Line modules ready?                                   Conditional
->   Problem: Card does not support required memory configuration  Conditional
     : Slot 1, OC3/OC12/DS3-ATM, requires at least 256 MB
     Reporting Slot: 6
     Impact: If you continue, the card will immediately be reset
     and then cold started when ISSU Upgrade completes
     Remedy: data unavailable
->   Problem: Card does not support required memory configuration  Conditional
     : Slot 8, CT3-12, requires at least 256 MB
     Reporting Slot: 6
     Impact: If you continue, the card will immediately be reset
     and then cold started when ISSU Upgrade completes
     Remedy: data unavailable
->   Problem: Card does not support required memory configuration  Conditional
     : Slot 9, CT3-12, requires at least 256 MB
     Reporting Slot: 6
     Impact: If you continue, the card will immediately be reset
     and then cold started when ISSU Upgrade completes
     Remedy: data unavailable
->   Problem: Card does not support required memory configuration  Conditional
     : Slot 10, CT3-12, requires at least 256 MB
     Reporting Slot: 6
     Impact: If you continue, the card will immediately be reset
     and then cold started when ISSU Upgrade completes
     Remedy: data unavailable
->   Problem: Card not disabled or not online: Slot 1, OC3/OC12/D  Conditional
     S3-ATM, 0/0
     Reporting Slot: 6
```



```
      Impact: If you continue, the card will immediately be reset
      and then cold started when ISSU Upgrade completes
      Remedy: If not standby, Wait for card to come online before
      proceeding
->    Problem: Card not disabled or not online: Slot 8, CT3-12, 0/  Conditional
      0
      Reporting Slot: 6
      Impact: If you continue, the card will immediately be reset
      and then cold started when ISSU Upgrade completes
      Remedy: If not standby, Wait for card to come online before
      proceeding
4     Configuration conversion support ready?                         Yes
5     CLI sessions ready?                                             Yes
6     Routing applications ready?                                     Yes
7     Protocol timers ready?                                          Yes
```

Meaning Table 17 on page 99 lists the **show issu** command output fields.

Table 17: show issu Output Fields

Field Name	Field Description
ISSU state	State of the upgrade process, idle, initializing, initialized, or upgrading
ISSU description	State of the upgrade, including percent complete
criteria met	Whether prerequisites for the upgrade have been met and, generally, what errors occurred
running release	Filename of JunosE Software release that is currently running on the SRP modules
armed release	Filename of JunosE Software release that is armed to become the next running release when the router reboots
ISSU Activation Criteria Summary	Summarizes the criteria for unified ISSU activation.
In-Service Software Upgrade ready?	Criteria required for unified ISSU activation. Possible values: Yes, No, Conditional. NOTE: All criteria must be "yes" for unified ISSU to be active.
High-Availability ready?	Criteria required for unified ISSU activation. Possible values: Yes, No, Conditional. NOTE: All criteria must be "yes" for unified ISSU to be active.
Line Modules ready?	Criteria required for unified ISSU activation. Possible values: Yes, No, Conditional. NOTE: All criteria must be "yes" for unified ISSU to be active.

Table 17: show issu Output Fields *(continued)*

Field Name	Field Description
Configuration conversion support ready?	Criteria required for unified ISSU activation. Possible values: Yes, No, Conditional. NOTE: All criteria must be “yes” for unified ISSU to be active.
CLI sessions ready?	Criteria required for unified ISSU activation. Possible values: Yes, No, Conditional. NOTE: All criteria must be “yes” for unified ISSU to be active.
Routing applications ready?	Criteria required for unified ISSU activation. Possible values: Yes, No, Conditional. NOTE: All criteria must be “yes” for unified ISSU to be active.
Protocol Timers ready?	Criteria required for unified ISSU activation. Possible values: Yes, No, Conditional. NOTE: All criteria must be “yes” for unified ISSU to be active.
ISSU Criterion Detail	Detailed information on why the criteria required for unified ISSU activation was not met or was conditional.
Problem	The reason why the criteria for unified ISSU activation is not met.
Reporting Slot	Slot where the issue occurred.
Impact	What happens if you continue with the upgrade.
Remedy	What you can do to fix the Problem.

Related Topics

- show issu

CHAPTER 5

Configuring VRRP

This chapter describes how to configure the Virtual Router Redundancy Protocol (VRRP) on your E Series router.

VRRP Overview

VRRP can prevent loss of network connectivity to end hosts if the static default IP gateway fails. By implementing VRRP, you can designate a number of routers as *backup* routers in the event that the default *master* router fails. VRRP fully supports Virtual Local Area Networks (VLANs) and stacked VLANs (S-VLANs).

NOTE: The term *virtual router* as defined in *Configuring Virtual Routers* in the *JunosE System Basics Configuration Guide*, is different from what is implied by VRRP. In this chapter, the term *virtual router* always refers to a VRRP router; that is, a router that has enabled VRRP.

In case of a failure, VRRP dynamically shifts the packet-forwarding responsibility to a backup router. VRRP creates a redundancy scheme that enables hosts to keep a single IP address for the default gateway but maps the IP address to a well-known virtual MAC address. VRRP provides this redundancy without user intervention or additional configuration at the end hosts.

The advantage of using VRRP is that you gain a higher availability for the default path without requiring configuration of dynamic routing or router discovery protocols on every end host.

VRRP routers viewed as a *redundancy group* share the responsibility for forwarding packets as if they *owned* the IP address corresponding to the default gateway configured on the hosts. At any time, one of the VRRP routers acts as the master, and other VRRP routers act as backup routers. If the master router fails, a backup router becomes the new master. In this way, router redundancy is always provided, allowing traffic on the LAN to be routed without relying on a single router.

A master always exists for the shared IP address. If the master goes down, the remaining VRRP routers elect a new master VRRP router. The new master forwards packets on behalf of the owner by taking over the virtual MAC address used by the owner.

When implemented in your network, VRRP interprets any active link to a subnet to indicate the router has access to the entire subnet. VRRP leverages the broadcast capabilities of Ethernet. Provided that one of the routers in a VRRP configuration is running, ARP requests for the IP addresses assigned to the default gateway always receive replies. Additionally, end hosts can send packets outside their subnet without interruption.

Related Topics

- VRRP Implementation in E Series Routers on page 103
- VRRP Router Election Rules on page 104
- Before You Configure VRRP on page 108
- Configuring VRRP on page 109

VRRP Platform Considerations

For information about modules that support VRRP on ERX14xx models, ERX7xx models, and the ERX310 Broadband Services Router:

- See *ERX Module Guide, Table 1, Module Combinations* for detailed module specifications.
- See *ERX Module Guide, Appendix A, Module Protocol Support* for information about the modules that support VRRP.

For information about modules that support VRRP on the E120 and E320 Broadband Services Routers:

- See *E120 and E320 Module Guide, Table 1, Modules and IOAs* for detailed module specifications.
- See *E120 and E320 Module Guide, Appendix A, IOA Protocol Support* for information about the modules that support VRRP.

VRRP Terms

Table 18 on page 103 provides definitions for the basic VRRP terms used in this chapter.

Table 18: VRRP Definitions

Term	Definition
VRRP router	A router that is running VRRP. It might participate in one or more virtual router IDs (VRIDs). An IP redundancy instance can: • Act as a master with associated addresses it owns at an IP interface • Act simultaneously as a backup for other routers with additional VRID mappings and priorities for those routers
Master router	The VRRP router that takes the responsibility of forwarding packets sent to the IP addresses associated with the virtual router, and that answers ARP requests for these IP addresses. If the IP address owner is available, it always becomes the master.
Backup router	The VRRP router available to take forwarding responsibility if the current master router fails.
IP address owner	The IP interface–VRID pair instance that has the associated IP addresses as real interface addresses. This router, when up, responds to packets addressed to one of these IP addresses for Internet Control Message Protocol (ICMP) pings or Transmission Control Protocol (TCP) connections. The IP address owner is the *primary router*.
Primary IP address	An IP address configured as primary from the set of real interface addresses. VRRP advertisements are always sent (by the master router) using the primary IP address as the source of the IP packet.

VRRP References

For more information about VRRP, see:

- RFC 2787—Definitions of Managed Objects for the Virtual Router Redundancy Protocol (March 2000)

NOTE: We recommend that you have some background understanding of the Address Resolution Protocol (ARP) before you configure VRRP. See *Address Resolution Protocol* in the *JunosE IP, IPv6, and IGP Configuration Guide*.

- RFC 3768—Virtual Router Redundancy Protocol (VRRP) (April 2004)

VRRP Implementation in E Series Routers

VRRP is implemented in E Series routers to meet two goals. The first goal is to avoid the single point of failure inherent to hosts that have a single default gateway configured.

The second goal is to keep the complexity of redundancy away from the hosts themselves. These goals comply with RFC 3768 and RFC 2787.

The association between VRIDs and IP addresses is coordinated among all participating VRRP routers. The following scenario can help you understand how VRRP is implemented in the router.

1. An E Series router assigns common VRIDs to the group of routers that are going to share IP addresses.
2. The E Series router sends VRRP advertisements to well-known multicast addresses. The router that owns the addresses automatically becomes the master and sends periodic VRRP advertisement messages. A VRRP advertisement consists of the IP addresses that the master router controls and the VRID.
3. If the master router stops advertising for a predetermined period of time, the remaining routers using the same VRID enter an election process to determine which router takes over the master router responsibilities.
4. Depending on the configuration, the master router that does not own the IP addresses might do one of the following:
   - Drop all packets that have destination addresses to these IP addresses (default)
   - Accept packets that have destination addresses to these IP addresses as if the addresses belonged to the master router (using the **ip vrrp accept-data** command).
5. If the elected master router fails, backup routers start the election process again.
6. When the original master router becomes operational again, it restarts broadcasting advertisements as long as preemption is enabled or the master router is the address owner. Packet forwarding responsibility then shifts back to the original master router.

Related Topics

- VRRP Router Election Rules on page 104
- Before You Configure VRRP on page 108
- Configuring VRRP on page 109

- ip vrrp accept-data

VRRP Router Election Rules

If the master router becomes unavailable, the following rules govern election of the master router:

- The backup router assigned the highest priority for each VRID becomes the master router.
- If two backup routers were assigned the same priority, the router that has the highest primary address becomes the master router. For example, if several routers were all assigned the default priority of 100, the IP addresses must be compared.
- Router election on a VRRP router can also be determined by whether the preemption option is enabled.

When a backup router detects a master router with a lower priority than the backup router has, the backup router might leave the current master router alone or take over the current master router and become the master router itself.

When preemption is enabled, a backup router always preempts or takes over the responsibility of the master router. When preemption is disabled, the lower-priority backup is left in the master state.

NOTE: Using VRRP can override the source address of the ICMP redirect. When a backup VRID functions as a master router on a given IP interface, its ICMP redirects must *fake* the source IP address of the IP address owner. The redirect must fake the IP address because hosts accept only an ICMP redirect that is sent by the current gateway of the host.

Related Topics

- VRRP Implementation in E Series Routers on page 103
- Before You Configure VRRP on page 108
- Configuring VRRP on page 109

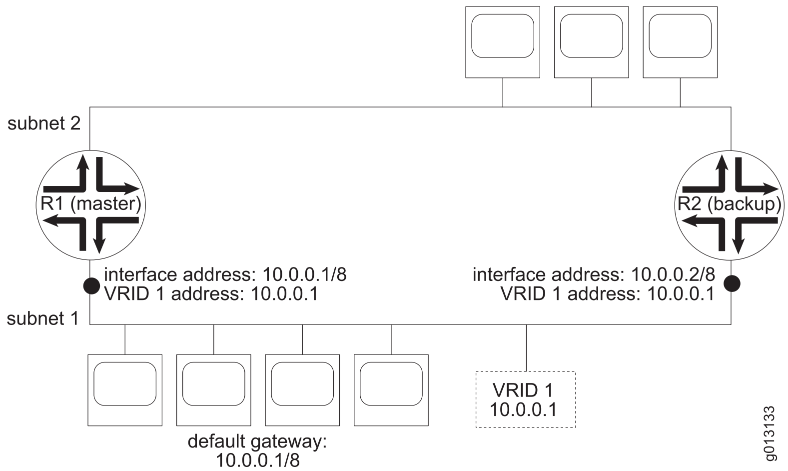
Example: Basic VRRP Configuration

As Figure 4 on page 106 shows, the basic VRRP configuration uses a single VRID (VRID 1). Because R1 is the address owner, it serves as the master router. Router R2 is the backup router. The four end hosts on subnet 1 are configured to use 10.0.0.1/8 as the default router. IP address 10.0.0.1 is associated with VRID 1.

In this example, if R1 becomes unavailable, R2 takes over VRID 1 and its associated IP addresses. Packets sent to IP destinations outside the 10.x.x.x subnet using 10.0.0.1 as the router are then forwarded by R2. Even though R2 assumes R1's forwarding responsibilities, it may or may not process any packet with destination address (DA) 10.0.0.1, depending on the accept-data configuration. When R1 becomes active again, it takes over as the master router and R2 reverts to the backup router.

The VRRP MAC address is always 00-00-5e-00-01-vrid. The valid VRID range is 0x01–0xFF.

Figure 4: Basic VRRP Configuration



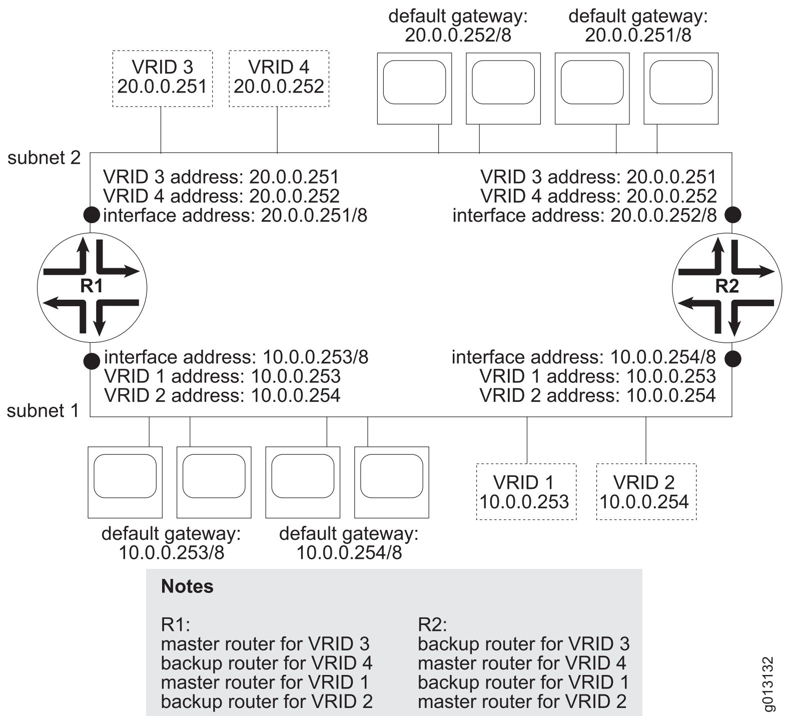
Related Topics

- VRRP Overview on page 101
- VRRP Implementation in E Series Routers on page 103
- VRRP Router Election Rules on page 104
- Before You Configure VRRP on page 108
- Configuring VRRP on page 109

Example: Commonly Used VRRP Configuration

Figure 5 on page 107 shows two physical routers backing up each other through VRRP. Routers R1 and R2 are both configured with VRID 1 and VRID 2. In this configuration, under normal circumstances the routing load is distributed between the two routers.

Figure 5: Commonly Used VRRP Configuration



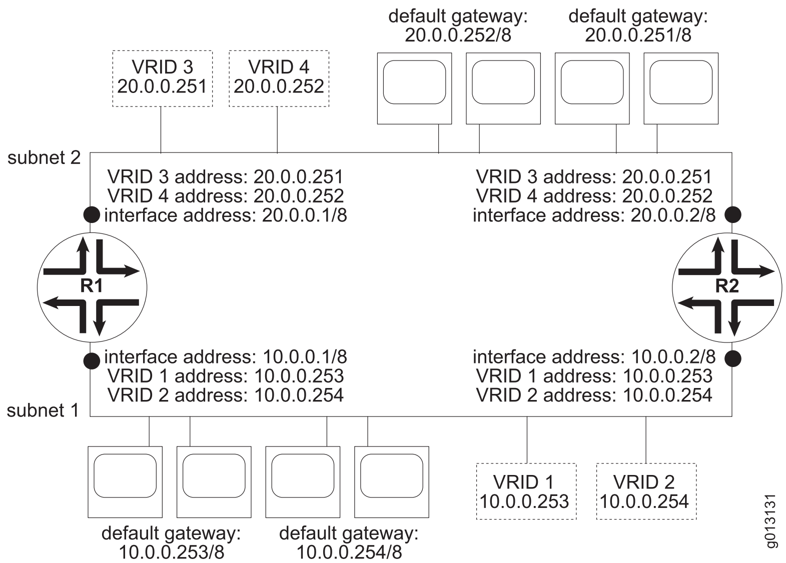
Related Topics

- VRRP Overview on page 101
- VRRP Implementation in E Series Routers on page 103
- VRRP Router Election Rules on page 104
- Before You Configure VRRP on page 108
- Configuring VRRP on page 109

Example: VRRP Configuration Without the Real Address Owner

Figure 6 on page 108 is noticeably similar to Figure 5 on page 107 except that the addresses configured by the VRIDs have no real owner. Consequently, both routers R1 and R2 are configured as backup routers for VRID 1, VRID 2, VRID 3, and VRID 4.

Figure 6: VRRP Configuration Without the Real Address Owner



Assuming that preemption is enabled, the router that is configured with the highest priority for each VRID becomes the master router. If priorities are the same, the router that has the highest primary address becomes the master router.

This configuration shows how the address owner does not necessarily need to exist under VRRP, and all PCs can reach destinations outside of their network through the current master VRRP router. Depending on the accept-data configuration, the PCs may even be able to ping their default gateway.

The election protocol specified in VRRP uses IP multicast packets to provide the router with redundancy. Therefore, VRRP can operate over a variety of multiaccess LAN technologies that support IP multicast. It is important to remember that there is always one master router for an IP address shared by the redundancy group.

Related Topics

- VRRP Overview on page 101
- VRRP Implementation in E Series Routers on page 103
- VRRP Router Election Rules on page 104
- Before You Configure VRRP on page 108
- Configuring VRRP on page 109

Before You Configure VRRP

Before you configure VRRP, you must configure an IP interface and assign a primary IP address and subnet mask. When the IP address belongs to the owner of the VRID, you must associate the IP address with the VRID that you create.

To configure the IP interface for VRRP:

1. Configure an IP interface.

host1(config)#**interface fastEthernet 4/0**

2. Assign an IP address and a subnet mask.

   host1(config-if)#**ip address 194.50.1.42 255.255.255.0**

NOTE: We recommend that you complete all IP address configurations before you configure VRRP. If for any reason the IP address information changes after you configure VRRP, you must revise the associated IP addresses configured on the related VRRP entries. If you specify **auto** addresses in the **ip vrrp virtual-address** command along with using priority 255, you must disable and reenable the VRRP entry to update the association list.

Related Topics

- Configuring VRRP on page 109
- VRRP Overview on page 101

Configuring VRRP

Before you configure VRRP, we recommend that you review the following VRRP configuration examples:

- Example: Basic VRRP Configuration on page 105
- Example: Commonly Used VRRP Configuration on page 106
- Example: VRRP Configuration Without the Real Address Owner on page 107

To configure VRRP parameters:

1. (Optional) Create a VRID instance.

   host1(config-if)#**ip vrrp 25**

2. (Optional) Set a VRRP advertisement interval for the same VRID.

   host1(config-if)#**ip vrrp 25 advertise-interval 50**

3. Set the VRRP router priority for owner or backup routers.

   This step is mandatory to configure priority for the owner VRID (255). This step is optional to configure priority for a backup VRID (1–254). The default value is 100.

   host1(config-if)#**ip vrrp 25 priority 255**
   host1(config-if)#**ip vrrp 22 priority 254**

4. (Optional) Enable the backup router to learn the VRRP advertisement interval.

   host1(config-if)#**ip vrrp 22 timers-learn**

5. (Optional) Specify that the backup router can process packets with an IP destination address of the virtual address.

   host1(config-if)#**ip vrrp 22 accept-data**

6. (Optional) Set the preempt option. This example creates a new VRID.

host1(config-if)#ip vrrp 10 preempt

7. Associate an IP address with a VRID.

   host1(config-if)#ip vrrp 25 virtual-address 194.2.1.63

NOTE: If you configure VRRP on a virtual router and associate the IP address with the VRRP instance ID (VRID) so that the virtual address becomes the interface address of the router, the priority of the router automatically changes to 255 making it the master router. This change of priority occurs in JunosE Software Releases 11.0.0 and higher-numbered releases and later to enable full compliance with RFC-Virtual Router Redundancy Protocol (VRRP) (April 2004).

Also, you cannot configure the priority of the VRRP router as 255 by using the **ip vrrp priority** command, unless you configured the router to automatically learn associated addresses by using the **auto** keyword with the **ip vrrp virtual-address** command. In addition, if you change the virtual address of the VRRP router, which is operating as the IP address owner, to an IP address that is no longer the IP address owner, the priority changes automatically to the default value of 100.

8. (Optional) Set the VRRP authentication type to either **text** or **none**.

   host1(config-if)#ip vrrp 25 authentication-type none

9. (Optional) Configure the VRRP authentication key.

   host1(config-if)#ip vrrp 25 authentication-key dublin

10. Enable the VRID instance.

    host1(config-if)#ip vrrp 25 enable

Related Topics

- Before You Configure VRRP on page 108
- VRRP Overview on page 101
- VRRP Implementation in E Series Routers on page 103

- ip vrrp
- ip vrrp accept-data
- ip vrrp advertise-interval
- ip vrrp authentication-key
- ip vrrp authentication-type
- ip vrrp enable
- ip vrrp preempt
- ip vrrp priority
- ip vrrp timers-learn
- ip vrrp virtual-address

Changing the Object Priority

You can use the **ip vrrp track** command (in conjunction with the **track** command) to track an object by its virtual router ID (VRID). When the state of the object changes from an up state to a down state, the priority of the vrid is decremented. When the object changes back to an up state the priority is restored.

To dynamically change the priority of a virtual router ID (VRID) in response to a change in the state of a specified object:

1. Track an object by its virtual ID. This example creates a new VRID.

   host1(config-if)#**ip vrrp 25 track abc**

NOTE: Multiple VRIDs can track the same object and a single VRID can track multiple objects.

2. Specify the value by which the priority must be decremented. This example dynamically changes the priority of the VRID in response to a change in state of object abc.

   host1(config-if)#**ip vrrp 25 track abc decrement 15**

NOTE: For information about the **track** command, see *Managing the System* in the *JunosE System Basics Configuration Guide*.

Related Topics

- ip vrrp track

Monitoring the Configuration of VRIDs

Purpose Display information about all configured VRIDs.

Action To display a detailed summary of all configured VRIDs:

```
host1#show ip vrrp
Interface: FastEthernet3/0 vrrpVrid: 1
  primary address: 12.60.1.1
  operational state: init
  admin state: disabled
  up time: N/A
  interval: 1 second
  Learning timer mode: disabled
  last error status: no error
  priority: 100  ( admin priority: 100 )
  auth type: none
  preemption: enabled
  accept data: disabled
  assoc address(es): none
  track object:  xyz  state:  Up  decrement:  10
```

To display the summary count on all configured VRIDs:

```
host1#show ip vrrp summary
ip interfaces with vrrp: 1
  entries: 10
  entries enabled: 10
  entries with owner priority: 1
  entries in init state: 0
  entries in backup state: 9
  entries in master state: 1
  entries performing tracking: 2
```

To display a brief summary of all configured VRIDs:

```
host1#show ip vrrp brief
Interface                VRID  Primary Address  State   Adv  Pri  Admin
-----------------------  ----  ---------------  ------  ---  ---  --------
fastEthernet12/8.1.1      255  123.123.123.123    init    1  100  disabled
gigabitEthernet12/8.1.1     1          1.1.1.1  master    1  254  enabled
```

Meaning Table 19 on page 112 lists the **show ip vrrp** command and **show ip vrrp summary** command output fields.

Table 19: show ip vrrp and show ip vrrp summary Output Fields

Field Name	Field Description
Interface	Fast Ethernet, Gigabit Ethernet, or 10-Gigabit Ethernet interface specifier and VRID
primary address	IP address used while in master state; not necessarily an associated address
operational state	State of the VRRP router: • master—Router that forwards packets sent to the IP address associated with the virtual router. • backup—Router that forwards packets if the current master router fails. Provides the current master router's IP address. • init—Router that transitions to either the master state or backup state depending on the priority assigned.
admin state	Administrative status: enabled or disabled.
up time	Number of seconds that the VRID has been enabled in non-init state
interval	VRRP advertisement interval in seconds or milliseconds
Learning timer mode	Mode of the VRRP router: • enabled—Router learns the VRRP advertisement interval that is useful in case of failure of the master router • disabled—Router does not learn the VRRP advertisement interval.

Table 19: show ip vrrp and show ip vrrp summary Output Fields *(continued)*

Field Name	Field Description
last error status	Help text used to debug any error detected
priority	Priority value of VRRP router
admin priority	Priority of the VRRP administrative router
auth type	Type of authentication used by VRRP: none or text
preemption	Status of VRRP router preemption: enabled or disabled • enabled—Backup router always takes over the responsibility of the master router. • disabled—Backup router with lower-priority remains in backup state.
accept data	Accept data status of the VRRP router: • enabled—Enables the backup router to process packets with an IP destination address equivalent to the virtual addresses while the backup router is in the master state. • disabled—Disables the processing of data packets by the backup router while the router is in the master state.
assoc address(es)	IP addresses associated with the VRID
track object	Name and state of the tracked object and the value by which the object priority changes following an object state change
ip interfaces with vrrp	Number of IP interfaces using VRRP
entries	Total number of entries
entries enabled	Number of enabled entries
entries with owner priority	Number of entries with an owner priority
entries in init state	Number of entries in an initialization state
entries in backup state	Number of entries in a backup state
entries in master state	Number of entries in a master state
entries performing tracking	Number of entries performing tracking functions
VRID	VRRP router instance configured on this interface

Table 19: show ip vrrp and show ip vrrp summary Output Fields *(continued)*

Field Name	Field Description
Primary Address	IP address used while in master state; not necessarily an associated address
State	Operational state of the VRRP router: • master—Router that forwards packets sent to the IP address associated with the virtual router. • backup—Router that forwards packets if the current master router fails. Provides the current master router's IP address. • init—Router that transitions to either the master or backup router depending on the priority assigned.
Adv	Advertisement interval, in seconds
Pri	Priority assigned to this router
Admin	Administrative state of the VRID: enabled or disabled

Related Topics

- VRRP Overview on page 101
- Before You Configure VRRP on page 108
- Configuring VRRP on page 109

Monitoring the Configuration of VRRP Neighbors

Purpose Display neighbor information to the VRRP routers. Neighbor is a router that shares a given VRID with the VRRP router. A neighbor is known to the VRRP router only when the neighbor becomes a master for an IP address and sends VRRP advertisements. If a router sharing the VRID has not yet become a master router, then the local router remains unaware of this neighbor and this command does not display that neighbor.

Action To display information about all known neighbors to the VRRP routers:

```
host1#show ip vrrp neighbor
Interface: fastEthernet5/0.0 vrrpVrid: 1
  time discovered: 08/09/2001 07:44
  primary address: 10.0.0.1
  adv interval (sec): 1
  priority: 255 (owner)
  auth type: none
  assoc address(es): 10.0.0.1, 100.0.0.1, 101.0.0.1
Interface: fastEthernet5/0.1 vrrpVrid: 11
  time discovered: 08/09/2001 07:44
  primary address: 11.0.0.1
  adv interval (sec): 1
  priority: 255 (owner)
  auth type: none
  assoc address(es): 11.0.0.1, 110.0.0.1, 111.0.0.1
```


Meaning Table 20 on page 115 lists the **show ip vrrp neighbor** command output fields.

Table 20: show ip vrrp neighbor Output Fields

Field Name	Field Description
Interface	Fast Ethernet, Gigabit Ethernet, or 10-Gigabit Ethernet interface specifier and VRID of neighbors known to the VRRP router.
time discovered	Date and time that the neighbor was detected
primary address	Primary IP address of neighbor
adv interval (sec)	VRRP advertisement interval in seconds
Priority	Priority status of VRRP router. If the priority value is 255, then the VRRP router is the master.
auth type	VRRP authentication type: none or text
assoc address(es)	IP addresses associated with the VRID that are advertised by the neighbor

Related Topics

- VRRP Overview on page 101
- Before You Configure VRRP on page 108
- Configuring VRRP on page 109

Monitoring the Statistics of VRRP Routers

Purpose Display global statistics, interface statistics, or statistics per interface and VRID of configured VRRP routers.

Action To display the statistics per interface:

```
host1#show ip vrrp statistics interface fastEthernet 4/0
Globals:
  checksumErrors: 0
  versionErrors: 0
  vrIdErrors: 1
  iccErrors: 0
  txErrors: 0
  rxErrors: 0
Interface: fastEthernet4/0 vrrpVrid: 1
  becomeMaster: 10
  advertiseRcvd: 0
  advertiseIntervalErrors: 0
  authFailures: 0
  ipTtlErrors: 0
  priorityZeroPktsRcvd: 0
  priorityZeroPktsSent: 9
  invalidTypePktsRcvd: 0
```



```
  addressListErrors: 0
  invalidAuthType: 0
  authTypeMismatch: 0
  packetLengthErrors: 0
Interface: fastEthernet4/0 vrrpVrid: 50
  becomeMaster: 0
  advertiseRcvd: 1000
  advertiseIntervalErrors: 0
  authFailures: 0
  ipTtlErrors: 0
  priorityZeroPktsRcvd: 0
  priorityZeroPktsSent: 0
  invalidTypePktsRcvd: 0
  addressListErrors: 0
  invalidAuthType: 0
  authTypeMismatch: 0
  packetLengthErrors: 0
```

To display the statistics per interface and VRID:

```
host1#show ip vrrp statistics interface fastEthernet 4/0 1
Interface: fastEthernet4/0 vrrpVrid: 1
  becomeMaster: 0
  advertiseRcvd: 0
  advertiseIntervalErrors: 0
  authFailures: 0
  ipTtlErrors: 0
  priorityZeroPktsRcvd: 0
  priorityZeroPktsSent: 0
  invalidTypePktsRcvd: 0
  addressListErrors: 0
  invalidAuthType: 0
  authTypeMismatch: 0
  packetLengthErrors: 0
```

To display the global statistics of a VRRP router:

```
host1#show ip vrrp statistics global
Globals:
  checksumErrors: 0
  versionErrors: 0
  vrIdErrors: 0
  iccErrors: 0
  txErrors: 0
  rxErrors: 0
```

Meaning Table 21 on page 116 lists the **show ip vrrp statistics** command output fields.

Table 21: show ip vrrp statistics Output Fields

Field Name	Field Description
Globals	
checksumErrors	Total number of VRRP packets received with an invalid VRRP checksum value
versionErrors	Total number of VRRP packets received with an unknown or unsupported version number

Table 21: show ip vrrp statistics Output Fields *(continued)*

Field Name	Field Description
vrIdErrors	Total number of VRRP packets received with an invalid VRID for this virtual router
iccErrors	Count of line module notifications that did not make it to the controller
txErrors	Count of advertisements that did not get sent due to resource limitations
rxErrors	Count of advertisements received that could not be parsed by VRRP applications
Interface	Fast Ethernet, Gigabit Ethernet, or 10-Gigabit Ethernet interface specifier and VRID
becomeMaster	Total number of times that this VRID state has transitioned to master
advertiseRcvd	Total number of VRRP advertisements received
advertiseIntervalErrors	Total number of VRRP advertisement packets received for which the advertisement interval is different from the one configured for the VRID
authFailures	Total number of VRRP packets received that do not pass the authentication check
ipTtlErrors	Total number of VRRP packets received with IP TTL (time-to-live) not equal to 255
priorityZeroPktsRcvd	Total number of VRRP packets received with a priority of 0
priorityZeroPktsSent	Total number of VRRP packets sent with a priority of 0
invalidTypePktsRcvd	Total number of VRRP packets received with an invalid value in the Type field
addressListErrors	Total number of VRRP packets received for which the address list does not match the locally configured list for the VRID
invalidAuthType	Total number of VRRP packets received with an unknown authentication type
authTypeMismatch	Total number of VRRP packets received with an authentication type not equal to the locally configured authentication method

Table 21: show ip vrrp statistics Output Fields *(continued)*

Field Name	Field Description
packetLengthErrors	Total number of VRRP packets received with a packet length less than the length of the VRRP header

Related Topics

- VRRP Overview on page 101
- Before You Configure VRRP on page 108
- Configuring VRRP on page 109

Monitoring the Configuration of VRRP Tracked Objects

Purpose Display details of objects tracked by various VRIDs.

Action To display the details of objects tracked using VRIDs.

```
host1#show ip vrrp tracked-objects
Interface           Vrid       Priority   Object       Type       State    Decrement
----------------    -------    --------   ------       --------   -----    ---------
FastEthernet3/0     1          100        ERX_Bangalore IP-route  Up       12
FastEthernet3/0     1          100        ERX_Bangalore IP-route  Up       15
FastEthernet3/0     1          100        ERX_Bangalore IP-route  Up       10
FastEthernet3/0     2          100        ERX_Bangalore IP-route  Up       10
FastEthernet3/0     3          100        ERX_Bangalore IP-route  Up       12
FastEthernet3/0     3          100        ERX_Bangalore IP-route  Up       15
```

Meaning Table 22 on page 118 lists the **show ip vrrp tracked-objects** command output fields.

Table 22: show ip vrrp tracked-objects Output Fields

Field Name	Field Description
Interface	Name of the Interface. Fast Ethernet, Gigabit Ethernet, or 10-Gigabit Ethernet interface specifier.
Vrid	VRRP router instance configured on the interface
Priority	Priority of the VRRP router. If the priority value is 255, then the VRRP router is the master.
Object	Name of the object being tracked
Type	Type of object being tracked
State	State of the object
Decrement	Value by which the priority is decremented or restored following an object state change

Related Topics

• Changing the Object Priority on page 111

CHAPTER 6

Managing Interchassis Redundancy

This chapter describes how to configure interchassis redundancy (ICR) on your E Series router.

ICR Overview

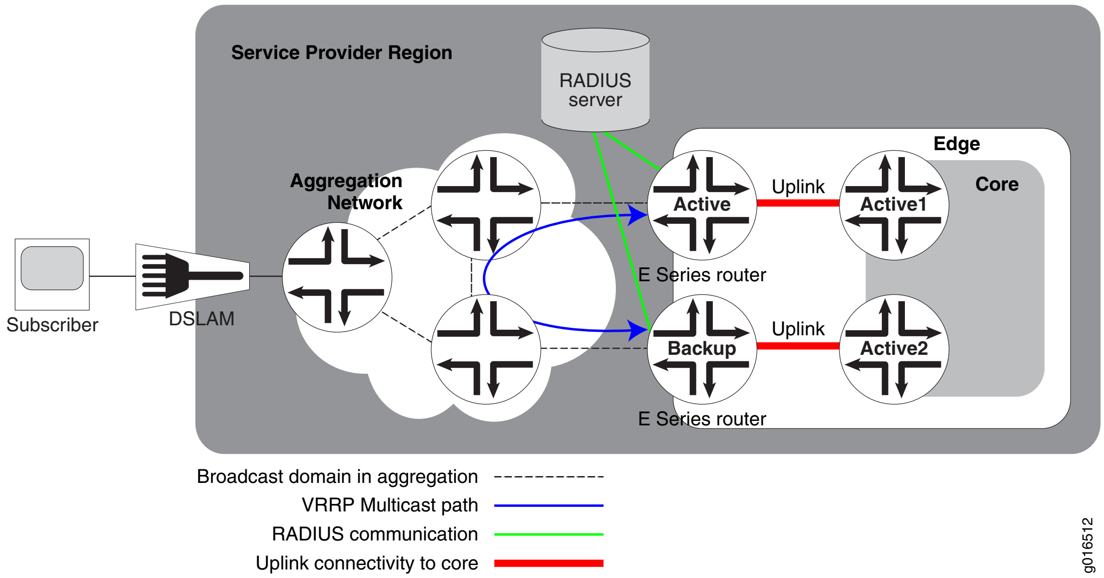
A broadband services router (BSR) aggregates many subscribers and services such as video on demand (VoD), voice over IP (VoIP), Internet Protocol television (IPTV), and the Internet, simultaneously. If the router fails because of hardware failures, subscriber downtime can result.

Interchassis redundancy (ICR) enables you to minimize subscriber downtime when the router or access interface on the edge router fails. ICR accomplishes this by re-creating subscriber sessions on the backup router that were originally terminated on the failed router. In this way, ICR enables you to completely recover from router failure. ICR uses

Virtual Router Redundancy Protocol (VRRP) to detect failures. ICR also enables you to track the failure of uplink interfaces. ICR currently supports only PPPoE subscribers.

Figure 7 on page 122 illustrates ICR deployment.

Figure 7: ICR Deployment



The subscriber broadcasts a PPPoE Active Discovery Initiation (PADI) packet to both the *master* and *backup* router. Only the *master* router processes the packet and creates the subscriber session. When the *master* router fails, VRRP switchover occurs and the *backup* router becomes the new *master* router. When receiving traffic for non-existent PPPoE sessions, the new *master* router sends early termination requests by sending PPPoE Active Discovery Termination (PADT) packets to the clients instead of waiting for the client to reconnect after the PPPoE session expires. The clients respond by sending requests to log in again. Then, the new *master* router creates new sessions for the PPPoE subscribers.

In lower-numbered releases, the new *master* router dropped the PPPoE packets because a session did not exist for the PPPoE subscribers and did not send PADT packets.

ICR achieves load balancing in case of failures on a per physical port basis by enabling you to create partitions. An *ICR partition* is a set of S-VLANs (and CVLANs) associated with a unique VRRP instance. There can be multiple partitions per physical port. A partition is the basic unit of redundancy. A partition cannot span multiple physical ports.

You can also create ICR clusters. An *ICR cluster* consists of a group of routers participating in ICR. You can use different E Series routers to configure a heterogeneous ICR cluster. For example, you can use an E120 or E320 router with an ES2 4G LM as a backup for subscribers on an ERX1440 router, or use an ERX1440 router with a GE-HDE LM as a backup for subscribers on an E120 or E320 router. However, you must keep in mind the hardware scaling limitations when you configure an ICR cluster containing both E320 routers and ERX routers.

NOTE: While deploying ICR, service providers must ensure that the aggregation layer between the E Series router and access node (DSLAM) provides a broadcast domain per VLAN or per S-VLAN between active and backup routers. In the case of a direct connect model the access node must provide the broadcast domain per VLAN or per S-VLAN between the active and backup routers or instead provide an Ethernet switch such as EX Series Ethernet Switch between the access node and E Series router.

Related Topics

- ICR Scaling Considerations on page 124
- Configuring an ICR Partition on page 127

ICR Platform Considerations

ICR is supported on all E Series routers.

For information about modules supported on E120 and E320 routers:

- See *E120 and E320 Module Guide, Table 1, Modules and IOAs* for detailed module specifications.
- See *E120 and E320 Module Guide, Appendix A, IOA Protocol Support* for information about the modules that support ICR.

For information about modules supported on ERX routers:

- See *ERX Module Guide, Table 1, ERX Module Combinations* for detailed module specifications.
- See *ERX Module Guide, Appendix A, Module Protocol Support* for information about the modules that support ICR.

Interface Specifiers

The majority of the configuration task examples in this topic collection use the *slot/adapter/port* format to specify an interface. However, the interface specifier format that you use depends on the router that you are using.

For ERX7xx models, ERX14xx models, and ERX310 routers, use the *slot/port* format. For example, the following command specifies a Gigabit Ethernet interface on slot 0, port 1 of an ERX7xx model, ERX14xx model, or ERX310 router.

```
host1(config)#interface gigabitEthernet 0/1
```

For E120 and E320 routers, use the *slot/adapter/port* format, which includes an identifier for the bay in which the I/O adapter (IOA) resides. In the software, adapter 0 identifies the right IOA bay (E120 router) and the upper IOA bay (E320 router); adapter 1 identifies the left IOA bay (E120 router) and the lower IOA bay (E320 router). For example, the following command specifies a10-Gigabit Ethernet interface on slot 5, adapter 0, port 0 of an E320 router.

```
host1(config)#interface tenGigabitEthernet 5/0/0
```


Related Topics

- Interface Types and Specifiers

ICR Terms

Table 23 on page 124 defines terms used in this discussion of ICR.

Table 23: ICR Terminology

Term	Description
ICR cluster	Group of E Series routers participating in interchassis redundancy (ICR) deployment.
ICR interface	Physical interface, for example, gigabitEthernet 3/1/3, on an E Series router on which ICR is enabled. The ICR interface is always tied to a unique router.
ICR partition	A logical group of subscriber interfaces within a single ICR interface. For example, the ICR partition can be a group of S-VLANs configured on a single physical interface. You can create multiple partitions on each ICR interface and configure the number of partitions, as well as assign subscribers to the partition. An ICR partition can be configured as master or backup.
VRRP	Virtual Router Redundancy Protocol. Use VRRP to prevent loss of network connectivity by configuring backup routers. The backup routers maintain network connectivity when the master router fails. You can configure unique VRRP instances to manage each ICR partition.
VSA	Vendor-specific attributes. VSAs are defined by remote-access server vendors to customize how RADIUS works on their servers. VSAs can be used in combination with RADIUS-defined attributes.

ICR References

For more information about ICR, see the following resources:

- RFC 2338—Virtual Router Redundancy Protocol (April 1998)
- RFC 2787—Definitions of Managed Objects for the Virtual Router (March 2000)
- RFC 2865—Remote Authentication Dial In User Service (RADIUS) (June 2000)
- RFC 2866—RADIUS Accounting (June 2000)

ICR Scaling Considerations

When planning an ICR cluster you must ensure that you have provisioned adequate backup capacity in the event of a worst-case failure scenario such as a multiple hardware or multiple router failure.

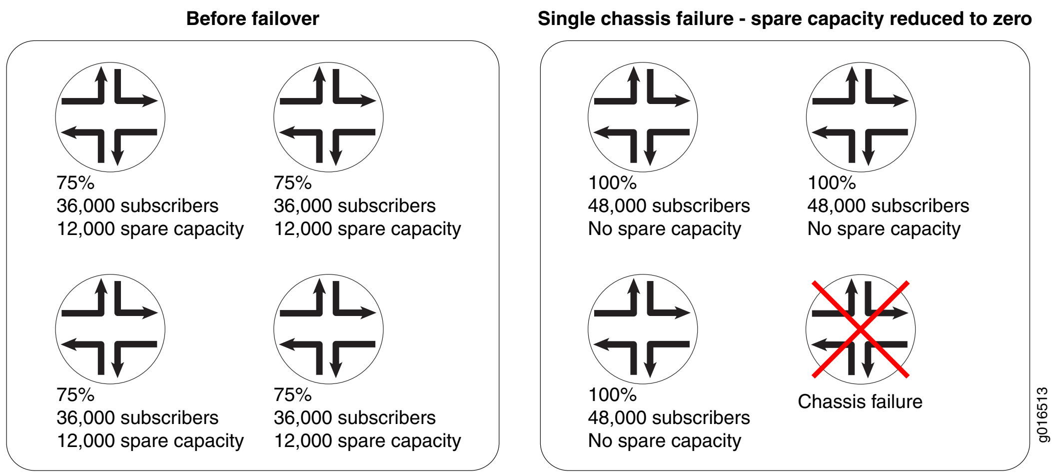
NOTE: Remember to consider parameters such as link bandwidth, QoS, and line module scaling limitations when you plan the deployment of the ICR cluster.

1:1 Subscriber Redundancy in a 4–Node ICR Cluster

Consider a 4–node ICR cluster that consists of four ERX1440 routers, as shown in Figure 8 on page 125. Each of the four routers is capable of supporting 48,000 PPP/PPPoE subscribers. The degree of redundancy that you can achieve in this cluster is 1:1. For every subscriber, you have a backup destination within the cluster. If one router fails, subscriber load is equally distributed to the other three routers. Thus, no single router serves as a dedicated backup. Instead, each router can be loaded with around 75 percent of its capacity while the remaining 25 percent is available to accommodate subscribers from the failing router. Failure of any one router causes all routers in the cluster to become fully loaded with no spare capacity to accommodate further failures. This is the minimum degree of redundancy in a 4–node ICR cluster.

Figure 8 on page 125 illustrates an example of a typical ICR configuration.

Figure 8: Sample 1:1 Subscriber Redundancy in a 4–Node ICR Cluster



Related Topics

- Configuring an ICR Partition on page 127

Interaction with RADIUS for ICR

Authorization and authentication access messages identify subscribers before the RADIUS server grants or denies those subscribers access to the network or network services. When an application requests user authentication, the request must have certain authenticating attributes, such as a user's name, password, and the particular type of service the user is requesting. This information is sent in the authentication request via the RADIUS protocol to the RADIUS server. In response, the RADIUS server grants or denies the request.

JunosE Software supports certain RADIUS vendor-specific attributes (VSAs) that define specific authentication, authorization, and accounting elements in a user's profile. The profile is stored on the RADIUS server. RADIUS messages contain RADIUS attributes to communicate information between an E Series Broadband Services Router and the RADIUS server. For complete information on VSAs, see *Configuring RADIUS Attributes* in the *JunosE Broadband Access Configuration Guide*. JunosE Software Release 10.3.x and later supports the ICR-Partition-Id VSA [26-150]. You can use this VSA to collect information on the ICR partition configured on the VLAN or S-VLAN subinterface on which subscribers are logged in.

You can include an ICR-Partition-Id vendor-specific attribute (VSA) in the following RADIUS messages:

- Access-Request
- Acct-Start
- Acct-Stop
- Interim-Acct (if Acct-Stop messages are specified)
- Partition-Accounting-On
- Partition-Accounting-Off

NOTE: For more information about the ICR partition accounting messages, see the *Configuring RADIUS Attributes* chapter in the *JunosE Broadband Access Configuration Guide*.

Determining the ICR partition is useful for accounting and authentication of subscribers in RADIUS messages.

Use the ICR-Partition-Id VSA to determine the ICR partition on which subscribers are logged in. You can configure the same ICR-Partition-Id string for an active ICR partition and its corresponding backup partition.

To configure inclusion of ICR-Partition-Id in RADIUS Access-Request, Acct-Start, and Acct-Stop messages, you can use the ICR-Partition-Id attribute in the **radius include** command. When included in Acct-Stop messages, the attributes are also included in Interim-Acct messages.

In addition to including the ICR-Partition-Id VSA in RADIUS Access-Request, Acct-Start, Acct-Stop, and Interim-Acct messages, the router also sends the Partition-Accounting-On and Partition-Accounting-Off messages:

Both Partition-Accounting messages include the ICR-Partition-Id VSA. Also, both these messages are sent to the RADIUS accounting server configured on the virtual router where the ICR partition is configured or the virtual router on which the corresponding ICR interface is configured.

You can optionally configure duplicate or broadcast AAA accounting on a virtual router, which sends the accounting information to additional virtual router simultaneously, so that the Partition-Accounting-On and Partition-Accounting-Off messages can also be sent to the duplicate and broadcast virtual routers.

ICR Partition Accounting Overview

To enable or disable sending of the ICR Partition-Accounting-On or Partition-Accounting-Off messages to the RADIUS servers, you can now use the **radius icr-partition-accounting** command.

The transition of the ICR partition states from master to backup and backup to master can occur because of chassis failure, an administrative switchover, or an interface or line module reset action. The following scenarios describe how ICR partition accounting messages are processed and subscriber logging is handled:

- In the event of a complete chassis failure, RADIUS cannot interact with the failing B-RAS application on the router. In such a scenario, when the new master partition takes over, the Partition-Accounting-On message is sent from the new master. After the response for the Partition-Accounting-On message is received from the new master partition, subscribers are allowed to log in to the master. When you remove certain VLAN or S-VLAN IDs from an ICR partition, the corresponding subscribers in that partition are removed and forced to log out from the chassis. This action causes the Acct-Stop messages to be sent to RADIUS.
- If ICR partition accounting is enabled and an administrative switchover forces subscribers in a particular ICR partition to be logged out, the Partition-Accounting-Off message is sent from the failing B-RAS application on the router only after Acct-Stop responses are received for all the logged out subscribers.
- If ICR partition accounting is enabled, and the interface or the line module that is configured with the ICR partition fails, the Partition-Accounting-Off message is sent from the failing B-RAS application on the router after Acct-Stop responses are received for all the logged out subscribers in that partition.

Related Topics

- Using RADIUS to Manage Subscribers Logging In to ICR Partitions on page 134
- radius include
- radius icr-partition-accounting
- show radius icr-partition-accounting
- *Configuring RADIUS Attributes* in the *JunosE Broadband Access Configuration Guide*

Configuring an ICR Partition

You can use RADIUS servers to authenticate subscribers and collect statistics related to the users logging in to an ICR partition on a virtual router. When you configure an ICR partition, you configure the interface on which the ICR partition resides and create a unique VRRP instance to manage the partition.

To configure an ICR partition:

1. Configure the interface.

   See “Configuring the Interface on Which the ICR Partition Resides” on page 128.

2. Create a unique VRRP instance to manage the ICR partition.

   See “Configuring VRRP Instances to Match ICR Requirements” on page 129.

3. Create and assign a name to the ICR partition.

   See “Naming ICR Partitions” on page 130.

4. (Optional) Select the grouping criterion for the ICR partition.

   See “Grouping ICR Subscribers Based on S-VLAN IDs” on page 130 and “Grouping ICR Subscribers Based on VLAN IDs” on page 131.

NOTE: Grouping subscribers based on S-VLAN IDs is the default grouping option for ICR partitions. If you do not explicitly specify the grouping option, subscribers are grouped based on S-VLAN IDs.

5. (Optional) Configure RADIUS.

   See “Using RADIUS to Manage Subscribers Logging In to ICR Partitions” on page 134.

Related Topics

- ICR Overview on page 121
- Monitoring the Configuration of ICR Partitions on page 136
- Monitoring the Configuration of an ICR Partition Attached to an Interface on page 135
- Monitoring the Status of ICR Partition Accounting

Configuring the Interface on Which the ICR Partition Resides

You can create multiple ICR partitions on an interface. For information on the number of ICR partitions that you can create, see *JunosE Release Notes, Appendix A, System Maximums*.

To configure the interface on which the ICR partition resides:

1. Specify a FastEthernet, GigabitEthernet, or 10–GigabitEthernet interface.

   ```
   host1(config)#interface gigabitEthernet 3/5/0
   host1(config-if)#
   ```

2. Specify VLAN as the encapsulation method to create the VLAN major interface.

   ```
   host1(config-if)#encapsulation vlan
   ```

3. Create a VLAN subinterface by adding a subinterface number to the interface identification number.

   ```
   host1(config-if)#interface gigabitEthernet 3/5/0.10
   ```


4. Assign a VLAN ID for the subinterface. The router configures the subinterface whether or not the subinterface is part of the ICR partition. Use the **icr-control-interface** keyword to specify that an ICR partition can be configured on the the subinterface.

   host1(config-if)#**vlan id 10 1 icr-control-interface**

5. Assign an IP address to the VLAN subinterface.

   host1(config-if)#**ip address 3.5.1.1/24**

Related Topics

- Configuring VRRP Instances to Match ICR Requirements on page 129
- Monitoring the Configuration of an ICR Partition Attached to an Interface on page 135

Configuring VRRP Instances to Match ICR Requirements

Each ICR partition is managed by a unique VRRP instance. You can specify an ICR partition as the *master* partition by assigning a higher priority. Use the **ip vrrp priority** command to assign priorities to the ICR partitions.

To configure the VRRP instance to match ICR requirements:

1. Create a VRRP instance by specifying the identification number, and associate an IP address with the identification number.

   host1(config-if)#**ip vrrp 1 virtual-address 3.5.1.10**

2. Specify the priority of the router. Assign the higher priority to the master ICR partition and a lower priority to the backup ICR partition.

   host1(config-if)#**ip vrrp priority 200**

3. (Optional) Enable the router to learn the VRRP advertisement interval. Use this only when you plan on upgrading your router by means of a unified in-service software upgrade (ISSU).

   host1(config-if)#**ip vrrp 1 timers-learn**

4. Enable the VRRP instance.

   host1(config-if)#**ip vrrp 1 enable**

5. (Optional) Configure additional VRRP instances by completing Steps 1 through 4, using unique numbering.

Related Topics

- VRRP Overview on page 101
- ip vrrp
- ip vrrp enable
- ip vrrp priority
- ip vrrp timers-learn
- ip vrrp virtual-address

Naming ICR Partitions

After you have configured the interface on which the ICR partition resides and the unique VRRP instance that manages the ICR partition, you must create the ICR partition. You can use the keywords *master* or *backup* to identify the type of ICR partition created.

To create and name ICR partitions:

1. Create an ICR partition by specifying a unique name for the partition. For easy identification, you can include the keywords *master* or *Backup* in the name of the partition.

   host1(config-if)#**ip vrrp 1 icr-partition part1Master**

2. (Optional) Create additional ICR partitions by repeating Step 1, using unique names or numbering.

   host1(config-if)#**ip vrrp 2 icr-partition part1Backup**

   host1(config-if)#**ip vrrp 3 icr-partition ICRBackup**

For information on the number of ICR partitions that you can create per line module or chassis, see *JunosE Release Notes, Appendix A, System Maximums*.

Related Topics

- ICR Overview on page 121
- ip vrrp icr-partition
- Monitoring the Configuration of ICR Partitions on page 136

Grouping ICR Subscribers Based on S-VLAN IDs

You can group ICR subscribers based on S-VLAN IDs. When you configure an S-VLAN list or S-VLAN range or an S-VLAN and VLAN subinterface pair, you can include any or all of the following keywords:

- Use the **control-interface** keyword to control the state of the corresponding subinterfaces (up/AdminDown) based on the state of the partition (master or backup). If the subinterfaces are part of the backup partition, the router changes the state of all the subinterfaces to AdminDown.
- Use the **use-default-mac** keyword to enable the subinterfaces to use the default MAC address instead of the VRRP MAC address. By default, subinterfaces use the virtual MAC address of the associated VRRP instance.
- Use the **advertise-mac** keyword to enable the subinterfaces to transmit gratuitous ARP (GARP) advertisements when the ICR partition moves from the backup state to the master state.

To group ICR subscribers based on S-VLAN IDs:

1. Specify **svlan** as the grouping type.

   host1(config-if)#**ip vrrp 1 icr-partition group svlan**

The default grouping option is S-VLAN. If you do not explicitly specify the grouping option, the subscribers are grouped based on S-VLAN.

2. Add S-VLAN subinterfaces to the ICR partition by doing either of the following:
   - Specify the S-VLAN IDs individually by using the **svlan-list** keyword. In the following example, you add individual S-VLAN subinterfaces by specifying each S-VLAN ID.

     host1(config-if)#**ip vrrp 1 icr-partition svlan-list 100 102 105 108 114 125 control-interface advertise-mac**

   - Specify the starting ID and ending ID of the range of S-VLAN subinterfaces. In the following example, you specify the first and the last ID of the range because the IDs are in sequential order.

     host1(config-if)#**ip vrrp 1 icr-partition svlan-range 100 110 control-interface advertise-mac**

3. (Optional) Add an S-VLAN and VLAN subinterface pair to the ICR partition.

   host1(config-if)#**ip vrrp 1 icr-partition svlan-list-explicit 120 1 120 2 control-interface advertise-mac**

NOTE: To enable the new master router to send PPPoE Active Discovery Termination (PADT) packets to the clients and create new sessions for the PPPoE subscribers, you must create a dummy IP interface for each S-VLAN that is part of the ICR partition.

4. (Optional) Configure additional S-VLAN subinterfaces by completing Steps 2 and 3 using unique numbering.

Related Topics

- Grouping ICR Subscribers Based on VLAN IDs on page 131
- ip vrrp icr-partition group
- ip vrrp icr-partition svlan-list
- ip vrrp icr-partition svlan-list explicit
- ip vrrp icr-partition svlan-range
- Monitoring the Configuration of an ICR Partition Attached to an Interface on page 135

Grouping ICR Subscribers Based on VLAN IDs

You can configure ICR subscribers based on VLAN IDs. When you configure a VLAN list or VLAN range, you can include any or all of the following keywords:

- Use the **control-interface** keyword to control the state of the corresponding subinterfaces (up/AdminDown) based on the state of the partition (master or backup). If the subinterfaces are part of the backup partition, the router changes the state of all the subinterfaces to AdminDown.
- Use the **use-default-mac** keyword to enable the subinterfaces to use the default MAC address instead of the VRRP MAC address. By default, subinterfaces use the virtual MAC address of the associated VRRP instance.

- Use the **advertise-mac** keyword to enable the subinterfaces to transmit gratuitous ARP (GARP) advertisements when the ICR partition moves from the backup state to the master state.

To group ICR subscribers based on VLAN IDs:

1. Specify VLAN as the grouping type.

   host1(config-if)#**ip vrrp 1 icr-partition group vlan**

   The default grouping option is S-VLAN. If you do not explicitly specify the grouping option, the subscribers are grouped based on S-VLAN.

2. Add VLAN subinterfaces to the ICR partition by doing either of the following:

   - Specify the VLAN IDs individually by using the **vlan-list** keyword to add a group of random VLAN IDs. In the following example, you add VLAN subinterfaces by specifying each VLAN ID individually because the IDs are in random order.

     host1(config-if)#**ip vrrp 1 icr-partition vlan-list 10 21 62 control-interface advertise-mac**

   - Specify the starting ID and ending ID of the range of VLAN subinterfaces. In the following example, you specify the first and the last ID of the range because the IDs are in sequential order.

     host1(config-if)#**ip vrrp 1 icr-partition vlan-range 10 40 control-interface advertise-mac**

3. (Optional) Configure additional VLAN subinterfaces by completing Step 2 using unique numbering.

Related Topics

- Grouping ICR Subscribers Based on S-VLAN IDs on page 130
- ip vrrp icr-partition group
- ip vrrp icr-partition vlan-list
- ip vrrp icr-partition vlan-range
- Monitoring the Configuration of an ICR Partition Attached to an Interface on page 135

Example: Configuring ICR Partitions That Group Subscribers by S-VLAN ID

The following example show how to configure a *master* ICR partition on an ERX1440 router. In this example, you first configure the interface on which the ICR partition resides. You can then create a new VRRP instance to manage the ICR partition. The value you assign to the **priority** keyword determines the state of the ICR partition.

1. Configure the interface on which the ICR partition resides.

   host1 (config)#**interface gigabitEthernet 3/5**
   host1 (config-if)#**encapsulation vlan**
   host1 (config-if)#**interface gigabitEthernet 3/5.10**
   host1 (config-if)#**svlan id 10 1 icr-control-interface**
   host1 (config-if)#**ip address 3.5.1.1/24**

2. Configure the VRRP instance based on the ICR partition requirements.

   host1 (config-if)#**ip vrrp 1 virtual-address 3.5.1.10**
   host1 (config-if)#**ip vrrp 1 priority 200**
   host1 (config-if)#**ip vrrp 1 timers-learn**
   host1 (config-if)#**ip vrrp 1 enable**

3. Create and identify the ICR partition.

   host1 (config-if)#**ip vrrp 1 icr-partition part1Master**

4. Group subscribers based on S-VLAN IDs.

   host1 (config-if)#**ip vrrp 1 icr-partition group svlan**
   host1 (config-if)#**ip vrrp 1 icr-partition svlan-range 100 110 control-interface**
   host1 (config-if)#**ip vrrp 1 icr-partition svlan-range 111 119 advertise-mac**
   host1 (config-if)#**ip vrrp 1 icr-partition svlan-list-explicit 120 1 120 2 advertise-mac control-interface**
   host1 (config-if)#**exit**

NOTE: To enable the new master router to send PPPoE Active Discovery Termination (PADT) packets to the clients and create new sessions for the PPPoE subscribers, you must create a dummy IP interface for each S-VLAN that is part of the ICR partition.

The following example shows how to configure a *backup* ICR partition on an E320 router. Configure the interface on which the ICR partition resides and then create a new VRRP instance that manages the backup ICR partition. The value you assign to the **priority** keyword determines the state of the ICR partition. In the case of a backup ICR partition, specify a value lower than the priority of the master ICR partition.

1. Configure the interface on which the ICR partition resides.

   host2 (config)#**interface gigabitEthernet 11/1/0**
   host2 (config-if)#**encapsulation vlan**
   host2 (config-if)#**interface gigabitEthernet 11/1/0.10**
   host2 (config-if)#**svlan id 10 1 icr-control-interface**
   host2 (config-if)#**ip address 3.5.1.2/24**

2. Configure the VRRP instance based on the ICR partition requirements.

   host2 (config-if)#**ip vrrp 1 virtual-address 3.5.1.10**
   host2 (config-if)#**ip vrrp 1 priority 100**
   host2 (config-if)#**ip vrrp 1 timers-learn**
   host2 (config-if)#**ip vrrp 1 enable**

3. Create and identify the ICR partition.

   host2 (config-if)#**ip vrrp 1 icr-partition part1Backup**

4. Group subscribers based on S-VLAN IDs.

   host2 (config-if)#**ip vrrp 1 icr-partition group svlan**
   host2 (config-if)#**ip vrrp 1 icr-partition svlan-range 100 110 control-interface**
   host2 (config-if)#**ip vrrp 1 icr-partition svlan-range 111 119 advertise-mac**
   host2 (config-if)#**ip vrrp 1 icr-partition svlan-list-explicit 120 1 120 2 advertise-mac control-interface**
   host2 (config-if)#**exit**

NOTE: To enable the new master router to send PPPoE Active Discovery Termination (PADT) packets to the clients and create new sessions for the PPPoE subscribers, you must create a dummy IP interface for each S-VLAN that is part of the ICR partition.

Grouping subscribers based on S-VLAN IDs is the default grouping method for ICR partitions. You can also explicitly choose S-VLAN as the grouping option as shown in this example. To add a group of random S-VLAN IDs, use the **svlan-list** command.

To group subscribers by VLAN IDs, use the **vlan** keyword instead of the **svlan** keyword. To add a group of random VLAN IDs, use the **vlan-list** command.

NOTE: While grouping subscribers based on VLAN IDs, you can use corresponding VLAN grouping commands. However, the **svlan-list-explicit** command does not have any corresponding VLAN command.

Related Topics

- ICR Overview on page 121
- ICR Scaling Considerations on page 124

Using RADIUS to Manage Subscribers Logging In to ICR Partitions

To configure RADIUS to manage subscribers logging in to ICR partitions on the router, perform the following tasks:

- Configure inclusion of the ICR-Partition-ID VSA in RADIUS messages.

  host1(config)#**radius-include icr-partition-id acct-start enable**

  Issuing this command includes the ICR-Partition-ID VSA in Acct-Start messages. To include the ICR-Partition-ID VSA in other accounting and access messages, see the *Configuring RADIUS Attributes* chapter in the *JunosE Broadband Access Configuration Guide*.

- Enable or disable sending of the ICR Partition-Accounting-On or Partition-Accounting-Off messages to the RADIUS servers.

  host1(config)#**radius icr-partition-accounting enable**

  For more information on enabling or disabling sending of partition accounting messages to RADIUS servers configured on a virtual router, see the *Configuring RADIUS Attributes* chapter in the *JunosE Broadband Access Configuration Guide*.

Related Topics

- radius include
- radius icr-partition-accounting
- show radius icr-partition-accounting
- Interaction with RADIUS for ICR on page 125
- Configuring an ICR Partition on page 127

Monitoring the Configuration of an ICR Partition Attached to an Interface

Purpose Display information about the ICR partition configured on an interface.

Action

```
host1#show icr-partition fastEthernet 3/5/0.1 1
  ICR Partition ID: part1A
  ICR Partition State: Master
  ICR Partition Grouping Criterion: SVLAN

  SVLAN     VLAN   control-interface    vrrp-mac    advertise-mac
  -----------------------------------------------------------------------
  100       Any     enabled          disabled          enabled
  101       Any     enabled          disabled          disabled
  102       Any     enabled          disabled          disabled
  103       Any     enabled          disabled          disabled
  104       Any     enabled          disabled          disabled
  105       Any     enabled          disabled          disabled
  106       Any     enabled          disabled          disabled
  107       Any     enabled          disabled          disabled
  108       Any     enabled          disabled          disabled
  109       Any     enabled          disabled          disabled
  -----------------------------------------------------------------------
  ICR Partition has 10 group members.
```

Meaning Table 24 on page 135 lists the **show icr-partition** command output fields.

Table 24: show icr-partition Output Fields

Field Name	Field Description
ICR Partition ID	Identifier for the ICR partition.
ICR Partition State	State of the ICR partition: • Master—ICR partition that accepts subscriber login requests. • Backup—ICR partition that does not accept subscriber login requests. • Dormant—When the IP address or virtual router is forcibly deleted, or if the lower interface is not available, the ICR partition moves to the Dormant state. The dormant ICR partition does not accept subscriber login requests. NOTE: The state of the ICR partition depends on the associated VRRP instance.
ICR Partition Grouping Criterion	Grouping option for the subscribers. Possible options: S-VLAN and VLAN. The default grouping option is S-VLAN.
SVLAN	S-VLAN identifier for the interface.
VLAN	VLAN identifier for the interface. **Any** indicates that the VLAN ID is a wildcard and you can specify any configured VLAN ID with the associated S-VLAN ID.

Table 24: show icr-partition Output Fields *(continued)*

Field Name	Field Description
control-interface	Controls the state of the corresponding subinterfaces (up/AdminDown) based on the state of the partition (master or backup). If the subinterfaces are part of the backup partition, the router changes the state of all the subinterfaces to AdminDown. You can also block all traffic on the backup partition. However, the router does not block VRRP advertisements as long as VRRP is running on a separate interface. Possible states: enabled or disabled. If the status is enabled, the router changes the state of the subinterface based on the state of the partition. If the status is disabled, the router does not control the state of the corresponding subinterface.
vrrp-mac	Configures the interface to use the default MAC address instead of the VRRP MAC address. Possible states: enabled or disabled. If the status is enabled, the interface uses the VRRP MAC address; otherwise, the interface uses the default MAC address.
advertise-mac	Enables the interface to transmit GARP advertisments when the partition moves from backup state to master state. Possible states: enabled or disabled. If the status is enabled, the interface transmits GARP advertisements; otherwise, the interface does not transmit GARP advertisements.

Related Topics

- Configuring the Interface on Which the ICR Partition Resides on page 128
- show icr-partition

Monitoring the Configuration of ICR Partitions

Purpose Display information about ICR partitions and their status.

Action To display information about all ICR partitions:

```
host1#show icr-partitions
  Interface-Location Vrrp-Id   State         Partition-ID
  ----------------------------------------------------------------------
  3/5/0.2              20        *Backup      part20A
  3/5/0.1              10        Master       part10A
  2/1/0.1              1         Backup       part1Backup
  2/5/0.2              2         Backup       part2Backup
  3/1/0.1              4         Dormant      part4
  ----------------------------------------------------------------------
  Total ICR Partitions: 5
```

To display information based on the state of a specific ICR partition:

```
host1#show icr-partitions Master
  Interface-Location Vrrp-Id   State         Partition-ID
  ----------------------------------------------------------------------
```



```
  3/5/0.1              10        Master       part10A
  -----------------------------------------------------------------------
  Total ICR Partitions in Master state: 1
```

To display a summary of the ICR partitions configured:

```
host1#show icr-partitions summary
  Dormant ICR Partitions: 1
  Backup ICR Partitions: 3
  Master ICR Partitions: 1
  Total ICR Partitions: 5
```

You can also display information about configured ICR partitions using a filter as an alternative to specifying the **state** keyword. For instance, to display information about the backup and dormant ICR partitions only, you can use the **exclude Master** keywords, as shown in the following example:

```
host1#show icr-partitions | exclude Master
  Interface-Location Vrrp-Id   State         Partition-ID
  -----------------------------------------------------------------------
  3/5/0.2              20        *Backup      part20A
  2/1/0.1              1         Backup       part1Backup
  2/5/0.2              2         Backup       part2Backup
  3/1/0.1              4         Dormant      part4
  -----------------------------------------------------------------------
  Total ICR Partitions: 5
```

Meaning Table 25 on page 137 lists the **show icr-partitions** command output fields.

Table 25: show icr-partitions Output Fields

Field Name	Field Description
Interface-Location	Interface Identifier or location identifier of the ICR partition.
Vrrp-Id	VRRP identifier of the VRRP instance associated with the ICR partition.
State	State of the ICR partition: • Master—ICR partition that accepts subscriber login requests. • Backup—ICR partition that does not accept subscriber login requests. • Dormant—When the IP address or virtual router is forcibly deleted, or if the lower interface is not available, the ICR partition moves to the Dormant state. The dormant ICR partition does not accept subscriber login requests. NOTE: The state of the ICR partition depends on the associated VRRP instance. When the state of the VRRP instance changes, the state of the ICR partition also changes. A '*' associated with an ICR partition indicates that the partition is in transition.
Partition-ID	Identifier for the ICR partition.
Dormant ICR Partitions	Number of dormant ICR partitions on the router.

Table 25: show icr-partitions Output Fields *(continued)*

Field Name	Field Description
Backup ICR Partitions	Number of backup ICR partitions configured on the router.
Master ICR Partitions	Number of master ICR partitions configured on the router.
Total ICR Partitions	Total number of ICR partitions configured on the router.

Related Topics

- Configuring the Interface on Which the ICR Partition Resides on page 128
- show icr-partitions

PART 2

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V

