



Junos[®] OS

Software Installation and Upgrade Guide

Release

11.3



Published: 2011-09-20

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Junos® OS Software Installation and Upgrade Guide

Release 11.3

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Revision History

September 2011—R1 Junos OS 11.3

The information in this document is current as of the date listed in the revision history.

YEAR 2000 NOTICE

Juniper Networks hardware and software products are Year 2000 compliant. The Junos OS has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.

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About This Guide

This preface provides the following guidelines for using the *Junos® OS Software Installation and Upgrade Guide*:

- [Junos OS Documentation and Release Notes on page xv](#)
- [Objectives on page xv](#)
- [Audience on page xvi](#)
- [Supported Routing Platforms on page xvi](#)
- [Documentation Conventions on page xvii](#)
- [Documentation Feedback on page xviii](#)
- [Requesting Technical Support on page xix](#)

Junos OS Documentation and Release Notes

For a list of related Junos OS documentation, see <http://www.juniper.net/techpubs/software/junos/>.

If the information in the latest release notes differs from the information in the documentation, follow the *Junos OS 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/>.

Juniper Networks supports a technical book program to publish books by Juniper Networks engineers and subject matter experts with book publishers around the world. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration using the Junos operating system (Junos OS) and Juniper Networks devices. In addition, the Juniper Networks Technical Library, published in conjunction with O'Reilly Media, explores improving network security, reliability, and availability using Junos OS configuration techniques. All the books are for sale at technical bookstores and book outlets around the world. The current list can be viewed at <http://www.juniper.net/books>.

Objectives

This guide provides a description of the Junos OS packages and includes detailed information about how to initially configure, reinstall, and upgrade the Junos OS software.



NOTE: For additional information about the Junos OS—either corrections to or information that might have been omitted from this guide—see the software release notes at <http://www.juniper.net/>.

Audience

This guide is designed for network administrators who are configuring and monitoring a Juniper Networks M Series, MX Series, T Series, EX Series, or J Series router or switch.

To use this guide, you need a broad understanding of networks in general, the Internet in particular, networking principles, and network configuration. You must also be familiar with one or more of the following Internet routing protocols:

- Border Gateway Protocol (BGP)
- Distance Vector Multicast Routing Protocol (DVMRP)
- Intermediate System-to-Intermediate System (IS-IS)
- Internet Control Message Protocol (ICMP) router discovery
- Internet Group Management Protocol (IGMP)
- Multiprotocol Label Switching (MPLS)
- Open Shortest Path First (OSPF)
- Protocol-Independent Multicast (PIM)
- Resource Reservation Protocol (RSVP)
- Routing Information Protocol (RIP)
- Simple Network Management Protocol (SNMP)

Personnel operating the equipment must be trained and competent; must not conduct themselves in a careless, willfully negligent, or hostile manner; and must abide by the instructions provided by the documentation.

Supported Routing Platforms

For the features described in this manual, the Junos OS currently supports the following routers:

- J Series
- M Series
- MX Series
- T Series
- EX Series

Documentation Conventions

Table 1 on page xvii defines notice icons used in this guide.

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 xvii defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the configure command: user@host> configure
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> show chassis alarms No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> Introduces important new terms. Identifies book names. Identifies RFC and Internet draft titles. 	<ul style="list-style-type: none"> A policy <i>term</i> is a named structure that defines match conditions and actions. <i>Junos OS System Basics Configuration Guide</i> RFC 1997, <i>BGP Communities Attribute</i>
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# set system domain-name <i>domain-name</i>

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

Convention	Description	Examples
Text like this	Represents names of configuration statements, commands, files, and directories; interface names; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none">To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level.The console port is labeled CONSOLE.
< > (angle brackets)	Enclose optional keywords or variables.	stub <default-metric <i>metric</i> >;
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	broadcast multicast (<i>string1</i> <i>string2</i> <i>string3</i>)
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	rsvp { # Required for dynamic MPLS only
[] (square brackets)	Enclose a variable for which you can substitute one or more values.	community name members [community-ids]
Indentation and braces ({ })	Identify a level in the configuration hierarchy.	<pre>[edit] routing-options { static { route default { nexthop address; retain; } } }</pre>
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
J-Web GUI Conventions		
Bold text like this	Represents J-Web graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none">In the Logical Interfaces box, select All Interfaces.To cancel the configuration, click Cancel.
> (bold right angle bracket)	Separates levels in a hierarchy of J-Web selections.	In the configuration editor hierarchy, select Protocols>Ospf .

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can send your comments to techpubs-comments@juniper.net, or fill out the documentation feedback form at <https://www.juniper.net/cgi-bin/docbugreport/>. If you are using e-mail, be sure to include the following information with your comments:

- Document or topic name
- URL or page number

- Software release version (if applicable)

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or JNASC support contract, or are covered under warranty, and need postsales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the JTAC User Guide located at <http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf>.
- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/>.
- JTAC Hours of Operation —The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: <http://www.juniper.net/customers/support/>
- 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, visit us at <http://www.juniper.net/support/requesting-support.html>

PART 1

Introduction

- [Introduction to Junos OS on page 3](#)
- [Hardware Architecture on page 15](#)

CHAPTER 1

Introduction to Junos OS

This chapter includes the following sections:

- [Junos OS Overview on page 3](#)
- [Software Naming Convention on page 5](#)
- [Junos OS Editions on page 5](#)
- [FIPS 140-2 Security Compliance on page 5](#)
- [Junos OS Installation Packages on page 6](#)
- [Installation Media on page 6](#)
- [Installation Bundles on page 7](#)
- [Installation Modules on page 7](#)
- [Junos OS Release Numbers on page 8](#)
- [Junos OS Feature Licenses on page 9](#)
- [Software Package Information Security on page 10](#)
- [Configuration Files on page 10](#)
- [Automatic Installation of Configuration Files \(J Series Routers and SRX Services Gateway\) on page 11](#)

Junos OS Overview

Juniper Networks provides high-performance network devices that create a responsive and trusted environment for accelerating the deployment of services and applications over a single network. Junos OS is the foundation of these high-performance networks. Unlike other complex, monolithic software architectures, Junos OS incorporates key design and developmental differences to deliver increased network availability, operational efficiency, and flexibility. The key advantages to this approach are:

- [One Operating System on page 4](#)
- [One Software Release on page 4](#)
- [One Modular Software Architecture on page 4](#)

One Operating System

Unlike other network operating systems that share a common name but splinter into many different programs, Junos OS is a single, cohesive operating system that is shared across all routers and product lines. This allows Juniper Networks engineers to develop software features once and share these features across all product lines simultaneously. Because features are common to a single source, they generally are implemented the same way for all product lines, thus reducing the training required to learn different tools and methods for each product. Because all Juniper Networks products use the same code base, interoperability between products is not an issue.

One Software Release

Each new version of Junos OS is released concurrently for all product lines following a preset quarterly schedule. Furthermore, each new version of software must include all working features released in previous releases of the software, and must have no critical regression errors. This discipline ensures reliable operations for the entire release.

One Modular Software Architecture

Although individual modules of the Junos OS communicate through well-defined interfaces, each module runs in its own protected memory space, preventing one module from disrupting another. This separation enables the independent restart of each module as necessary. This is in contrast to monolithic operating systems where a malfunction in one module can ripple to other modules and cause a full system crash or restart. This modular architecture then provides for high performance, high availability, security, and device scalability not found in other operating systems.

The Junos OS is preinstalled on your Juniper Networks router when you receive it from the factory. Thus, when you first power on the router, all software starts automatically. You simply need to configure the software so that the router can participate in the network.

You can upgrade the router software as new features are added or software problems are fixed. You normally obtain new software by downloading the software installation packages from the Juniper Networks Support Web page onto your router or onto another system on your local network. You then install the software upgrade onto the router.

Juniper Networks routing platforms run only binaries supplied by Juniper Networks, and currently do not support third-party binaries. Each Junos OS image includes a digitally signed manifest of executables that are registered with the system only if the signature can be validated. Junos OS will not execute any binary without a registered signature. This feature protects the system against unauthorized software and activity that might compromise the integrity of your router.

Related Documentation

- [Junos OS Editions on page 5](#)
- [Junos OS Installation Packages on page 6](#)

Software Naming Convention

All Junos OS conforms to the following naming convention:

package-release-edition-cfxxx-signed.comp

For example:

jinstall-9.2R1.8-domestic-signed.tgz

where:

- **package** is the name of the Junos OS package.
- **cfxxx** designates the CompactFlash card size to use with the software. This value is optional.
- **signed** means that the software includes a digital signature for verification purposes. This value is not used with all software packages.

Junos OS Editions

Junos OS is released in the following editions:

- Domestic—Junos OS for customers in the United States and Canada. This edition includes high-encryption capabilities for data leaving the router.
- Export—Junos OS for all other customers. This edition does not include any high-encryption capabilities for data leaving the router.
- Junos-FIPS—Junos OS that provides advanced network security for customers who need software tools to configure a network of Juniper Networks routers in a Federal Information Processing Standards (FIPS) 140-2 environment. For more information about Junos-FIPS, see [“FIPS 140-2 Security Compliance” on page 5](#).

FIPS 140-2 Security Compliance

For advanced network security, a special version of the Junos OS, called Junos-FIPS 140-2, is available. Junos-FIPS 140-2 provides customers with software tools to configure a network of Juniper Networks routers in a FIPS environment. FIPS support includes:

- Upgrade package to convert Junos OS to Junos-FIPS 140-2
- Revised installation and configuration procedures
- Enforced security for remote access
- FIPS user roles (Crypto Officer, User, and Maintenance)
- FIPS-specific system logging and error messages
- IPsec configuration for Routing Engine-to-Routing Engine communication
- Enhanced password creation and encryption

Junos-FIPS has special installation and configuration requirements. Installation procedures include downloading the FIPS software package from www.juniper.net. For detailed guidelines on how installation and configuration procedures differ between the Junos OS and Junos-FIPS 140-2, see the [Secure Configuration Guide for Common Criteria and Junos-FIPS](#).



NOTE: Junos-FIPS has special password requirements. FIPS passwords must be between 10 and 20 characters in length. Passwords must use at least three of the five defined character sets (uppercase letters, lowercase letters, digits, punctuation marks, and other special characters). If Junos-FIPS is installed on the router, you cannot configure passwords unless they meet this standard.

Junos OS Installation Packages

The installation package is used to upgrade and downgrade from one release to another. When installed, the installation package completely reinstalls the software, rebuilds the Junos OS file system, and may erase system logs and other auxiliary information from the previous installation. The installation package does, however, retain the configuration files from the previous installation.

The following installation packages are available for download:

Installation Package	Description
jinstall*	Junos OS for the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers.
jinstall-ex*	Junos OS for the EX Series Ethernet Switch portfolio.
junos-jsr*	Junos OS for the J Series routers.
junos-juniper*	Junos-FIPS for the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers. Once the package is installed on a device, you cannot revert back to the standard Junos OS installation without performing a software recovery procedure.
jinstall64*	64-bit Junos OS for the JCS1200 Route Reflector.

Installation Media

The installation media is used to recover a router from a software failure. The installation media repartitions the media and completely reinstalls the Junos OS. No information from previous installations is retained during this installation. Thus, an initial configuration is required before the router can be put back into service. For more information on creating an initial configuration, see the *Getting Started Guide* for your router.



NOTE: Once you have rebuilt a router using the installation media, access to the router is restricted to the console port until the management port is configured during the initial configuration.

The following installation media files are available for download:

Installation Media	Description
<code>floppy1-<release>*</code> <code>floppy2-<release>*</code>	Junos OS for the M40 router when you use the LS-120 external drive.
<code>install-media*</code>	Junos OS for the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers.
<code>junos-jsr-<release>-export-cf<size>.gz</code>	Junos OS for the J Series routers. You must select the correct installation media file that corresponds to the correct CompactFlash card you are using.

Installation Bundles

The installation bundle can be used to downgrade or upgrade the Junos OS between minor revisions (from Release 9.1 to Release 9.2, for example). When used, the installation bundle modifies only the files required for the upgrade or downgrade between versions.



NOTE: You should only use the installation bundle under direction of a Juniper Networks support representative.

The following installation bundle files are available for download:

Installation Bundle	Description
<code>jbundle*</code>	Junos OS for the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers.

Installation Modules

Installation modules are used to upgrade individual software modules within the software. For example, you can upgrade only the Routing Engine software by installing the `jroute*` installation module.



NOTE: You should only use installation module files under the direction of a Juniper Networks support representative.

The following installation module files are available for download:

Installation Module	Description
jkernel*	The kernel and network tools package. This package contains the basic operating system files.
jbase*	The base package for the Junos OS. This package contains additions to the operating system.
jroute*	The Routing Engine package. This package contains the Routing Engine software.
jpfe*	The Packet Forwarding Engine package. This package contains the PFE software.
jdocs*	The documentation package. This package contains the documentation set for the software.
jcrypto*	The encryption package. This package contains the domestic version of the security software.
jweb*	The J-Web package. This package contains the graphical user interface software for M Series, MX Series, T Series, TX Matrix, TX Matrix Plus, and J Series routers.

Junos OS Release Numbers

The Junos OS release number represents a particular revision of the software that runs on a Juniper Networks routing platform, for example, Junos OS Release 8.5, 9.1, or 9.2. Each Junos OS release has certain new features that complement the software processes that support Internet routing protocols, control the router's interfaces and the router chassis itself, and allow router system management. On the Juniper Networks Support Web page, you download Junos OS for a particular Junos OS release number.

The following example shows how the software release number is formatted:

m.nZb.s

For example:

9.2R1.8

Where:

- ***m*** is the major release number of the product
- ***n*** is the minor release number of the product
- ***Z*** is the type of software release. The following release types are used:

- **R**—Released software: Major software release
- **B**—Beta release software: Minor software release
- **I**—Internal release software: Private software release for verifying fixes
- **S**—Service release software: Maintenance software release for a released software on a need basis
- **X**—Exceptional release software: Update software release for a released software to solve a particular issue
- **b** is the build number of the product
- **s** is the spin number of the product

Junos OS Feature Licenses

Some Junos OS software features require a license to activate the feature. To enable a licensed feature, you need to purchase, install, manage, and verify a license key that corresponds to each licensed feature. To conform to Junos OS feature licensing requirements, you must purchase one license per feature per device. The presence of the appropriate software license key on your device determines whether you are eligible to configure and use the licensed feature.

To speed deployment of licensed features, the Junos OS software implements an honor-based licensing structure and provides you with a 30-day grace period to use a licensed feature without a license key installed. The grace period begins when you configure the feature and your device uses the licensed feature for the first time, but not necessarily when you install the license. After the grace period expires, the system generates system log messages saying that the feature requires a license. To clear the error message and use the licensed feature properly, you must install and verify the required license.

For information on how to purchase software licenses, contact your Juniper Networks sales representative.

Related Documentation

- Software Features That Require Licenses on the QFX Series
- [License Key Components on page 69](#)
- [Adding New Licenses on page 71](#)
- [Deleting a License on page 72](#)
- [Saving License Keys on page 73](#)
- [Verifying Junos OS License Installation on page 74](#)

Software Package Information Security

All Junos OS is delivered in signed packages that contain digital signatures, Secure Hash Algorithm (SHA-1), and Message Digest 5 (MD5) checksums. A package is installed only if the checksum within it matches the hash recorded in its corresponding file. Which checksum is used depends on the software version:

- Digital signatures are used when you upgrade or downgrade between Junos OS Release 7.0 and a later version.
- The SHA-1 checksum is used when you upgrade or downgrade between Junos OS Release 6.4 and a later version.
- The MD5 checksum is used when you upgrade or downgrade between Junos OS Release 6.3 or earlier and a later version.

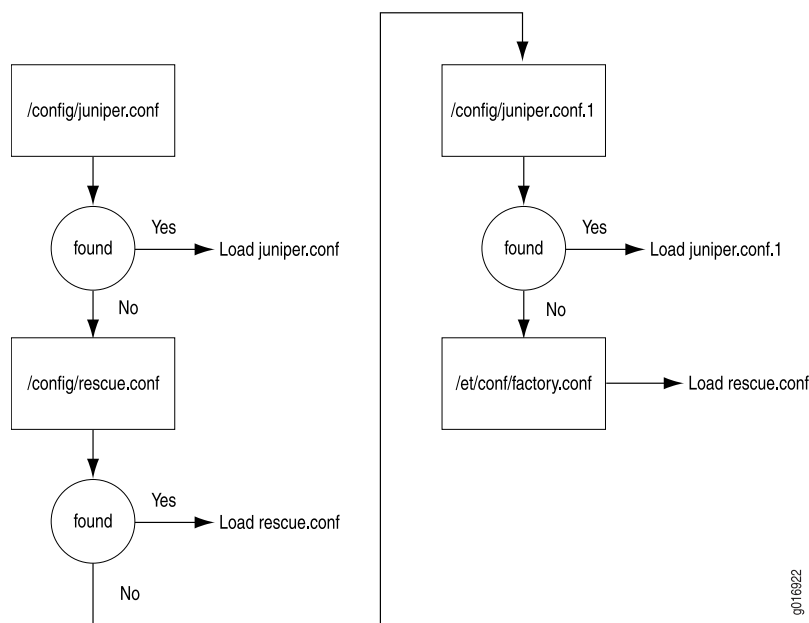
Configuration Files

All configuration settings for the router are handled in the configuration files on the router. These files are saved in the `/config` directory on the router.

Configuration File Selection Sequence

During the boot process, the router is configured based on a predefined configuration file. The router selects the configuration file based on the sequence shown in [Figure 1 on page 10](#).

Figure 1: Configuration Selection Sequence



1. `/config/juniper.conf`—Active configuration file.

2. `/config/rescue.conf`—Rescue configuration file. This file is created by the router administrator.
3. `/config/juniper.conf.1`—First rollback configuration.
4. `/etc/config/factory.conf`—Default factory configuration file.

The **factory.conf** file is the initial router configuration file shipped with the system. All configuration settings are returned to the factory default, and access to the router is restricted to the console. For more information on setting up your router from the factory default configuration, see the specific hardware guide for your router.

Remote Storage of Configuration Files

Configuration files can be stored off the router. This can be helpful if the router encounters a software failure or other problem that forces you to restore the router's software. Once the software is restored, you can then reload the saved configuration file. For more information on restoring the Junos OS, see [“Load and Commit the Configuration File” on page 62](#).

When the configuration file is stored off the router, you can encrypt the configuration files using the Data Encryption Standard (DES) encryption algorithm.

Automatic Installation of Configuration Files (J Series Routers and SRX Services Gateway)

Autoinstallation provides automatic configuration for a new device that you connect to the network and turn on, or for a device configured for autoinstallation.

[Table 3 on page 11](#) lists the autoinstallation support on SRX Series Secure Services Gateways devices and J Series Services Routers.

Table 3: Autoinstallation Support

Feature	SRX100 SRX210 SRX240	SRX650	SRX3400 SRX3600 SRX5600 SRX5800	J Series Routers
Autoinstallation	Yes	Yes	No	Yes

J Series Automatic Installation Overview

On J Series routers, you can specify a remote server where configuration files are located. If a configuration file cannot be found on the router's CompactFlash card, the router automatically retrieves the configuration file from this remote server. For security purposes, you can encrypt these remote files using the DES cipher, and once they have been retrieved, the router decrypts them for use on the server.

To encrypt the files, we recommend the openssl tool. You can get the open SSL tool at: <http://www.openssl.org/>. To encrypt the file, use the following syntax:

```
% openssl enc -des -k passphrase -in original-file -out encrypted-file
```

- ***passphrase***—Passphrase used to encrypt the configuration file. The passphrase should be the name of the file without the path information or file extension.
- ***original-file***—Unencrypted configuration file.
- ***encrypted-file***—Name of the encrypted configuration file.

For example, if you are encrypting the active configuration file **juniper.conf.gz**, the passphrase is **juniper.conf**. The openssl syntax used to encrypt the file is:

```
% openssl enc -des -k juniper.conf -in juniper.conf.gz -out juniper.conf.gz.enc
```

For more information about the automatic installation feature, see the [J Series Services Router Administration Guide](#).

SRX Services Gateway Automatic Installation Overview

The autoinstallation process begins any time a services gateway is powered on and cannot locate a valid configuration file in the internal flash. Typically, a configuration file is unavailable when a services gateway is powered on for the first time or if the configuration file is deleted from the internal flash. The autoinstallation feature enables you to deploy multiple services gateways from a central location in the network.

If you are setting up many devices, autoinstallation can help automate the configuration process by loading configuration files onto new or existing devices automatically over the network. You can use either the J-Web configuration editor or the CLI configuration editor to configure a device for autoinstallation.

For the autoinstallation process to work, you must store one or more host-specific or default configuration files on a configuration server in the network and have a service available—typically Dynamic Host Configuration Protocol (DHCP)—to assign an IP address to the services gateway.

Autoinstallation takes place automatically when you connect an Ethernet port on a new services gateway to the network and power on the device. To simplify the process, you can explicitly enable autoinstallation on a device and specify a configuration server, an autoinstallation interface, and a protocol for IP address acquisition.

For more information about the automatic installation feature, see the [Junos Software Administration Guide](#).

CHAPTER 2

Hardware Architecture

- [Hardware Architecture Overview on page 15](#)
- [M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers on page 16](#)
- [J Series Routers and SRX Services Gateway on page 21](#)

Hardware Architecture Overview

Juniper Network routing platforms are made up of two basic routing components:

- **Routing Engine**—The Routing Engine controls the routing updates and system management.
- **Packet Forwarding Engine (PFE)**—The Packet Forwarding Engine performs Layer 2 and Layer 3 packet switching, route lookups, and packet forwarding.

From a system administration perspective, you install the software onto the Routing Engine and during the installation, the appropriate software is forwarded to other components as necessary. Each Routing Engine includes a CompactFlash card that stores the Junos OS. On M Series Multiservice Edge Routers, MX Series 3D Universal Edge Routers, T Series Core Routers, and TX Matrix routers, the system also includes a hard drive that acts as a backup boot drive. The TX Matrix Plus router includes either a hard drive or a solid state drive as a backup boot drive.



NOTE: The MX80 router is a single-board router with a built-in Routing Engine and single Packet Forwarding Engine. On an MX80 router, the Junos OS is stored on dual, internal NAND flash devices. These devices provide the same functionality as a CompactFlash card and hard drive.

On routing platforms with dual Routing Engines, each Routing Engine is independent with regard to upgrading the software. To install new software on both Routing Engines, you need to install the new software on each Routing Engine. On platforms with dual Routing Engines configured for high availability, you can use the unified in-service software upgrade procedure to upgrade the software. For more information on this procedure, see the [Junos High Availability Configuration Guide](#).

M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers

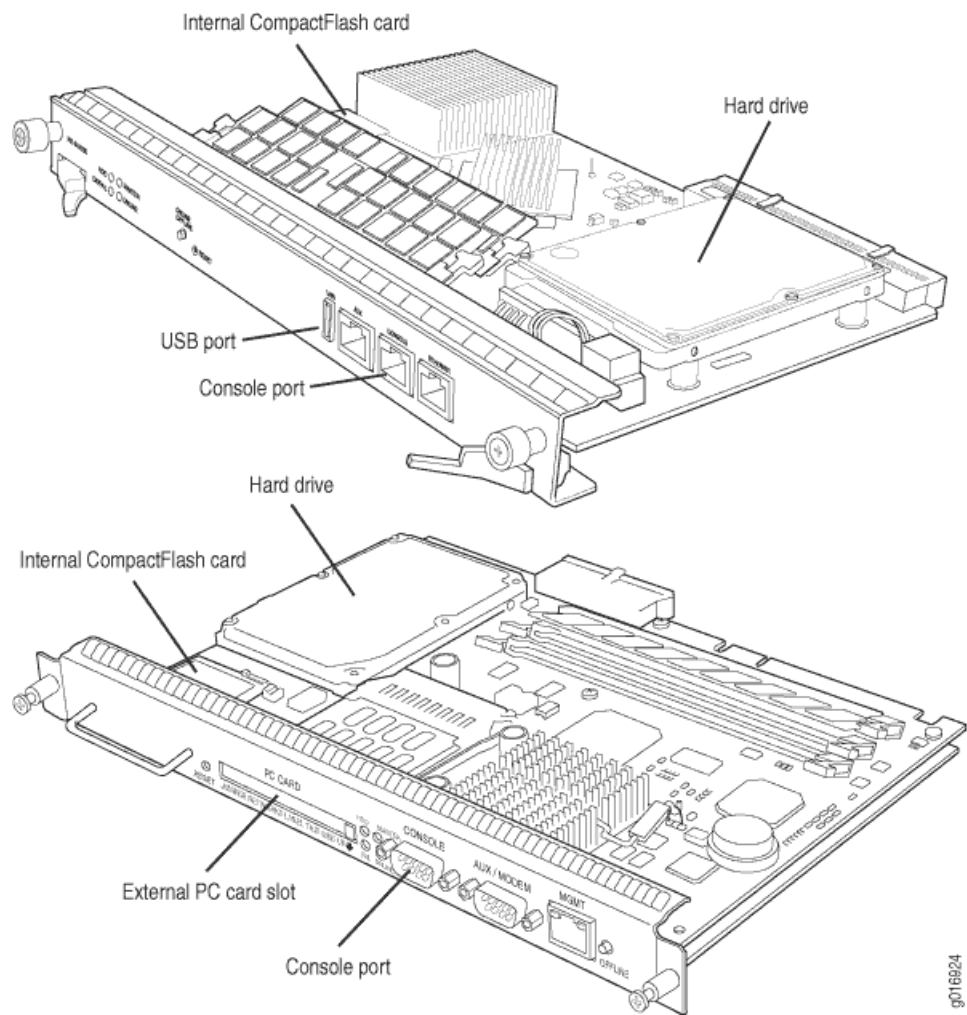
The following topics give a brief overview of the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers.

- [Hardware Overview \(M Series, MX Series, T Series, and TX Matrix Routers\)](#) on page 16
- [Routing Engines and Storage Media Names \(M Series, MX Series, T Series, TX Matrix, TX Matrix Plus, and JCS Routers\)](#) on page 18
- [Boot Sequence \(M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers\)](#) on page 20

Hardware Overview (M Series, MX Series, T Series, and TX Matrix Routers)

Except for MX80 routers, the Junos OS is installed on both the CompactFlash card and the hard drive. When installed, the internal CompactFlash card is the primary boot device and the hard drive is the secondary boot device. When the internal CompactFlash card is not installed, the hard drive is the primary boot device. [Figure 2 on page 17](#) shows the standard layout of a typical Routing Engine. On MX80 routers, the internal NAND flash devices (first **da0**, then **da1**) act as the primary and secondary boot devices.

Figure 2: Routing Engines



The M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers include the following:

- [System Memory on page 17](#)
- [Storage Media on page 18](#)

System Memory

Starting with Junos OS Release 9.0, all routing platforms require a minimum of 512 MB of system memory on each Routing Engine. All M7i and M10i routers delivered before December 7, 2007, had 256 MB of memory. These routers require a system memory upgrade before you install Junos OS Release 9.0. To determine the amount of memory currently installed on your system, use the **show chassis routing-engine** command in the command-line interface (CLI).

For more information about upgrading your M7i or M10i router, see the Customer Support Center JTAC Technical Bulletin PSN-2007-10-001:

<https://www.juniper.net/alerts/viewalert.jsp?txtAlertNumber=PSN-2007-10-001&actionBtn=Search>.

Storage Media

Except for MX80 routers, the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers use the following media storage devices:

- CompactFlash card—The CompactFlash card is typically the primary storage device. T1600 and TX Matrix Plus routers using RE-C1800 and RE-C2600 respectively, have external Compact cards. In this case, the solid state drive is the primary boot device. M7i and M10i routers using RE-400 are not delivered from factory with the compact flash installed. In this case, the hard drive is the primary and only boot device. The M7i and M10i routers with RE-400 can be upgraded to include the CompactFlash card.
- Hard drive or solid state drive—The hard drive is the secondary boot device for M7i, M10i, M40e, T320, T640, and TX Matrix routers. The solid state drive is the secondary boot device for TX Matrix Plus routers. The M120, M320, MX240, MX480, MX960, and T1600 routers include either a hard drive or a solid state drive as the secondary boot device depending on the type of Routing Engine installed on them. When the CompactFlash card is not installed on the router, the hard drive or the solid state drive becomes the primary boot drive. It is also used to store system log files and diagnostic dump files.
- External media storage device—Depending on the system, the external device can be a CompactFlash card, a solid state drive, a USB storage device, or an LS-120 floppy disk.

On MX80 routers, the internal NAND flash devices (first **da0**, then **da1**) act as the primary and secondary boot devices.

The external devices such as a USB or a floppy disk are emergency boot devices and can be used to revive a routing platform with damaged Junos OS. When these external devices are attached to the system, the router attempts to boot from these devices before it boots from the internal CompactFlash drive, the hard drive, or CompactFlash card.

When booting from the external emergency boot disk, the router requests a boot acknowledgment from you on the console interface. If you enter yes, the external media repartitions the internal primary drive and reloads the Junos OS onto that drive. When the loading is complete, the routing platform requests that you remove the external media and reboot the system. Once the reboot is complete, you must perform an initial configuration of the router before it can be used on your network.

Routing Engines and Storage Media Names (M Series, MX Series, T Series, TX Matrix, TX Matrix Plus, and JCS Routers)

Table 4 on page 19 specifies the storage media names by Routing Engine. The storage media device names are displayed when the router boots.

Table 4: Routing Engines and Storage Media Names (M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers)

Routing Engine	CompactFlash Card	Hard Disk	Solid State Drive	Removable Media
RE-400-768 (RE5) Supported platforms: M7i and M10i	ad0	ad1	No	ad3
RE-600-2048 (RE3) Supported platforms: M40e, T320, T640, T1600, and TX Matrix	ad0	ad1	No	ad3
RE-850-1536 (RE-850) Supported platforms: M7i and M10i	ad0	ad1	No	ad3
RE-A-1000-2048 (RE-A-1000) Supported platforms: M120 and M40e	ad0	ad2	No	da0
RE-A-1800x2 (RE-A-1800) Supported platforms: M120, M320, and JCS1200	ad0	No	Yes SSD1: ad1 SSD2: ad2	da0
RE-S-1300-2048 (RE-S-1300) Supported platforms: MX240, MX480, and MX960	ad0	ad2	No	da0
RE-S-1800x2 RE-S-1800x4 (RE-S-1800) Supported platforms: MX240, MX480, and MX960	ad0	No	Yes SSD1: ad1 SSD2: ad2	da0
RE-1600-2048 (RE4) Supported platforms: M320, T320, T640, T1600, and the TX Matrix	ad0	ad1	No	ad3 and ad4

Table 4: Routing Engines and Storage Media Names (M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers) (continued)

Routing Engine	CompactFlash Card	Hard Disk	Solid State Drive	Removable Media
RE-A-2000-4096 (RE-A-2000) Supported platforms: M120, M320, T320, T640, T1600, and the TX Matrix	ad0	ad2	No	da0
RE-S-2000-4096 (RE-S-2000) Supported platforms: MX240, MX480, and MX960	ad0	ad2	No	da0
RE-DUO-C2600-16G-S (RE-DUO-2600) Supported platforms: The TX Matrix Plus and JCS1200	ad0	No	ad1	da0
RE-DUO-C1800-8G-S (RE-DUO-1800) Supported platforms: T1600 and standalone T640	ad0	No	ad1	da0
RE-JCS1200-1x2330 Supported platforms: JCS1200	da0	da1	No	da2



NOTE: On MX80 routers, the Routing Engine is a built-in device and has no model number. The dual internal NAND flash devices are da0 and da1. The USB storage device is da2.

To view the storage media currently available on your system, use the CLI **show system storage** command. For more information about this command, see the [Junos OS CLI User's Guide](#).

Boot Sequence (M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers)

The M Series, MX Series (except for the MX80 routers), T Series, and TX Matrix routers attempt to boot from the storage media in the following order:

1. Removable media

2. CompactFlash card (if present)
3. Hard disk

MX80 routers attempt to boot from the storage media in the following order:

1. USB media
2. Dual, internal NAND flash device (first **da0**, then **da1**)

The TX Matrix Plus router attempts to boot from the storage media in the following order:

1. USB media
2. CompactFlash card (if present)
3. Disk 1
4. Storage media available on the LAN



NOTE: Do not insert the removable media during normal operations. The router does not operate normally when it is booted from the removable media.

If the router boots from an alternate boot device, the Junos OS displays a message indicating this when you log in to the router. For example, the following message shows that the software booted from the hard disk (**/dev/ad2s1a**):

```
login: username
Password: password
Last login: date on terminal
```

```
--- Junos 8.0 R1 built date
```

```
---
```

```
--- NOTICE: System is running on alternate media device (/dev/ad2s1a).
```

Related Documentation

- Router Architecture for M-series Routers and T-series Platforms
- Hardware Components

J Series Routers and SRX Services Gateway

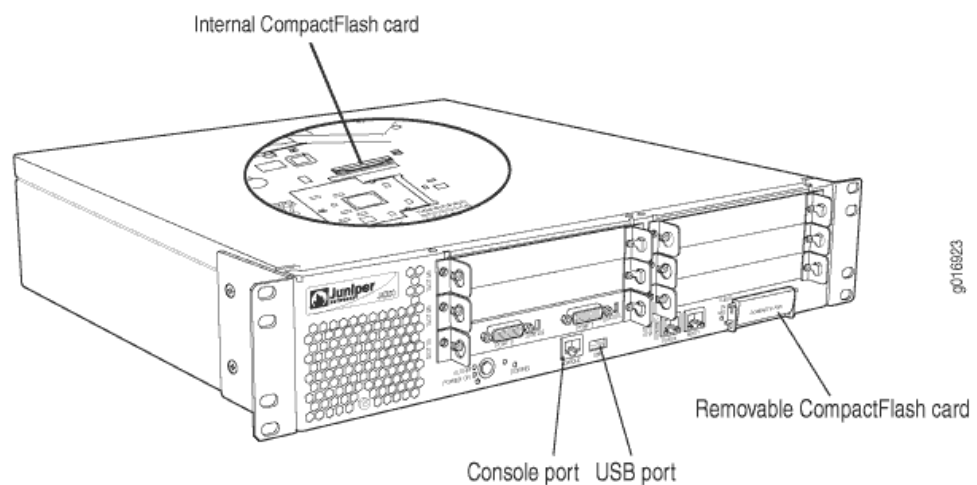
The following topics give a brief overview of the J Series routers. For information about SRX Series Services hardware, see the [SRX Series Services Gateway Hardware Documentation](#).

- [Hardware Overview \(J Series Routers\) on page 22](#)
- [Routing Engines and Storage Media Names \(J Series Routers\) on page 23](#)
- [Boot Sequence \(J Series Routers\) on page 23](#)

Hardware Overview (J Series Routers)

The Junos OS is installed on the internal CompactFlash card. This internal CompactFlash card is the primary and only boot drive on the J Series routers when they are delivered from the factory. All J Series routers have one or more USB ports. The 4300 and 6300 J Series routers also include an external CompactFlash card slot. You can install external storage devices through the USB ports and CompactFlash card slots. When external storage devices are installed, these external devices can be used as backup boot drives. You can also create a backup internal boot drive on any externally attached CompactFlash card. This CompactFlash card can then be used to replace the internal CompactFlash card on the J Series router in the event that the internal card is damaged or otherwise made unusable by the router. [Figure 3 on page 22](#) shows the location of the memory and ports on a J Series router.

Figure 3: J Series Routers (J4300 Shown)



The J Series routers include the following:

- [System Memory on page 22](#)
- [Storage Media on page 23](#)

System Memory

Starting with Junos OS Release 9.1, all J Series routers require a minimum of 512 MB of router memory on each Routing Engine. Any router without this minimum requires a system memory upgrade before you install Junos OS Release 9.1. To determine the amount of memory currently installed on your router, use the CLI **show chassis routing-engine** command.

For more information about memory requirements for the J Series routers, see the Customer Support Center JTAC Technical Bulletin PSN-2008-04-021: <http://www.juniper.net/alerts/viewalert.jsp?txtAlertNumber=PSN-2008-04-021&actionBtn=Search>.

Storage Media

The J Series routers use the following media storage devices:

- Internal CompactFlash card—The CompactFlash card is the primary boot device.
- External media device—Depending on the system, this external device can be a CompactFlash card or a USB storage device. Juniper Networks recommends that you attach an external device to the system and use this external device as the backup boot device for the system.

Routing Engines and Storage Media Names (J Series Routers)

Table 5 on page 23 specifies the storage media names used by the J Series routers. The storage media device names are displayed as the router boots.

Table 5: Routing Engines and Storage Media Names (J Series Routers)

Routing Engine	Internal CompactFlash Card	External CompactFlash Card J4300 and J6300 Routers Only	USB Storage Media Devices
J Series Routers	ad0	ad2	da0

To view the storage media currently available on your system, use the CLI **show system storage** command. For more information about this command, see the [Junos OS CLI User's Guide](#).

Boot Sequence (J Series Routers)

The router attempts to boot from the storage media in the following order:

1. Internal CompactFlash card
2. External CompactFlash card (J4300 and J6300 routers only)
3. USB storage media device

PART 2

Junos OS Installation

- [Installation Overview on page 27](#)
- [Completing a Standard or Change Category Installation on page 31](#)
- [Completing a Recovery Installation on page 49](#)

CHAPTER 3

Installation Overview

This section describes how to install a different Junos OS version on a routing platform, for example, upgrading from Junos OS Release 8.4 to Junos OS Release 9.2. This chapter covers the different methods used to upgrade and downgrade the software and why each method is employed. It also covers the options available to you during the installation process as well as issues that you need to understand before you start an installation process.

This chapter includes the following topics:

- [Installation Type Overview on page 27](#)
- [Installation Categories on the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers on page 28](#)
- [Installation Categories on the J Series Routers on page 29](#)
- [Verifying PIC Combinations on page 29](#)

Installation Type Overview

The three types of installations used to upgrade or downgrade your routing platform are standard installation, category change, and recovery. The standard installation is the standard method of upgrading and downgrading the software. Use a category change installation when you are moving from one software category to another; for example, if you are changing the router from using the standard Junos OS to the Junos-FIPS category. Perform a recovery installation when the software on the router is damaged or otherwise unable to accommodate a software upgrade or downgrade.

Standard Installation

A standard installation is the typical method used to upgrade or downgrade software on the server. This method uses the installation package that matches the installation package already installed on the system. For example, you might upgrade an M120 router running the Junos OS installed using the **jinstall*** installation package. If you upgrade the router from the 9.0R2.10 release to the 9.1R1.8 release, you use the **jinstall-9.1R1.8-domestic-signed.tgz** installation package. For information on the different installation packages available, see [“Junos OS Installation Packages” on page 6](#).

Category Change Installation

The category change installation process is used to move from one category of the Junos OS to another on the same router; for example, moving from a Junos OS standard installation on an M Series, MX Series, or T Series router to a Junos-FIPS installation. When moving from one installation category to another, you need to be aware of the restrictions regarding this change.



NOTE: Juniper Networks does not support using the `request system software rollback` command to restore a different installation category on the router. When installing a different Junos OS category on a router, once the installation is complete, you should execute a `request system snapshot` command to delete the backup installation from the system.

Recovery Installation

A recovery installation is performed to repair a router with damaged software or a condition that prevents the upgrade, downgrade, or change in installation category of the software.

For example, you may need to perform a recovery installation to change a router's software category from Junos-FIPS to standard Junos OS.

Installation Categories on the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers

The following installation categories are available with the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers:

- Standard Junos OS, domestic—`jinstall-<release>-domestic-signed.tgz`

This software includes high-encryption capabilities for data leaving the router. Because of U.S. government export restrictions, this software can only be installed on systems within the United States and Canada. Furthermore, no router can be shipped out of the United States or Canada without the domestic edition first being overwritten by the export edition. There are no current system-enforced restrictions when you install this software category.

- Standard Junos OS, export—`jinstall-<release>-export-signed.tgz`

This software does not include high-encryption capabilities. It can be installed on any system worldwide. There are no current system-enforced restrictions when you install this software category.

- Junos-FIPS—`junos-juniper-<release>-domestic-signed.tgz` and `junos-juniper-<release>-fips-signed.tgz`

The Junos-FIPS OS base provides customers with the software tools to configure the router for use within a Federal Information Processing Standards (FIPS) environment. Once you have installed this software category onto a router, you cannot install a

different software category on the router using the **request system software add** command. When attempting to install a different Junos OS category package on the router, you receive the following warning message:

WARNING: Package jinstall-<release>-<edition>-signed is not compatible with this system.

WARNING: Please install a supported package (junos-juniper-*.tgz).

To return to a standard Junos OS category installation, you must perform a system recovery installation of the software. All configuration files, logs, and other data files on the server are overwritten during a recovery installation.

For more information about the Junos-FIPS OS base, see [“FIPS 140-2 Security Compliance” on page 5](#).



NOTE: When you install a Junos OS installation package, the previous installation is maintained as a backup installation. You should issue a **request system software snapshot** command to overwrite the backup files any time you change software categories on a router. This is mandatory if the router is to be shipped outside of the United States or Canada after the Export edition of the Junos OS has been installed. There are no current system-enforced restrictions when you install this software category,

Installation Categories on the J Series Routers

The following installation categories are available with the J Series routers:

- Junos OS, domestic—**junos-jsr-<release>-domestic.tgz**

This software includes high-encryption capabilities for data leaving the router. Because of U.S. Government export restrictions, this software can only be installed on systems within the United States and Canada. Furthermore, no router can be shipped out of the U.S. or Canada without first overwriting the domestic edition with the worldwide edition. There are no current system-enforced restrictions when you install this software category.

- Junos OS, export—**junos-jsr-<release>-export.tgz**

This software does not include high-encryption capabilities. It can be installed on any system worldwide. There are no current system-enforced restrictions when you install this software category.

Verifying PIC Combinations

On Juniper Networks routing platforms, you can typically install any combination of Physical Interface Cards (PICs) on a single Enhanced Flexible PIC Concentrator (FPC) or in two PIC slots served by a single Layer 2/Layer 3 Packet Processing application-specific integrated circuit (ASIC).

Newer Junos OS services for some PICs can require significant Internet Processor ASIC memory, and some configuration rules limit certain combinations of PICs if they are installed on some platforms.

During software installation, the configuration checker in the installation program checks the router's PICs. If any configuration rules affect your PIC combinations, the installation process stops and displays a message similar to the following:

```
The combination of PICS in FPC slot 3 is not supported with this release
  PIC slot 0 -
  PIC slot 1 - 1x OC-12 ATM-II IQ
  PIC slot 2 - 1x G/E IQ, 1000 BASE
  PIC slot 3 - 1x Link Service (4)
If you continue the installation, one or more PICs on
FPC slot 3 might appear to be online but
cannot be enabled and cannot pass traffic with this release of JUNOS.
See the Release Notes for more information.
WARNING: This installation attempt will be aborted. If you
WARNING: wish to force the installation despite these warnings
WARNING: you may use the 'force' option on the command line.
pkg_add: package /var/tmp/jbundle-7.6R1.x-domestic-signed.tgz fails requirements
- not installed
```

The configuration checker has the following limitations:

- If a PIC is offline when you upgrade the router with new software, the configuration checker cannot detect PIC combinations affected by configuration rules and cannot warn about them.
- If you specify the **force** option when you upgrade the Junos OS, the configuration checker warns about the affected PIC combination and the software installation continues. However, after rebooting, one or more PICs might fail to initialize.
- The configuration checker looks for combinations of three affected PICs. If an Enhanced FPC contains four affected PICs, the script generates multiple warnings.

If you install a PIC into a router already running Junos OS, you can identify the presence of affected PIC combinations from messages in the system logging (**syslog**) file:

```
Feb 6 17:57:40 CE1 feb BCHIP 0: uCode overflow - needs 129 inst space to load
b3_atm2_LSI_decode for stream 12
Feb 6 17:57:41 CE1 chassisd[2314]: CHASSISD_IFDEV_DETACH_PIC:
ifdev_detach_pic(0/3)
Feb 6 17:57:41 CE1 feb BCHIP 0: binding b3_atm2_LSI_decode to stream 12 failed
Feb 6 17:57:41 CE1 feb PFE: can not bind B3 ucode prog b3_atm2_LSI_decode to FPC
0: stream 12
```

For more information about checking for unsupported PIC combinations, see the corresponding PIC guide for your router, the [Junos OS Release Notes](#), and *Technical Support Bulletin PSN-2004-12-002, PIC Combination Notes Summary* on the Juniper Networks Support Web site at <http://www.juniper.net/support/>.

CHAPTER 4

Completing a Standard or Change Category Installation

This chapter describes how to perform a standard or change category installation of the Junos OS.

For information about Junos OS media and packages, see [“Introduction to Junos OS” on page 3](#). For information on the installation process, see [“Installation Overview” on page 27](#)



NOTE: When you upgrade from a previous installation of the Junos OS to Release 8.4R1 or later on an MX Series router, the MAC addresses on the Dense Port Concentrator (DPC) Ethernet ports change.

The change category installation process is used to move from one category of the Junos OS to another. For example, you can move from standard Junos OS on an M Series router to the export version of Junos OS. When performing a software category change, you need to take special precautions during the installation. These precautions delete the previous installation and prevent users from rolling back the server to these older installations.

This chapter discusses the following topics:

- [Checking the Current Configuration and Candidate Software Compatibility on page 32](#)
- [Determining the Junos OS Version on page 32](#)
- [Downloading Software on page 32](#)
- [Connecting to the Console Port on page 34](#)
- [Backing Up the Current Installation \(M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers\) on page 34](#)
- [Backing Up the Current Installation \(J Series Routers and SRX Services Gateway\) on page 35](#)
- [Installing the Software Package on a Router with a Single Routing Engine on page 36](#)
- [Installing the Software Package on a Router with Redundant Routing Engines on page 37](#)
- [Upgrading Individual Software Packages on page 42](#)

- [Upgrading to 64-bit Junos OS on page 44](#)
- [Upgrading Routers Using ISSU on page 47](#)

Checking the Current Configuration and Candidate Software Compatibility

When you upgrade or downgrade Junos OS, we recommend that you include the **validate** option with the **request system software add** command to check that the candidate software is compatible with the current configuration. By default, when you add a package with a different release number, the validation check is done automatically. For more information about the **request system software add** command, see the [Junos System Basics and Services Command Reference](#).

Determining the Junos OS Version

To determine which software packages are running on the router and to get information about these packages, use the **show version** operational mode command at the top level of the command-line interface (CLI).



NOTE: The **show version** command does not show the software category installed, only the release number of the software.

Downloading Software

You can download the software in one of the two ways:

- [Downloading Software with a Browser on page 32](#)
- [Downloading Software Using the Command-Line Interface on page 33](#)

Downloading Software with a Browser

You download the software package you need from the Juniper Networks Support Web site at <http://www.juniper.net/support/>.



NOTE: To access the download section, you must have a service contract and an access account. If you need help obtaining an account, complete the registration form at the Juniper Networks Web site: <https://www.juniper.net/registration/Register.jsp>.

To download the software:

1. In a browser, go to <http://www.juniper.net/support/>.

The Support page opens.

2. In the Download Software section, select the software version to download.

Depending on your location, select Junos Canada and US, or Junos Worldwide.

3. Select the current release to download.
4. Click the Software tab and select the Junos Installation Package to download.
A dialog box opens.
5. Save the file to your system. If you are placing the file on a remote system, you must make sure that the file can be accessible by the router or switch using HTTP, FTP, or scp.

Downloading Software Using the Command-Line Interface

Download the software package you need from the Juniper Networks Support Web site at <http://www.juniper.net/support/>, and place the package on a local system. You can then transfer the downloaded package to the router or switch using either the router or switch command-line interface, or the local system command-line interface.



NOTE: To access the download section, you must have a service contract and an access account. If you need help obtaining an account, complete the registration form at the Juniper Networks Web site:
<https://www.juniper.net/registration/Register.jsp>.

Before you transfer the software package, ensure that the FTP service is enabled on the router or switch.

Enable the FTP service using the **set system services ftp** command:

```
user@host# set system services ftp
```

To transfer the software package using the router or switch command-line interface:

1. From the router or switch command line, initiate an FTP session with the local system (host) where the package is located using the **ftp** command:

```
user@host> ftp host
```

host is the Hostname or address of the local system.

2. Log in with your customer support–supplied username and password:

```
User Name: username
331 Password required for username.
Password: password
```

Once your credentials have been validated, the FTP session opens.

3. Navigate to the software package location on the local system, and transfer the package using the **get** command:

```
user@host> get installation-package
```

Following is an example of an *installation-package* name:
jinstall-9.2R1.8–domestic-signed.tgz

4. Close the FTP session using the **bye** command:

```
user@host> bye
```

Goodbye

To transfer the package using the local system command-line interface:

1. From the local system command line, initiate an FTP session with the router or switch using the **ftp** command:

```
user@host> ftp host
```

host is the Hostname or address of the router or switch.

2. Log in with your customer support–supplied username and password:

```
User Name: username  
331 Password required for username.  
Password: password
```

Once your credentials have been validated, the FTP session opens.

3. Navigate to the software package location on the local system, and transfer the package using the **put** command:

```
user@host> put installation-package
```

Following is an example of an *installation-package* name:

```
jinstall-9.2R1.8–domestic-signed.tgz
```

4. Close the FTP session using the **bye** command:

```
user@host> bye  
Goodbye
```

Connecting to the Console Port

The console port is a data terminal equipment (DTE) interface, providing a direct and continuous interface with the router. It is important to connect to the console during installation procedures so you can respond to any required user input and detect any errors that may occur.

For more information about connecting to the console port, see the administration guide for your particular router.

Backing Up the Current Installation (M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus Routers)

You should back up the current installation so that you can return to the current software installation. In a dual Routing Engine system, you need to back up both Routing Engines. This section covers the following:

The installation process using the installation package (**jinstall***, for example) removes all stored files on the router except the **juniper.conf** and SSH files. Therefore, you should back up your current configuration in case you need to return to the current software installation after running the installation program.

To back up the Junos OS on the M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers, issue the **request system snapshot** CLI operational command. This command saves the current software installation on the hard drive.



NOTE: On M Series, MX Series, T Series, TX Matrix, and TX Matrix Plus routers with dual Routing Engines, complete this operation on both Routing Engines. On routers without a CompactFlash card, where the hard drive is the primary boot device, you cannot back up your software installation.

When the **request system snapshot** command is issued, the **/root** file system is backed up to **/altroot**, and **/config** is backed up to **/altconfig**. The **/root** and **/config** file systems are on the router's CompactFlash card, and the **/altroot** and **/altconfig** file systems are on the router's hard disk. When the backup is completed, the current and backup software installations are identical.

To copy the files to the router's hard disk, use the following command:

```
user@host> request system snapshot
```

Backing Up the Current Installation (J Series Routers and SRX Services Gateway)

You should back up the current installation so that you can return to the current software installation. In a dual Routing Engine system, you need to back up both Routing Engines.

The installation process using the installation package (**junos-jsr***) removes all stored files on the router except the **juniper.conf** and SSH files. Therefore, you should back up your current configuration in case you need to return to the current software installation after running the installation program.

For information on backing up SRX Services Gateway, see the [Performing Software Upgrades and Reboots](#) section in the Junos Administration Guide.

The following instructions offer the minimum steps required to create a backup on a J Series router during the installation process. For a complete description of the backup process on the J Series routers, see the [J Series Services Router Administration Guide](#) and the [Junos OS Systems Basics Configuration Guide](#).

To back up the Junos OS on the J Series routers:

1. Attach an external memory device to the router.



NOTE: Even when attached to a J Series router, the USB memory device is not listed as a storage device in the **show system storage** CLI command output. You can view the installed USB memory device on the J-Web interface's system monitor screen.

2. Issue the **request system snapshot media usb** command.

The current software installation and configuration are saved on the external USB storage device.

Installing the Software Package on a Router with a Single Routing Engine

To upgrade the router software, follow these steps:

1. Install the new software package using the **request system software add** command:

```
user@host> request system software add /var/tmp/installation-package
```

installation-package is the name of the installation package; for example `jinstall-9.2R1.8-domestic-signed.tgz`



WARNING: Do not include the *re0* | *re1* option when you install a package using the **request system software add** command, if the Routing Engine on which the package is located and the Routing Engine on which you want to install the package is the same. In such cases, the package gets deleted after a successful upgrade.

For more information about the **request system software add** command, see the [Junos System Basics and Services Command Reference](#).

2. Reboot the router to start the new software using the **request system reboot** command:

```
user@host> request system reboot
Reboot the system? [yes, no] (no) yes
```



NOTE: You must reboot the device to load the new installation of the Junos OS on the device.

To abort the installation, do not reboot the device; instead, finish the installation and then issue the **request system software delete jinstall** command. This is your last chance to stop the installation.

The software is loaded when you reboot the system. Installation can take between 5 and 10 minutes. The router then reboots from the boot device on which the software was just installed. When the reboot is complete, the router displays the login prompt.

While the software is being upgraded, the Routing Engine on which you are performing the installation does not route traffic.

3. Log in and issue the **show version** command to verify the version of the software installed.
4. (Optional) Add the **jweb** package using the **request system software add** command. Before you can add this package, you must first download the software as you did the installation package. For more information on downloading the **jweb** package, see [“Downloading Software” on page 32](#).

The **jweb** installation module adds a router management graphical user interface that you can use to view and configure your router. For more information about the **jweb** package, see [“Installation Modules” on page 7](#).

5. After you have upgraded or downgraded the software and are satisfied that the new software is successfully running, issue the **request system snapshot** command to back up the new software.

Installing the Software Package on a Router with Redundant Routing Engines

If the router has two Routing Engines, perform a Junos OS installation on each Routing Engine separately to avoid disrupting network operation.



WARNING: If graceful Routing Engine switchover (GRES), or nonstop active routing (NSR) is enabled when you initiate a software installation, the software does not install properly. Make sure you issue the CLI **delete chassis redundancy** command when prompted. If GRES is enabled, it will be removed with the **redundancy** command. By default, NSR is disabled. If NSR is enabled, remove the **nonstop-routing** statement from the **[edit routing-options]** hierarchy level to disable it.

To upgrade the router software, perform the following tasks:

1. [Preparing the Router for the Installation on page 37](#)
2. [Installing Software on the Backup Routing Engine on page 38](#)
3. [Installing Software on the Master Routing Engine on page 39](#)
4. [Finalizing the Installation on page 41](#)

Preparing the Router for the Installation

Perform the following steps before installing the software:

1. Log in to the master Routing Engine's console.

For more information on logging in to the Routing Engine through the console port, see the specific hardware guide for your router.

2. From the router command line, enter configuration mode:

```
a. user@host#> configure
   Entering configuration mode
```

```
[edit]
user@host#
```

3. Disable Routing Engine redundancy:

```
[edit]
user@host# delete chassis redundancy
```

4. Save the configuration change on both Routing Engines:

```
[edit]
user@host# commit synchronize
```

5. Exit out of the CLI configuration mode:

```
[edit]
user@host# exit
```

Installing Software on the Backup Routing Engine

After the router has been prepared, you first install the new Junos OS release on the backup Routing Engine while keeping the currently running software version on the master Routing Engine. This enables the master Routing Engine to continue operations, minimizing disruption to your network.

After making sure that the new software version is running correctly on the backup Routing Engine, you are ready to switch routing control to the backup Routing Engine and then upgrade or downgrade the software version on the other Routing Engine.

1. Log in to the console port on the other Routing Engine (currently the master).

For more information on logging in to the Routing Engine through the console port, see the specific hardware guide for your router.

2. Install the new software package using the **request system software add** command:

```
user@host> request system software add validate
/var/tmp/jinstall-9.2R1.8-domestic-signed.tgz
```



WARNING: Do not include the *re0* | *re1* option when you install a package using the **request system software add** command, if the Routing Engine on which the package is located and the Routing Engine on which you want to install the package is the same. In such cases, the package gets deleted after a successful upgrade.

For more information on the **request system software add** command, see the [Junos System Basics and Services Command Reference](#).

3. Reboot the router to start the new software using the **request system reboot** command:

```
user@host> request system reboot
Reboot the system? [yes, no] (no) yes
```



NOTE: You must reboot the device to load the new installation of the Junos OS on the router.

To abort the installation, do not reboot your device, instead, finish the installation and then issue the **request system software delete jinstall** command. This is your last chance to stop the installation.

All the software is loaded when you reboot the device. Installation can take between 5 and 10 minutes. The router then reboots from the boot device on which the software was just installed. When the reboot is complete, the router displays the login prompt.

While the software is being upgraded, the Routing Engine on which you are performing the installation is not routing traffic.

4. Log in and issue the **show version** command to verify the version of the software installed.
5. (Optional) Add the **jweb** package using the **request system software add** command. Before you can add this package, you must first download the software as you did the installation package. For more information on downloading the **jweb** package, see [“Downloading Software” on page 32](#).

The **jweb** installation module adds a router management graphical user interface that you can use to view and configure your router. For more information about the **jweb** package, see [“Installation Modules” on page 7](#).

Installing Software on the Master Routing Engine

Once the software is installed on the backup Routing Engine, you are ready to switch routing control to the backup Routing Engine and then upgrade or downgrade the master Routing Engine software:

1. Log in to the master Routing Engine console port.

For more information on logging in to the Routing Engine through the console port, see the specific hardware guide for your router.

2. Transfer routing control to the backup Routing Engine:

```
user@host> request chassis routing-engine master switch
```

For more information about the **request chassis routing-engine master** command, see the [Junos System Basics and Services Command Reference](#).

3. Verify that the backup Routing Engine (slot 1) is the master Routing Engine:

```
user@host> show chassis routing-engine
Routing Engine status:
Slot 0:
  Current state      Backup
  Election priority  Master (default)
Routing Engine status:
Slot 1:
  Current state      Master
  Election priority  Backup (default)
```

4. Install the new software package using the **request system software add** command:

```
user@host> request system software add validate
/var/tmp/jinstall-9.2R1.8-domestic-signed.tgz
```



WARNING: Do not include the *re0* | *re1* option when you install a package using the **request system software add** command, if the Routing Engine on

which the package is located and the Routing Engine on which you want to install the package is the same. In such cases, the package gets deleted after a successful upgrade.

For more information about the **request system software add** command, see the [Junos System Basics and Services Command Reference](#).

5. Reboot the Routing Engine using the **request system reboot** command:

```
user@host> request system reboot
Reboot the system? [yes, no] (no) yes
```



NOTE: You must reboot to load the new installation of the Junos OS on the router.

To abort the installation, do not reboot your system; instead, finish the installation and then issue the **request system software delete jinstall** command. This is your last chance to stop the installation.

The software is loaded when you reboot the system. Installation can take between 5 and 10 minutes. The router then reboots from the boot device on which the software was just installed. When the reboot is complete, the router displays the login prompt.

While the software is being upgraded, the Routing Engine on which you are performing the installation does not route traffic.

6. Log in and issue the **show version** command to verify the version of the software installed.
7. (Optional) Add the **jweb** package using the **request system software add** command. Before you can add this package, you must first download the software as you did the installation package. For more information on downloading the **jweb** package, see ["Downloading Software" on page 32](#).

The **jweb** installation module adds a router management graphical user interface that you can use to view and configure your router. For more information about the **jweb** package, see ["Installation Modules" on page 7](#).

8. Transfer routing control back to the master Routing Engine:

```
user@host> request chassis routing-engine master switch
```

For more information about the **request chassis routing-engine master** command, see the [Junos System Basics and Services Command Reference](#).

9. Verify the master Routing Engine (slot 0) is indeed the master Routing Engine:

```
user@host> show chassis routing-engine
Routing Engine status:
Slot 0:
  Current state      Master
  Election priority  Master (default)
outing Engine status:
```

Slot 1:	
Current state	Backup
Election priority	Backup (default)

Finalizing the Installation

Once the software is installed on both Routing Engines, you return the router back to its original configuration and back up the new installation.

1. Restore the configuration that existed before you deleted it at the start of this procedure:

```
{backup}
user@host-re0> configure
[edit]
user@host-re0# rollback 1
```

2. Save the configuration change on both Routing Engines:

```
[edit]
user@host-re0> commit synchronize and-quit
```

3. After you have installed the new software and are satisfied that it is successfully running, issue the **request system snapshot** command to back up the new software on both master and backup Routing Engines:

```
{master}
user@host-re0> request system snapshot
{master}
user@host-re0> request routing-engine login other routing-engine
{backup}
user@host-re1> request system snapshot
{backup}
```

The root file system is backed up to **/altroot**, and **/config** is backed up to **/altconfig**. The root and **/config** file systems are on the router's CompactFlash card, and the **/altroot** and **/altconfig** file systems are on the router's hard disk.

For more information on the **request routing-engine login** command, see the [Junos System Basics and Services Command Reference](#).



NOTE: After you issue the **request system snapshot** command, you cannot return to the previous version of the software because the running copy and backup copy of the software are identical.

Upgrading Individual Software Packages



NOTE: When you install individual software packages, the following notes apply:

- When upgrading from Junos OS Release 8.2 or earlier to Junos OS Release 8.5, use the `system software add <image> no-validate` command option.
- Only use the `jinstall` Junos OS image when upgrading or downgrading to or from Junos OS Release 8.5. Do not use the `jbundle` image.
- Before upgrading to Junos OS Release 8.5, ensure that the routing platform's CompactFlash card is 256 MB or larger to avoid disk size restrictions. (M7i routers without a CompactFlash card are excluded.)

To upgrade an individual Junos OS package, follow these steps:

1. Download the software packages you need from the Juniper Networks Support Web site at <http://www.juniper.net/support/>. Choose either the Canada and U.S. Version or the Worldwide Version.

To download the software packages, you must have a service contract and an access account. If you need help obtaining an account, complete the registration form at the Juniper Networks Web site: <https://www.juniper.net/registration/Register.jsp>.



NOTE: We recommend that you upgrade all individual software packages using an out-of-band connection from the console or management Ethernet interface, because in-band connections can be lost during the upgrade process.

2. Back up the currently running and active file system so that you can recover to a known, stable environment in case something goes wrong with the upgrade:

```
user@host> request system snapshot
```

The root file system is backed up to `/altroot`, and `/config` is backed up to `/altconfig`. The root and `/config` file systems are on the router's CompactFlash card, and the `/altroot` and `/altconfig` file systems are on the router's hard disk.



NOTE: After you issue the `request system snapshot` command, you cannot return to the previous version of the software, because the running copy and the backup copy of the software are identical.

3. If you are copying multiple software packages to the router, copy them to the `/var/tmp` directory on the hard disk:

```
user@host> file copy ftp://username :prompt@ftp.hostname  
.net/filename/var/tmp/filename
```

4. Add the new software package:

```
user@host> request system software add /var/tmp/ installation package validate
```

installation-package is the full URL to the file.



WARNING: Do not include the *re0* | *re1* option when you install a package using the `request system software add` command, if the Routing Engine on which the package is located and the Routing Engine on which you want to install the package is the same. In such cases, the package gets deleted after a successful upgrade.

The system might display the following message:

```
pkg_delete: couldn't entirely delete package
```

This message indicates that someone manually deleted or changed an item that was in a package. You do not need to take any action; the package is still properly deleted.

If you are upgrading more than one package at the same time, add `jbase` first. If you are using this procedure to upgrade all packages at once, add them in the following order:

```
user@host> request system software add /var/tmp/jbase-release-signed.tgz
user@host> request system software add /var/tmp/jkernel-release-signed.tgz
user@host> request system software add /var/tmp/jpfe-release-signed.tgz
user@host> request system software add /var/tmp/jdocs-release- signed.tgz
user@host> request system software add /var/tmp/jweb-release- signed.tgz
user@host> request system software add /var/tmp/jroute-release-signed.tgz
user@host> request system software add /var/tmp/jcrypto-release-signed.tgz
```

For more information about the `request system software add` command, see the [Junos System Basics and Services Command Reference](#).

5. Reboot the router to start the new software:

```
user@host> request system reboot
```

6. After you have upgraded or downgraded the software and are satisfied that the new software is successfully running, issue the `request system snapshot` command to back up the new software:

```
user@host> request system snapshot
```

The root file system is backed up to `/altroot`, and `/config` is backed up to `/altconfig`. The root and `/config` file systems are on the router's CompactFlash card, and the `/altroot` and `/altconfig` file systems are on the router's hard disk.



NOTE: After you issue the `request system snapshot` command, you cannot return to the previous version of the software, because the running copy and backup copy of the software are identical.

Upgrading to 64-bit Junos OS

Just like any other operating system, the 64-bit version of the Junos OS can address more memory than the 32-bit version of the operating system. In order to support larger Routing Engine memory sizes, an upgrade from the 32-bit to the 64-bit Junos OS running on the Routing Engine hardware is necessary. The upgrade path is relatively straightforward and another form of Routing Engine hardware and software upgrade. However, there are three different and distinct Routing Engine configurations that must be taken into account when upgrading to the 64-bit Junos OS. This topic covers all three.



NOTE:

The 64-bit Junos OS is supported on the following Routing Engines only:

- RE-DUO-C2600-16G
 - RE-A-1800x2-16G
 - RE-S-1800x4-16G
 - RE-JCS1200-1x2330
-

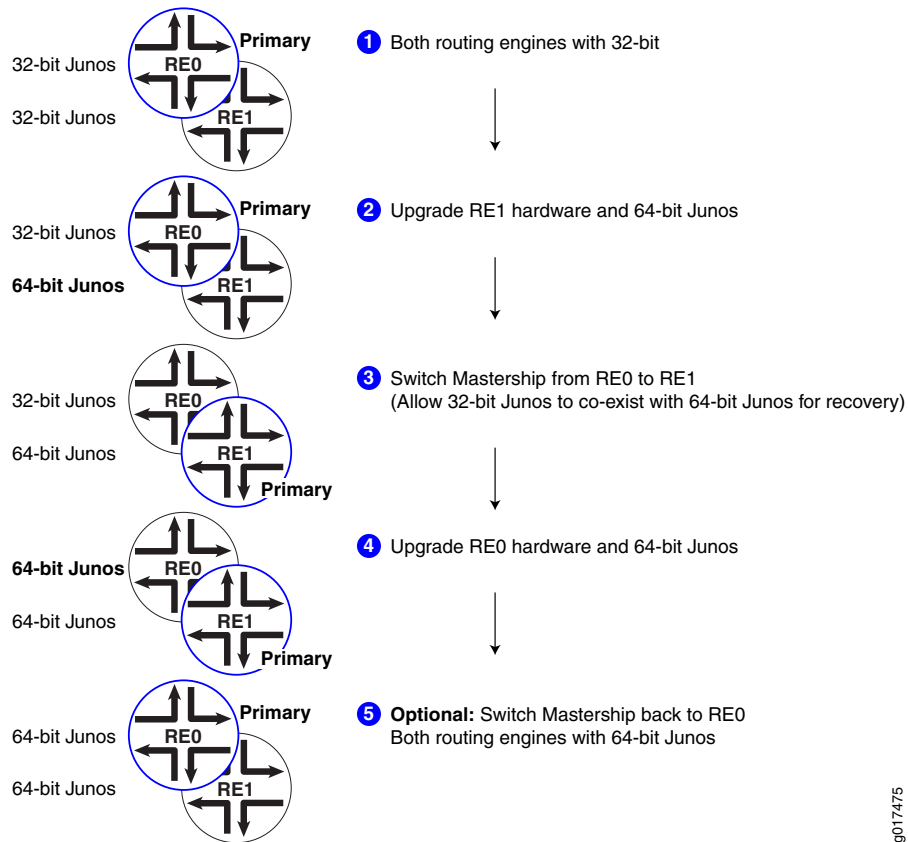
Before you begin, you must have:

- A properly configured and functional router
- One or two Routing Engines installed that support the 64-bit Junos OS
- Decided to allow single Routing Engines systems to use either slot 0 or slot 1 as master or not (this decision will determine which upgrade path to follow for single Routing Engine systems)

When you upgrade a Routing Engine to the 64-bit Junos OS, you can support larger Routing Engine memory sizes. However, the exact procedure depends on whether there are one or two Routing Engines installed. For systems with a single Routing Engine, the procedure varies based on whether the master Routing Engine must always be in slot 0 or not.

To upgrade a system with two Routing Engines, refer to [Figure 4 on page 45](#) and perform the following steps:

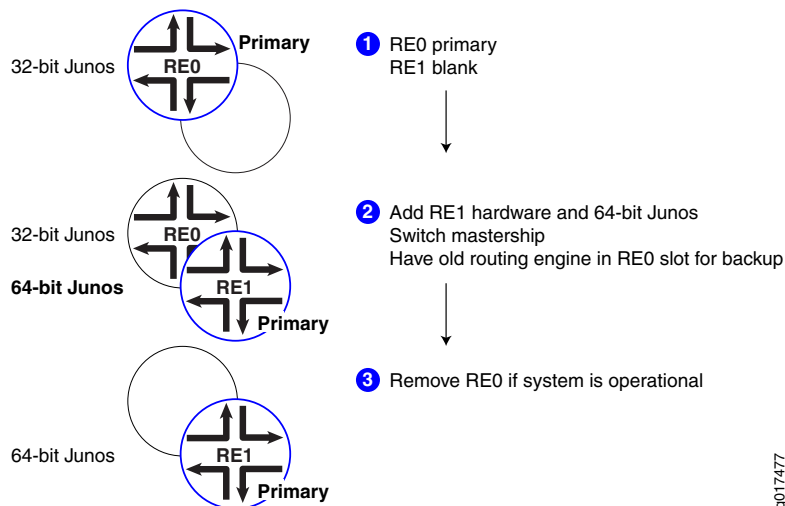
Figure 4: Upgrading to the 64-bit Junos OS with Dual Routing Engines



1. In the initial state, both Routing Engines are running the 32-bit Junos OS, and slot 0 has the master Routing Engine.
2. Upgrade the slot 1 Routing Engine hardware and install the 64-bit Junos OS.
3. Switch the master Routing Engine from slot 0 to slot 1 (allow the 32-bit Junos OS to co-exist with the 64-bit Junos OS).
4. Upgrade the slot 0 routing engine hardware and install the 64-bit Junos OS.
5. Both Routing Engines now run the 64-bit Junos OS. Optionally, you can switch the master Routing Engine back to slot 0.

To upgrade a system with a single Routing Engine, where the master Routing Engine can be in either slot 0 or slot 1, refer to [Figure 4 on page 45](#) and perform the following steps:

Figure 5: Upgrading to the 64-bit Junos OS with a Single Routing Engine (Master in Either Slot)

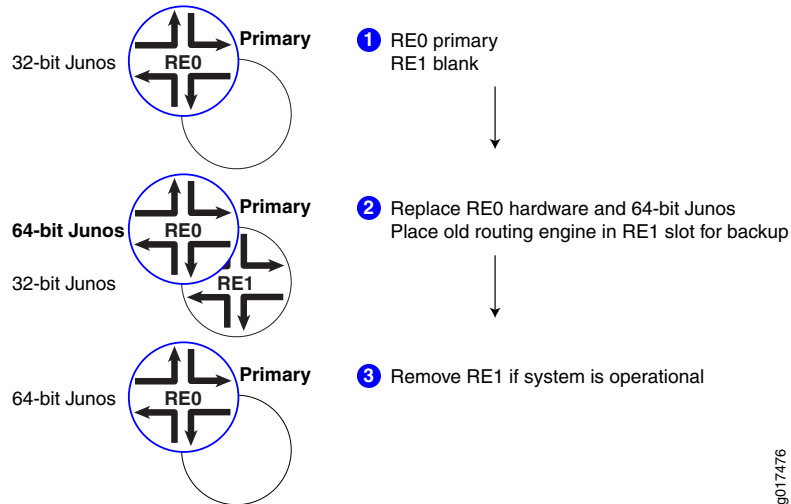


1. In the initial state, the slot 0 Routing Engine is running the 32-bit Junos OS and slot 1 is blank.
2. Install the upgraded Routing Engine hardware in slot 1 and install the 64-bit Junos OS.
3. When the 64-bit Junos OS is configured properly, remove the slot 0 Routing Engine running the 32-bit Junos OS.

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To upgrade a system with a single Routing Engine, where the master Routing Engine must be in slot 0, refer to [Figure 6 on page 47](#) and perform the following steps:

Figure 6: Upgrading to the 64-bit Junos OS with a Single Routing Engine (Master Must Be in Slot 0)



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1. In the initial state, the slot 0 Routing Engine is running the 32-bit Junos OS and slot 1 is blank.
2. Install the slot 0 Routing Engine hardware in slot 1. Install the upgraded Routing Engine hardware in slot 0 and install the 64-bit Junos OS.
3. When the 64-bit Junos OS is configured properly, remove the slot 1 routing engine running the 32-bit Junos OS.

Related Documentation

- [Checklist for Reinstalling Junos OS](#)

Upgrading Routers Using ISSU

Unified in-service software upgrade (ISSU) enables you to upgrade between two different Junos OS releases with no disruption on the control plane and with minimal disruption of traffic. ISSU is only supported by dual Routing Engine platforms. In addition, graceful Routing Engine switchover (GRES) and nonstop active routing (NSR) must be enabled.

For additional information about using ISSU, see the [Junos High Availability Guide](#).

CHAPTER 5

Completing a Recovery Installation

If the router's software is corrupted or otherwise damaged, you may need to perform a recovery installation, using the emergency boot disk to restore the default factory installation. Once you have recovered the software in this fashion, you must configure the router as you would for a new router.

This chapter discusses the following topics:

- [Creating an Emergency Boot Device on page 49](#)
- [Saving a Rescue Configuration File on page 50](#)
- [Performing a Recovery Installation on page 51](#)
- [Creating a New Configuration on a Single Routing Engine on page 52](#)
- [Creating a New Configuration with Redundant Routing Engines on page 57](#)
- [Restoring a Saved Configuration on page 62](#)

Creating an Emergency Boot Device

If the router's Junos OS software is damaged in some way that prevents the Junos OS software from loading completely, you can use the emergency boot device to revive the router. The emergency boot device repartitions the primary disk and reloads a fresh installation of the Junos OS software.

The procedures outlined in this section discuss how to create an emergency boot device for any M Series, MX Series, T Series, TX Matrix, or TX Matrix Plus router.

To create an emergency boot device:

1. Use FTP to copy the installation media into the router's **/var/tmp** directory.
2. Insert the PC Card into the external PC Card slot or USB port.
3. In the UNIX shell, navigate to the **/var/tmp** directory:

```
start shell
cd /var/tmp
```

4. Log in as **su**:

```
su [enter]
password: [enter SU password]
```

5. Issue the following commands:

```
dd if=/dev/zero of=/dev/externalDrive count=20
dd if=installMedia of=/dev/externalDrive bs=64k
```

where:

- **externalDrive**—Refers to the removable media name. For example, the removable media name on the M120 is **da0** for both Routing Engines. For the names of the storage media, see [“Routing Engines and Storage Media Names \(M Series, MX Series, T Series, TX Matrix, TX Matrix Plus, and JCS Routers\)”](#) on page 18.
- **installMedia**—Refers to the installation media downloaded into the **/var/tmp** directory. For example, **install-media-9.0R2.10-domestic.tgz**.

The following code example can be used to create an emergency boot disk using a PC Card on an M20 router:

```
dd if=/dev/zero of=/dev/ad3 count=20
dd if=install-media-9.0R2.10-domestic.tgz of=/dev/ad3 bs=64k
```

The following code example can be used to create an emergency boot disk using a USB storage device on an M120 router or a TX Matrix Plus router:

```
dd if=/dev/zero of=/dev/da0 count=20
dd if=install-media-9.0R2.10-domestic.tgz of=/dev/da0 bs=64k
```

6. Log out as **su**:

```
exit
```

Saving a Rescue Configuration File

A rescue configuration file is helpful in the event that your router's configuration file has been misconfigured. You can restore the router to this rescue configuration to bring the router back online. If you save this file off the router, the rescue configuration can also be used to restore your router in the event of a software failure.

To save a current router configuration as a rescue configuration file:

1. Edit the configuration file on the router to reflect the base configuration you wish to use.

For more information about editing the configuration, see the [Junos System Basics Configuration Guide](#).

2. In the CLI operational mode, save this edited base configuration as the rescue configuration file:

```
user@host> request system configuration rescue save
```

3. Copy the rescue configuration to a remote server:

```
user@host> ftp host
Name: username
Password: password
230 User user logged in.
```

```

ftp> cd /filepath
ftp> lcd /config
ftp> bin
Type set to I.
ftp> put rescue.conf.gz
Transfer complete.
ftp> bye
Goodbye.

```

Performing a Recovery Installation

If the router or switch's software is corrupted or otherwise damaged, you may need to perform a recovery installation, using the emergency boot disk to restore the default factory installation. Once you have recovered the software you will need to restore the router or switch's configuration. You can either create a new configuration as you did when the router or switch was shipped from the factory, or if you saved the router or switch's previous configuration, you can simply restore that file to the system.

Depending on the situation, you should try to perform the following steps before you perform the recovery installation:

1. Ensure you have an emergency recovery disk to use during the installation. When the router or switch is first shipped, an emergency recovery disk is provided with it. For instructions on creating an emergency boot disk, see [“Creating an Emergency Boot Device”](#) on page 49
2. Copy the existing configuration in the file `/config/juniper.conf.gz` from the router or switch to a remote system. For extra safety, you can also copy the backup configurations (the files named `/config/juniper.conf.n`, where *n* is a number from 0 through 9).



WARNING: The recovery installation process completely overwrites the entire contents of the fixed storage media.

3. Copy any other stored files to a remote system as desired.

To reinstall the Junos OS:

1. Insert the removable media into the router or switch.



NOTE: You can store a configuration on installation media such as a PC Card or USB stick.

2. Reboot the router or switch. Do not power off the router or switch if it is already on. Issue the CLI **request system reboot** command.
3. When the software prompts you with the following question, type **y**:

WARNING: The installation will erase the contents of your disk. Do you wish to continue (y/n)? **y**

4. The router or switch copies the software from the removable media onto your system, occasionally displaying status messages. Copying the software can take up to 10 minutes.
5. Remove the removable media when prompted. The router or switch then reboots from the boot device on which the software was just installed. When the reboot is complete, the router or switch displays the login prompt.
6. Create a new configuration as you did when the router or switch was shipped from the factory, or restore a previously saved configuration file to the system. For more information, see [“Creating a New Configuration on a Single Routing Engine” on page 52](#), [“Creating a New Configuration with Redundant Routing Engines” on page 57](#), and [“Restoring a Saved Configuration” on page 62](#).

Creating a New Configuration on a Single Routing Engine

To create a new base configuration on a single Routing Engine:

- [Log In to the Router Console on page 52](#)
- [Configure Administration User Accounts on page 53](#)
- [Add the Management Console to the Network on page 53](#)
- [Commit Changes on page 54](#)

Log In to the Router Console

To log in to the router’s console interface and open the CLI in configuration mode:

1. Verify the router is powered on.
2. Log in through the console port as root.

```
Amnesiac <ttyd0>
```

```
login: root
```



NOTE: From the factory, the root administration user account is not associated with a password. However, you must add a password to the root administration account before you can successfully commit a configuration.

3. Start the CLI, which initially opens in operational mode. Note the command prompt ends with > in the CLI operational mode.

```
root@% cli
root>
```

4. Enter the CLI configuration mode. Note the command prompt ends with # in the CLI configuration mode.

```
root> configure
[edit]
root#
```


Configure Administration User Accounts

Set the root administration user account password. You also need to set up one or more administration user accounts. These administration user accounts are used to log in to the router through the management console. To configure administration user accounts:

1. Add a password to the root (superuser) administration user account.

```
[edit]
root# set system root-authentication plain-text-password
New password: password
Retype new password: password
```

2. Create a management console user account.

```
[edit]
root# set system login user user-name authentication plain-text-password
New Password: password
Retype new password: password
```

3. Set the user account class to **super-user**.

```
[edit]
root# set system login user user-name class super-user
```

Add the Management Console to the Network

To add the management console to the network:

1. Specify the router hostname.



NOTE: The hostname specified in the router configuration is not used by the DNS server to resolve to the correct IP address. This hostname is used to display the name of the Routing Engine in the CLI. For example, this hostname appears on the command line prompt when the user is logged in to the CLI:

```
user-name@host-name>
```

```
[edit]
root# set system host-name host-name
```

2. Configure the IP address of the DNS server.

```
[edit]
root# set system name-server address
```

3. Configure the router domain name.

```
[edit]
root# set system domain-name domain-name
```

4. Configure the IP address and prefix length for the router Ethernet interface.

- For all routers *except* the TX Matrix Plus router and T1600 routers in a routing matrix:

```
[edit]
```

```
root@# set interfaces fxp0 unit 0 family inet address address/prefix-length
```

- For TX Matrix Plus and T1600 routers in a routing matrix only:

```
[edit]
```

```
root@# set interfaces em0 unit 0 family inet address address/prefix-length
```

To use **em0** as an out-of-band management Ethernet interface, you must configure its logical port, **em0.0**, with a valid IP address.

- For a T1600 standalone router (not connected to a TX Matrix Plus router and not in a routing matrix):

```
[edit]
```

```
root@# set interfaces fxp0 unit 0 family inet address address/prefix-length
```

5. Configure the IP address of a backup router. The backup router is used while the local router is booting and if the routing process fails to start. Once the routing process starts, the backup router address is removed from the local routing and forwarding tables. For more information on the backup router, see the [Junos System Basics Configuration Guide](#).

```
[edit]
```

```
root# set system backup-router address
```

6. (Optional) Configure the static routes to remote subnets with access to the management port. Access to the management port is limited to the local subnet. To access the management port from a remote subnet, you need to add a static route to that subnet within the routing table. For more information on static routes, see the [Junos System Basics Configuration Guide](#).

```
[edit]
```

```
root# set routing-options static route remote-subnet next-hop destination-IP retain no-readvertise
```

7. Configure telnet service at the **[edit system services]** hierarchy level.

```
[edit]
```

```
root# set system services telnet
```

Commit Changes

Now that you have completed your changes to the configuration file, commit the configuration changes.

1. Before committing the configuration, you can review your changes to the configuration with the **show** command.

```
root# show
```

```
## Last changed: 2008-08-27 22:30:42 UTC
```

```
version 9.3B1.5;
```

```
system {
```

```
  host-name tp8;
```

```
  domain-name subnet.juniper.net;
```

```
  backup-router 192.168.71.254;
```

```
  root-authentication {
```

```
    encrypted-password "xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"; ## SECRET-DATA
```

```
  }
```

```

name-server {
    192.168.5.68;
    172.17.28.101;
}
login {
    user regress {
        class super-user;
        authentication {
            encrypted-password "xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"; ## SECRET-DATA
        }
    }
}
services {
    telnet;
}
syslog {
    user * {
        any emergency;
    }
    file messages {
        any notice;
        authorization info;
    }
    file interactive-commands {
        interactive-commands any;
    }
}
}
interfaces {
    fxp0 {
        unit 0 {
            family inet {
                address 192.128.69.205/21;
            }
        }
    }
}
routing-options {
    static {
        route 172.16.0.0/12 {
            next-hop 192.168.71.254;
            retain;
            no-readvertise;
        }
        route 192.168.0.0/16 {
            next-hop 192.168.71.254;
            retain;
            no-readvertise;
        }
    }
}
}

```

On a TX Matrix Plus router, the management Ethernet interface is **em0** and not **fxp0**. Therefore, when you issue the **show** command in the configuration mode, the configuration statements would be:

```
[edit]
root@ show
system {
  host-name hostname;
  domain-name domain.name;
  backup-router address ;
  root-authentication {
    (encrypted-password "password" | public-key);
    ssh-rsa "public-key";
    ssh-dsa "public-key";
  }
  name-server {
    address;
  }
  interfaces {
    em0 {
      unit 0 {
        family inet {
          address address ;
        }
      }
    }
  }
}
```

2. Commit the configuration.

```
[edit]
root# commit
commit complete
```



NOTE: If you receive an error message after you issue the commit statement, you can review the configuration using the show command to find the errors in your configuration. You can delete incorrect entries using the delete command. For example, to delete a hostname from the configuration, issue the following statement:

```
[edit]
root# delete system host-name host-name
```

3. Exit configuration mode.

```
[edit]
root# exit
Exiting configuration mode

root>
```

Creating a New Configuration with Redundant Routing Engines

To create a new base configuration on a router with redundant Routing Engines:

- [Configure Administration User Accounts on page 57](#)
- [Set Up Routing Engine Configuration Groups on page 57](#)
- [Complete the Management Console Configuration on page 59](#)
- [Commit and Synchronize Changes on page 60](#)

Configure Administration User Accounts

Set the root administration user account password. You also need to set up one or more administration user accounts. These administration user accounts are used to log in to the router through the management console. To configure administration user accounts:

1. Add a password to the root (superuser) administration user account.

```
[edit]
root# set system root-authentication plain-text-password
New password: password
Retype new password: password
```

2. Create a management console user account.

```
[edit]
root# set system login user user-name authentication plain-text-password
New Password: password
Retype new password: password
```

3. Set the user account class to **super-user**.

```
[edit]
root# set system login user user-name class super-user
```

Set Up Routing Engine Configuration Groups

In a router with two Routing Engines, one configuration should be shared between both Routing Engines. This ensures that both Routing Engine configurations are identical. Within this configuration, create two Routing Engine groups, one for each Routing Engine. Within these groups, you specify the Routing Engine–specific parameters.

For more information about creating configuration groups, see [Junos OS CLI User Guide](#).

For more information about the initial configuration for redundant Routing Engine systems and the re0 group, see [Junos OS High Availability Configuration Guide](#).

1. Create the configuration group **re0**. The **re0** group is a special group designator that is only used by **RE0** in a redundant routing platform.

```
[edit]
root# set groups re0
```

2. Navigate to the **groups re0** level of the configuration hierarchy.

```
[edit]
```

```
root# edit groups re0
```

3. Specify the router hostname.

```
[edit groups re0]
```

```
root# set system host-name host-name
```



NOTE: The hostname specified in the router configuration is not used by the DNS server to resolve to the correct IP address. This hostname is used to display the name of the Routing Engine in the CLI. For example, the hostname appears at the command-line prompt when the user is logged in to the CLI:

```
user-name@host-name>
```

4. Configure the IP address and prefix length for the router Ethernet interface.

- For all routers *except* the TX Matrix Plus router and T1600 routers in a routing matrix:

```
[edit]
```

```
root@# set interfaces fxp0 unit 0 family inet address address/prefix-length
```

- For TX Matrix Plus and T1600 routers in a routing matrix only:

```
[edit]
```

```
root@# set interfaces em0 unit 0 family inet address address/prefix-length
```

To use **em0** as an out-of-band management Ethernet interface, you must configure its logical port, **em0.0**, with a valid IP address.

- For a T1600 standalone router (not connected to a TX Matrix Plus router and not in a routing matrix):

```
[edit]
```

```
root@# set interfaces fxp0 unit 0 family inet address address/prefix-length
```

5. Return to the top level of the hierarchy.

```
[edit groups re0]
```

```
root# top
```

6. Create the configuration group **re1**.

```
[edit]
```

```
root# set groups re1
```

7. Navigate to the **groups re1** level of the configuration hierarchy.

```
[edit]
```

```
root# edit groups re1
```

8. Specify the router hostname.

```
[edit groups re1]
```

```
root# set system host-name host-name
```

9. Configure the IP address and prefix length for the router Ethernet interface.

- For all routers *except* the TX Matrix Plus router and T1600 routers in a routing matrix:

```
[edit]
root@# set interfaces fxp0 unit 0 family inet address address/prefix-length
```

- For TX Matrix Plus and T1600 routers in a routing matrix only:

```
[edit]
root@# set interfaces em0 unit 0 family inet address address/prefix-length
```

To use **em0** as an out-of-band management Ethernet interface, you must configure its logical port, **em0.0**, with a valid IP address.

- For a T1600 standalone router (not connected to a TX Matrix Plus router and not in a routing matrix):

```
[edit]
root@# set interfaces fxp0 unit 0 family inet address address/prefix-length
```

10. Return to the top level of the hierarchy.

```
[edit groups re0]
root# top
```

11. Specify the group application order.

```
[edit]
root# set apply-groups [ re0 re1 ]
```

Complete the Management Console Configuration

To configure the global management console parameters.

1. Configure the IP address of the DNS server.

```
[edit]
root# set system name-server address
```

2. Configure the router domain name.

```
[edit]
root# set system domain-name domain-name
```

3. Configure the IP address of a backup router. The backup router is used while the local router is booting and if the routing process fails to start. Once the routing process starts, the backup router address is removed from the local routing and forwarding tables. For more information about the backup router, see the [Junos System Basics Configuration Guide](#).

```
[edit]
root# set system backup-router address
```

4. (Optional) Configure the static routes to remote subnets with access to the management port. Access to the management port is limited to the local subnet. To access the management port from a remote subnet, you need to add a static route to that subnet within the routing table. For more information about static routes, see the [Junos System Basics Configuration Guide](#).

```
[edit]
root# set routing-options static route remote-subnet next-hop destination-IP retain
no-readvertise
```

5. Configure telnet service at the **[edit system services]** hierarchy level.

```
[edit]
root# set system services telnet
```

Commit and Synchronize Changes

Commit the configuration changes. When you issue the **synchronize** command, the configuration is shared between both Routing Engines and committed on both Routing Engines simultaneously.

1. Before committing the configuration, you can review the configuration entries using the **show** command.

```
root# show
## Last changed: 2008-10-17 18:32:25 UTC
version 9.1R1.8;
groups {
  re0 {
    system {
      host-name spice-re0;
    }
    interfaces {
      fxp0 {
        unit 0 {
          family inet {
            address 192.168.69.155/21;
          }
        }
      }
    }
  }
  re1 {
    system {
      host-name spice-re1;
    }
    interfaces {
      fxp0 {
        unit 0 {
          family inet {
            address 192.168.70.72/21;
          }
        }
      }
    }
  }
}
global;
}
apply-groups [ re0 re1 ];
system {
  domain-name englab.juniper.net;
  backup-router 192.168.71.254;
  root-authentication {
    encrypted-password "xxxxxxxxxx"; ## SECRET-DATA
  }
  name-server {
```



```

    192.168.1.1;
}
login {
  user regress {
    uid 2001;
    class super-user;
    authentication {
      encrypted-password "xxxxxxxxxx"; ## SECRET-DATA
    }
  }
}
services {
  telnet;
}
syslog {
  user * {
    any emergency;
  }
  file messages {
    any notice;
    authorization info;
  }
  file interactive-commands {
    interactive-commands any;
  }
}
}
routing-options {
  static {
    /* corporate office */
    route 172.16.0.0/12 {
      next-hop 192.168.71.254;
      retain;
      no-readvertise;
    }
  }
}
}

```

2. Commit and synchronize the configuration. The **commit synchronize** command commits this new configuration on both Routing Engines simultaneously.

```

[edit]
root# commit synchronize
re0:
configuration check succeeds
re1:
commit complete
re0:
commit complete

```

If you receive an error message after you issue the **commit** statement, you can review the configuration using the **show** command to find the errors in your configuration. You can delete incorrect entries using the **delete** command. For example, to delete a hostname from the configuration, issue the following command:

```

[edit]
root# delete system host-name host-name

```

3. Exit configuration mode.

```
[edit]
root# exit
Exiting configuration mode

root>
```

Restoring a Saved Configuration

To restore a saved configuration, perform the following tasks:

1. [Copy Saved Files to the Router on page 62](#)
2. [Load and Commit the Configuration File on page 62](#)

Copy Saved Files to the Router

To copy the saved configuration to the router:

1. Log in to the console as **root**. There is no password.

```
Escape character is '^['.
[Enter]
router (ttyd0)
```

```
login: root
Password: [Enter]
```

Initially, access to the router is limited to the console port after a recovery installation. Access through the management ports and interfaces is set in the configuration. For information about accessing the router through the console port, see the administration guide for your particular router.

2. Start the CLI:

```
# cli
```

3. Copy the configuration file on the remote server to the router's **/var/tmp** directory:

```
root@host> ftp remote-server
user: username
password: password
ftp> bin
Type set to I.
ftp> get /path/file
ftp> bye
Goodbye.
```

Load and Commit the Configuration File

Once the saved configuration file is copied to the router, you load and commit the file:

1. Start the CLI configuration mode.

```
user@routename> configure
Entering configuration mode
```

```
[edit]  
user@host#
```

2. Load the file into the current configuration. You should override the existing file.

```
user@host#  
load override /var/tmp/filename  
load complete
```

3. Commit the file.

```
user@host# commit  
commit complete
```

4. Exit the CLI configuration mode.

```
user@host# exit  
user@host>
```

5. Back up the Junos OS.

After you have installed the software on the router, committed the configuration, and are satisfied that the new configuration is successfully running, issue the **request system snapshot** command to back up the new software to the **/altconfig** file system. If you do not issue the **request system snapshot** command, the configuration on the alternate boot drive will be out of sync with the configuration on the primary boot drive.

The **request system snapshot** command causes the root file system to be backed up to **/altroot**, and **/config** to be backed up to **/altconfig**. The root and **/config** file systems are on the router's CompactFlash card, and the **/altroot** and **/altconfig** file systems are on the router's hard disk.

PART 3

Junos OS Licenses

- [Junos OS Licenses Overview on page 67](#)
- [Managing Junos OS Licenses on page 71](#)

CHAPTER 6

Junos OS Licenses Overview

- [Junos OS Feature Licenses on page 67](#)
- [License Enforcement on page 68](#)
- [Software Feature Licenses on page 68](#)
- [License Key Components on page 69](#)

Junos OS Feature Licenses

Some Junos OS software features require a license to activate the feature. To enable a licensed feature, you need to purchase, install, manage, and verify a license key that corresponds to each licensed feature. To conform to Junos OS feature licensing requirements, you must purchase one license per feature per device. The presence of the appropriate software license key on your device determines whether you are eligible to configure and use the licensed feature.

To speed deployment of licensed features, the Junos OS software implements an honor-based licensing structure and provides you with a 30-day grace period to use a licensed feature without a license key installed. The grace period begins when you configure the feature and your device uses the licensed feature for the first time, but not necessarily when you install the license. After the grace period expires, the system generates system log messages saying that the feature requires a license. To clear the error message and use the licensed feature properly, you must install and verify the required license.

For information on how to purchase software licenses, contact your Juniper Networks sales representative.

Related Documentation

- [Software Features That Require Licenses on the QFX Series](#)
- [License Key Components on page 69](#)
- [Adding New Licenses on page 71](#)
- [Deleting a License on page 72](#)
- [Saving License Keys on page 73](#)
- [Verifying Junos OS License Installation on page 74](#)

License Enforcement

For features or scaling levels that require a license, you must install and properly configure the license to meet the requirements for using the licensable feature or scale level. The router enables you to commit a configuration that specifies a licensable feature or scale without a license for a 30-day grace period. The grace period is a short-term grant that enables you to start using features in the pack or scale up to the system limits (regardless of the license key limit) without a license key installed. The grace period begins when the licensable feature or scaling level is actually used by the router (not when it is first committed). In other words, you can commit licensable features or scaling limits to the router configuration, but the grace period does not begin until the router uses the licensable feature or exceeds a licensable scaling level.



NOTE: Configurations might include both licensed and nonlicensed features. For these situations, the license is enforced up to the point where the license can be clearly distinguished. For example, an authentication-order configuration is shared by both Authentication, Authorization, and Accounting (AAA), which is licensed, and by Layer 2 Tunneling Protocol (L2TP), which is not licensed. When the configuration is committed, the router does not issue any license warnings, because it is not yet known whether AAA or L2TP is using the configuration. However, at runtime, the router checks for a license when AAA authenticates clients, but does not check when L2TP authenticates clients.

The router reports any license breach as a warning log message whenever a configuration is committed that contains a feature or scale limit usage that requires a license. Following the 30-day grace period, the router periodically reports the breach to syslog messages until a license is installed and properly configured on the router to resolve the breach.



NOTE: Successful commitment of a licensable feature or scaling configuration does not imply that the required licenses are installed or not required. If a required license is not present, the system issues a warning message after it commits the configuration.

Software Feature Licenses

Each license is tied to one software feature pack or scaling level, and that license is valid for only one router. [Table 6 on page 68](#) lists the software features, their current level of support, and the license name.

Table 6: Junos OS Feature Licenses

Licensed Software Feature	Supported?	License Name
Per-subscriber RADIUS accounting	Yes	Junos Subscriber Access Feature Pack

Table 6: Junos OS Feature Licenses (*continued*)

Licensed Software Feature	Supported?	License Name
Per-subscriber RADIUS authentication	Yes	Junos Subscriber Access Feature Pack
Address pool assignment	Yes	Junos Subscriber Access Feature Pack
Change-of-Authorization (CoA)	Yes	Junos Service Management Feature Pack
Dynamic autosensed VLAN	No	Junos Subscriber Access Feature Pack
Dynamic and static IP	No	Junos Subscriber Access Feature Pack
Subscriber Secure Policy	Yes	Subscriber Secure Policy
Subscriber scaling (1000; base license)	Yes	Dynamic/Static Subscriber Base
Subscriber scaling (4000)	Yes	Junos Subscriber Access Feature Pack
Subscriber scaling (8000)	Yes	Junos Subscriber Access Feature Pack
Subscriber scaling (16000)	Yes	Junos Subscriber Access Feature Pack
Subscriber scaling (32000)	Yes	Junos Subscriber Access Feature Pack
Subscriber scaling (64000)	Yes	Junos Subscriber Access Feature Pack
Subscriber scaling (96000)	Yes	Junos Subscriber Access Feature Pack
Subscriber scaling (128000)	Yes	Junos Subscriber Access Feature Pack
Subscriber scaling (256000)	Yes	Junos Subscriber Access Feature Pack
L2TP scaling (1000; base license)	No	L2TP Base
Mobile IP scaling (1000; base license)	No	Mobile IP Base
MX Series Virtual Chassis Redundancy	Yes	MX Virtual Chassis Redundancy Feature Pack

License Key Components

To manage Junos OS licenses, you must understand the components of a license key. A license key consists of two parts:

- License ID—Alphanumeric string that uniquely identifies the license key. When a license is generated, it is given a license ID.
- License data—Block of binary data that defines and stores all license key objects.

For example, in the following typical license key, the string **li29183743** is the license ID, and the trailing block of data is the license data:

```
li29183743 4ky27y acasck 82fsj6 jzsn4q ix8i8d adj7kr  
            8uq38t ix8i8d jzsn4q ix8i8d 4ky27y acasck  
            82fsj6 ii8i7e adj7kr 8uq38t ks2923 a9382e
```

The license data defines the device ID for which the license is valid and the version of the license.

**Related
Documentation**

- [Junos OS Feature Licenses on page 9](#)
- Software Features That Require Licenses on the QFX Series
- [Adding New Licenses on page 71](#)
- [Deleting a License on page 72](#)
- [Saving License Keys on page 73](#)
- [Verifying Junos OS License Installation on page 74](#)

CHAPTER 7

Managing Junos OS Licenses

- [Adding New Licenses on page 71](#)
- [Deleting a License on page 72](#)
- [Saving License Keys on page 73](#)
- [Verifying Junos OS License Installation on page 74](#)

Adding New Licenses

Before adding new licenses, complete the following tasks:

- Purchase the required licenses.
- Establish basic network connectivity with the router or switch. For instructions on establishing basic connectivity, see the *Getting Started Guide* or *Quick Start Guide* for your router or switch.

To add a new license key to the router or switch with the CLI:

1. Enter operational mode in the CLI.
2. Enter one of the following CLI commands:
 - To add a license key from a file or URL, enter the following command, specifying the filename or the URL where the key is located:
`user@host> request system license add filename | url`
 - To add a license key from the terminal, enter the following command:
`user@host> request system license add terminal`
3. When prompted, enter the license key, separating multiple license keys with a blank line.

If the license key you enter is invalid, an error appears in the CLI output when you press Ctrl+d to exit license entry mode.



NOTE: If the router has two Routing Engines, add the new license on each Routing Engine separately. This ensures that the license key is enabled on the backup Routing Engine during changeover of mastership between the Routing Engines.

To add a new license key to a router with dual Routing Engines:

- a. After adding the new license key on the master Routing Engine, use the `request chassis routing-engine master switch` command to have the backup Routing Engine become the master Routing Engine.
- b. Log in to the active Routing Engine and add the new license key, repeating the same process.

-
4. Go on to [“Verifying Junos OS License Installation” on page 74](#).



NOTE: Adding a license key to the router or switch might be delayed if a kernel resynchronization operation is in progress at that time. The following message is displayed on the CLI when the license-adding operation is about to be delayed:

A kernel re-sync operation is in progress. License update may take several minutes to complete.

Related Documentation

- [Junos OS Feature Licenses on page 9](#)
- [Software Features That Require Licenses on the QFX Series](#)
- [License Key Components on page 69](#)
- [Deleting a License on page 72](#)
- [Saving License Keys on page 73](#)
- [Verifying Junos OS License Installation on page 74](#)
- `request system license add`

Deleting a License

Before deleting a license, establish basic network connectivity with the router or switch. For instructions on establishing basic connectivity, see the *Getting Started Guide* or *Quick Start Guide* for your router or switch.

To delete a license key from the router or switch with the CLI:

1. Enter operational mode in the CLI.
2. Enter the following command for each license, specifying the license ID. You can delete only one license at a time.

```
user@host> request system license delete license-id
```

- Go on to [“Verifying Junos OS License Installation” on page 74](#).



NOTE: Deleting a license key from the router or switch might be delayed if a kernel resynchronization operation is in progress at that time. The following message is displayed on the CLI when the license-deleting operation is about to be delayed:

A kernel re-sync operation is in progress. License update may take several minutes to complete.

Related Documentation

- [Junos OS Feature Licenses on page 9](#)
- Software Features That Require Licenses on the QFX Series
- [License Key Components on page 69](#)
- [Adding New Licenses on page 71](#)
- [Saving License Keys on page 73](#)
- [Verifying Junos OS License Installation on page 74](#)
- `request system license delete`

Saving License Keys

Before saving a license, establish basic network connectivity with the router or switch. For instructions on establishing basic connectivity, see the *Getting Started Guide* or *Quick Start Guide* for your router or switch.

To save the licenses installed on the router or switch to a file using the CLI:

- Enter operational mode in the CLI.
- To save the installed license keys to a file or URL, enter the following command:

```
user@host> request system license save filename | url
```

For example, the following command saves the installed license keys to a file named `license.config`:

```
user@host> request system license save ftp://user@host/license.config
```

- Go on to [“Verifying Junos OS License Installation” on page 74](#).

Related Documentation

- [Junos OS Feature Licenses on page 9](#)
- Software Features That Require Licenses on the QFX Series
- [License Key Components on page 69](#)
- `request system license save`
- [Deleting a License on page 72](#)

- [Verifying Junos OS License Installation on page 74](#)

Verifying Junos OS License Installation

To verify Junos OS license management, perform the following tasks:

- [Displaying Installed Licenses on page 74](#)
- [Displaying License Usage on page 75](#)

Displaying Installed Licenses

Purpose Verify that the expected licenses are installed and active on the router or switch.

Action From the CLI, enter the **show system license** command.

Sample Output

```
user@host> show system license
```

```
License usage:
```

Feature name	Licenses used	Licenses installed	Licenses needed	Expiry
subscriber-acct	0	1	0	permanent
subscriber-auth	0	1	0	permanent
subscriber-addr	0	1	0	permanent
subscriber-vlan	0	1	0	permanent
subscriber-ip	0	1	0	permanent
scale-subscriber	0	1000	0	permanent
scale-l2tp	0	1000	0	permanent
scale-mobile-ip	0	1000	0	permanent

```
Licenses installed:
```

```
License identifier: E000185416
```

```
License version: 2
```

```
Features:
```

```
subscriber-acct - Per Subscriber Radius Accounting
permanent
subscriber-auth - Per Subscriber Radius Authentication
permanent
subscriber-addr - Address Pool Assignment
permanent
subscriber-vlan - Dynamic Auto-sensed Vlan
permanent
subscriber-ip - Dynamic and Static IP
permanent
```

Meaning The output shows a list of the license usage and a list of the licenses installed on the router or switch. Verify the following information:

- Each license is present. Licenses are listed in ascending alphanumeric order by license ID.
- The state of each license is **permanent**.



NOTE: A state of invalid indicates that the license key is not a valid license key. Either it was entered incorrectly or it is not valid for the specific device.

- The feature for each license is the expected feature. The features enabled are listed by license. An all-inclusive license has all features listed.
- All configured features have the required licenses installed. The Licenses needed column must show that no licenses are required.

Displaying License Usage

Purpose Verify that the licenses fully cover the feature configuration on the router or switch.

Action From the CLI, enter the **show system license usage** command.

Sample Output

```
user@host> show system license usage
```

	Licenses	Licenses	Licenses	Expiry
Feature name	used	installed	needed	
subscriber-addr	1	0	1	29 days
scale-subscriber	0	1000	0	permanent
scale-l2tp	0	1000	0	permanent
scale-mobile-ip	0	1000	0	permanent

Meaning The output shows any licenses installed on the router or switch and how they are used. Verify the following information:

- Any configured licenses appear in the output. The output lists features in ascending alphabetical order by license name. The number of licenses appears in the third column. Verify that you have installed the appropriate number of licenses.
- The number of licenses used matches the number of configured features. If a licensed feature is configured, the feature is considered used. The sample output shows that the subscriber address pooling feature is configured.
- A license is installed on the router or switch for each configured feature. For every feature configured that does not have a license, one license is needed.

For example, the sample output shows that the subscriber address feature is configured but that the license for the feature has not yet been installed. The license must be installed within the remaining grace period to be in compliance.

PART 4

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