Junos® OS

Getting Started Guide for Routing Devices

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Juniper Networks, Inc.
1133 Innovation Way
Sunnyvale, California 94089
USA
408-745-2000
www.juniper.net

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Junos® OS Getting Started Guide for Routing Devices
14.2
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For the features described in this document, the following platforms are supported:

- ACX Series
- M Series
- MX Series
- T Series
- J Series
- PTX Series

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Using the Examples in This Manual

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

If the example configuration contains the top level of the hierarchy (or multiple hierarchies), the example is a *full example*. In this case, use the **load merge** command.

If the example configuration does not start at the top level of the hierarchy, the example is a *snippet*. In this case, use the **load merge relative** command. These procedures are described in the following sections.

Merging a Full Example

To merge a full example, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration example into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following configuration to a file and name the file **ex-script.conf**. Copy the **ex-script.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   system {
     scripts {
       commit {
         file ex-script.xsl;
       }
     }
   }
   interfaces {
     fxp0 {
       disable;
       unit 0 {
         family inet {
           address 10.0.0.1/24;
         }
       }
     }
   }
   ```

2. Merge the contents of the file into your routing platform configuration by issuing the **load merge** configuration mode command:

   ```
   [edit]
   user@host# load merge /var/tmp/ex-script.conf
   load complete
   ```


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Merging a Snippet

To merge a snippet, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration snippet into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following snippet to a file and name the file **ex-script-snippet.conf**. Copy the **ex-script-snippet.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   commit {
     file ex-script-snippet.xsl; }
   ```

2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

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

3. Merge the contents of the file into your routing platform configuration by issuing the **load merge relative** configuration mode command:

   ```
   [edit system scripts]
   user@host# load merge relative /var/tmp/ex-script-snippet.conf
   load complete
   ```

For more information about the **load** command, see the *CLI User Guide*.

Documentation Conventions

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

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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.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page xii 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`
Italic text like this	• Introduces or emphasizes important new terms. • Identifies guide names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS CLI User Guide* • RFC 1997, *BGP Communities Attribute*
Italic text like this	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** *domain-name*

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

Convention	Description	Examples
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	• 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)	Encloses optional keywords or variables.	**stub <default-metric *metric*>;**
| (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** **(*string1* | *string2* | *string3*)**
# (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)	Encloses a variable for which you can substitute one or more values.	**community name members [*community-ids*]**

Indention and braces ({ })	Identifies a level in the configuration hierarchy.	[edit]
		routing-options {
		  static {
		  route default {
		  nexthop *address*;
		  retain;
		  }
		  }
		}

; (semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
GUI Conventions		
Bold text like this	Represents graphical user interface (GUI) items you click or select.	• In the Logical Interfaces box, select **All Interfaces**. • To cancel the configuration, click **Cancel**.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select **Protocols>Ospf**.

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- Product warranties—For product warranty information, visit http://www.juniper.net/support/warranty/.
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- Find product documentation: http://www.juniper.net/techpubs/
- Find solutions and answer questions using our Knowledge Base: http://kb.juniper.net/
- Download the latest versions of software and review release notes: http://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: http://kb.juniper.net/InfoCenter/
- 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/

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- 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).

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CHAPTER 1

Accessing a Junos OS Device

Understanding the Console Port

Console ports allow root access to the Junos operating system (Junos OS) devices through a terminal or laptop interface, regardless of the state of the Junos OS device, unless it is completely powered off. By connecting to the console port, you can access the root level of the Junos OS device without using the network to which the device might or might not be connected. This creates a secondary path to the Junos OS device without relying on the network.

Using the terminal interface provides a technician sitting in a Network Operations Center a long distance away the ability to restore a Junos OS device or perform an initialization configuration securely, using a modem, even if the primary network has failed. Without a connection to the console port, a technician would have to visit the site to perform repairs or initialization. A remote connection to the Junos OS device through a modem requires the cable and connector (provided in the device accessory box), plus a DB-9 male to DB-25 male (or similar) adapter for your modem, which you must purchase separately. For more information about connecting to the console port, see the administration guide for your particular router or switch.

To configure the device initially, you must connect a terminal or laptop computer to the device through the console port, as shown in Figure 1 on page 18.

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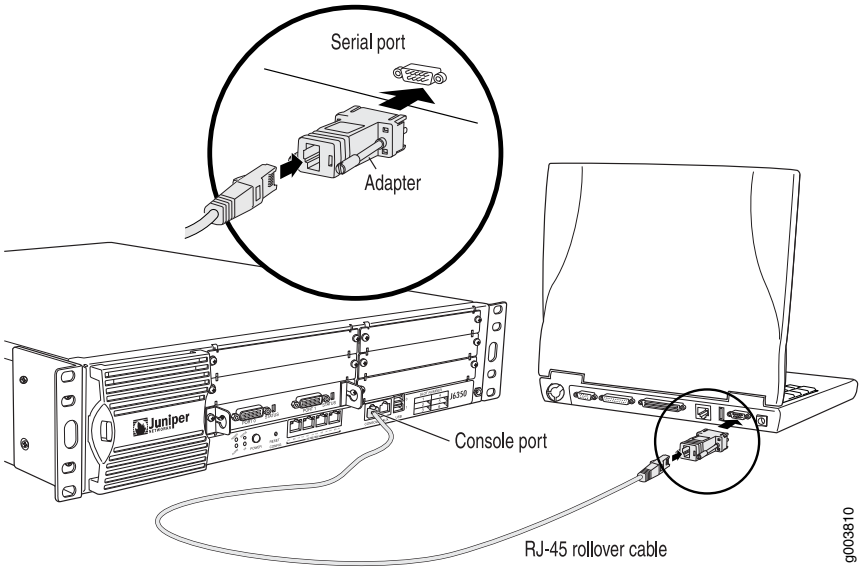
Figure 1: Connecting to the Console Port on a Junos OS Device



Related Documentation

- Accessing a Junos OS Device the First Time on page 18

Accessing a Junos OS Device the First Time

When you power on a Junos OS device the first time, Junos OS automatically boots and starts.

To configure the device initially, you must connect a terminal or laptop computer to the device through the console port—a serial port on the front of the router. Only console access to the device is enabled by default. Remote management access to the router and all management access protocols, including Telnet, FTP, and SSH, are disabled by default.

To access a Junos OS device the first time:

1. Connect a terminal or laptop computer to the Junos OS device through the console port—a serial port on the front of the device.
2. Power on the device and wait for it to boot.

   Junos OS boots automatically. The boot process is complete when you see the **login:** prompt on the console.
3. Log in as the user **root**.

   Initially, the root user account requires no password. You can see that you are the **root** user, because the prompt on the device shows the username **root@#**.
4. Start the Junos OS command-line interface (CLI).

   ```
   root@# cli
   root@>
   ```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5. Enter Junos OS configuration mode.

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

Related Documentation

- Understanding the Root Password on page 21
- Protecting Network Security by Configuring the Root Password on page 22
- Recovering the Root Password on page 24

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CHAPTER 2

Configuring the Root Password

Understanding the Root Password

The root user has complete privileges to operate and configure the Junos OS device, perform upgrades, and manage files in the file system. Initially, the root password is not defined on the Junos OS device. To ensure basic security, you must define the root password during initial configuration. If a root password is not defined, you cannot commit configuration settings on the device.

NOTE: If you use a plain text password, Junos OS displays the password as an encrypted string so that users viewing the configuration cannot see it.

The root password must meet the following conditions:

- Be at least six characters long. Most character classes can be included in a password (alphabetic, numeric, and special characters), except control characters.
- Contain at least one change of case or character class.

Related Documentation

- Protecting Network Security by Configuring the Root Password on page 22

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Protecting Network Security by Configuring the Root Password

Configuring the root password on your Junos OS-enabled router helps prevent unauthorized users from making changes to your network. The root user (also referred to as superuser) has unrestricted access and full permissions within the system, so it is crucial to protect these functions by setting a strong password when setting up a new router.

After a new router is initially powered on, you log in as the user **root** with no password. Junos OS requires configuration of the root password before it accepts a commit operation. On a new device, the root password must always be a part of the configuration submitted with your initial commit.

To set the root password, you have a few options as shown in Step 1 of the following procedure.

- Enter a plain-text password that Junos OS encrypts.
- Enter a password that is already encrypted.
- Enter a secure shell (ssh) public key string.

The most secure options of these three are using an already encrypted password or an ssh public key string. Pre-encrypting your password or using a ssh public key string means the plain-text version of your password will never be transferred over the internet, protecting it from being intercepted by a man-in-the-middle attack.

BEST PRACTICE: **Optionally, instead of configuring the root password at the [edit system] hierarchy level, you can use a configuration group to strengthen security, as shown in Step 2 of this procedure. This step uses a group called global as an example.**

To set the root password:

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1. Use one of these methods to configure the root password:

   - To enter a plain-text password that the system encrypts for you:

     ```
     [edit groups global system]
     root@# set root-authentication plain-text-password
     New Password: type password here
     Retype new password: retype password here
     ```

     If you use a plain-text password, Junos OS displays the password as an encrypted string so that users viewing the configuration cannot see it. As you enter the password in plain text, Junos OS encrypts it immediately. You do not have to configure Junos OS to encrypt the password as in some other systems. Plain-text passwords are hidden and marked as **## SECRET-DATA** in the configuration.

   - To enter a password that is already encrypted:

     

     CAUTION: Do not use the **encrypted-password** option unless the password is *already* encrypted, and you are entering the encrypted version of the password.

     If you accidentally configure the **encrypted-password** option with a plain-text password or with blank quotation marks (" "), you will not be able to log in to the device as root, and you will need to complete the root password recovery process.

     ```
     [edit groups global system]
     root@# set root-authentication encrypted-password password
     ```

   - To enter an ssh public key string:

     ```
     [edit groups global system]
     root@# set root-authentication (ssh-dsa | ssh-ecdsa | ssh-rsa key)
     ```

2. (Optional) Strengthen security by only allowing root access from the console port.

   ```
   [edit groups global system]
   root@# set services ssh root-login deny
   ```

3. If you used a configuration group in Step 2, apply the configuration group, substituting **global** with the appropriate group name.

   ```
   [edit]
   user@host# set apply-groups global
   ```

4. Commit the changes.

   ```
   root@# commit
   ```

Related Documentation

- Accessing a Junos OS Device the First Time on page 18
- Understanding User Accounts on page 43
- Recovering the Root Password on page 24

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Recovering the Root Password

If you forget the root password for the router, you can use the password recovery procedure to reset the root password.

NOTE: You need console access to recover the root password.

Video: Recovering the Root Password

To recover the root password:

1. Power off the router by pressing the power button on the front panel.
2. Turn off the power to the management device, such as a PC or laptop computer, that you want to use to access the CLI.
3. Plug one end of the Ethernet rollover cable supplied with the router into the RJ-45–to–DB-9 serial port adapter supplied with the router.
4. Plug the RJ-45–to–DB-9 serial port adapter into the serial port on the management device.
5. Connect the other end of the Ethernet rollover cable to the console port on the router.
6. Turn on the power to the management device.
7. On the management device, start your asynchronous terminal emulation application (such as Microsoft Windows Hyperterminal) and select the appropriate COM port to use (for example, COM1).
8. Configure the port settings as follows:
   - Bits per second: 9600
   - Data bits: 8
   - Parity: None
   - Stop bits: 1
   - Flow control: None
9. Power on the router by pressing the power button on the front panel.

   Verify that the POWER LED on the front panel turns green.

   The terminal emulation screen on your management device displays the router's boot sequence.
10. When the following prompt appears, press the Spacebar to access the router's bootstrap loader command prompt:

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Depending on your device hardware, the bootstrap loader might proceed quite quickly at this step without pausing for input. Therefore, you might need to press the spacebar multiple times at the beginning of the boot sequence.

```
Hit [Enter] to boot immediately, or space bar for command prompt.
Booting [kernel] in 9 seconds...
```

11. At the following prompt, type **boot -s** to start the system in single-user mode.

```
ok boot -s
```

12. At the following prompt, type **recovery** to start the root password recovery procedure.

```
Enter full pathname of shell or 'recovery' for root password recovery or RETURN
for /bin/sh: recovery
```

13. Enter configuration mode in the CLI.
14. Set the root password.

When you configure a plain-text password, Junos OS encrypts the password for you.

CAUTION: Do not use the encrypted-password option unless the password is *already* encrypted, and you are entering the encrypted version of the password. If you commit the encrypted-password option with a plain-text password or with blank quotation marks (" "), you will not be able to log in to the device as root, and you will need to repeat this password recovery process.

Optionally, instead of configuring the root password at the **[edit system]** hierarchy level, you can use a configuration group, as shown in this procedure. This is a recommended best practice for configuring the root password.

For example:

```
user@host# set groups global system root-authentication plain-text-password
```

15. At the following prompt, enter the new root password, for example:

```
New password: password
Retype new password:
```

16. At the second prompt, reenter the new root password.
17. If you used a configuration group, apply the configuration group, substituting **global** with the appropriate group name.

```
[edit]
user@host# set apply-groups global
```

18. After you have finished configuring the password, commit the configuration.

```
root@host# commit
commit complete
```

19. Exit configuration mode in the CLI.
20. Exit operational mode in the CLI.
21. At the prompt, type **y** to reboot the router.

```
Reboot the system? [y/n] y
```

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Related Documentation

- *Configuring the Root Password*

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CHAPTER 3

Configuring the Hostname

Understanding Hostnames

Almost all devices in your network have a hostname.

The hostname is the name that identifies the device on the network and is easier to remember than an IP address. When you first power on a Juniper Networks router, switch, or security device, the default hostname is Amnesiac. The Amnesiac prompt is indicative of a device that is booting from a factory-fresh Junos OS software load, which, by definition, does not have a hostname configured.

Administrators often follow conventions for naming devices. One such convention is to name the device based on its location, for example: germany-berlin-R1. The hostname should be unique within your network infrastructure, but there is no need for the local hostname to be globally unique.

A device's hostname usually has a corresponding entry in the domain name system (DNS) so that administrators can connect to the device using the hostname. The fully qualified domain name (FQDN), which is used in DNS, includes the hostname and the domain name. The hostname and the domain name labels are separated by periods or dots, as follows: *hostname.domain*. For example, if the hostname is germany-berlin-R1 and the domain name is emea, the FQDN is germany-berlin-R1.emea. If the emea domain is registered and can be reached as emea.net on the Internet, the FQDN for the device is germany-berlin-R1.emea.net. The FQDN is globally unique.

In Junos OS, the hostname can contain any combination of alphabetic characters, numbers, dashes, and underscores. No other special characters are allowed.

Although Junos OS allows hostnames to contain up to 255 characters, keep in mind that the total length of the hostname as an FQDN cannot exceed 255 characters (including the delimiting dots), with each domain name label having a maximum length of 63 characters. In any case, an overly long hostname is difficult to type and to remember, so short and meaningful hostnames are a best practice.

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Related Documentation

- Configuring the Hostname of a Router or Switch by Using a Configuration Group on page 28

Configuring the Hostname of a Router or Switch by Using a Configuration Group

The hostname of a device is its identification. A router or switch must have its identity established to be accessible on the network to other devices. That is perhaps the most important reason to have a hostname, but a hostname has other purposes: Junos OS uses the configured hostname as part of the command prompt, to prepend log files and other accounting information, as well as in other places where knowing the device identity is useful. We recommend that the hostname be descriptive and memorable.

You can configure the hostname at the **[edit system]** hierarchy level, a procedure shown in *Example: Configuring the Unique Identity of a Router for Making it Accessible on the Network*. Optionally, instead of configuring the hostname at the **[edit system]** hierarchy level, you can use a configuration group, as shown in this procedure. This is a recommended best practice for configuring the hostname, especially if the device has dual Routing Engines. This procedure uses groups called **re0** and **re1** as an example.

To set the hostname using a configuration group:

1. Include the **host-name** statement in the configuration at the **[edit groups *group-name* system** hierarchy level.

   The name value must be less than 256 characters.

   ```
   [edit groups group-name system]
   host-name hostname;
   ```

   For example:

   ```
   [edit groups re0 system]
   root@# set host-name san-jose-router

   [edit groups re1 system]
   root@# set host-name san-jose-router1
   ```

2. If you used one or more configuration groups, apply the configuration groups, substituting the appropriate group names.

   For example:

   ```
   [edit]
   user@host# set apply-groups [re0 re1]
   ```

3. Commit the changes.

   ```
   [edit]
   root@# commit
   ```

   The hostname subsequently appears in the device CLI prompt.

   ```
   san-jose-router@#
   ```

Related Documentation

- Understanding Hostnames on page 27

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CHAPTER 4

Configuring DNS

Understanding DNS

A domain name system (DNS) is a distributed hierarchical system that converts hostnames to IP addresses. DNS is divided into sections called zones. Each zone has name servers that respond to the queries belonging to their zones.

It is easier for most people to remember names rather than numbers especially if those numbers are IPv4 or IPv6 addresses. Because of this, DNS servers are used to map device hostnames to IP addresses. DNS allows you to use names to designate key external systems such as file and log servers that your device might need to contact. The DNS server maintains a centralized repository for device hostnames on the network, ensuring that each device hostname is unique. This centralized repository makes it easier to query and to administer translations between the network IP addresses and hostnames. You can configure your device to query one or more DNS servers by specifying the DNS server IP addresses in your Junos OS configuration.

DNS Components

DNS includes three main components:

- DNS resolver—Resides on the client side of the DNS. When a user sends a hostname request, the resolver sends a DNS query request to the name server to request the hostname's IP address.
- Name server—Processes the DNS query requests received from the DNS resolver and returns the IP address to the resolver.
- Resource records—Data elements that define the basic structure and content of DNS.

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DNS Server Caching

A DNS name server is responsible for providing the hostname IP address to users. The TTL field in the resource record defines the period for which DNS query results are cached. When the TTL value expires, the name server sends a fresh DNS query and updates the cache.

Related Documentation

- Example: Configuring the TTL Value for DNS Server Caching on page 32

Reaching a Domain Name System Server

Domain name system (DNS) servers are used for resolving hostnames to IP addresses.

For redundancy, it is a best practice to configure access to multiple DNS servers. You can configure a maximum of three DNS servers. The approach is similar to the way Web browsers resolve the names of a Web site to its network address. Additionally, Junos OS enables you configure one or more domain names, which it uses to resolve hostnames that are not fully qualified (in other words, the domain name is missing). This is convenient because you can use a hostname in configuring and operating Junos OS without the need to reference the full domain name. After adding DNS server addresses and domain names to your Junos OS configuration, you can use DNS resolvable hostnames in your configuration and commands instead of IP addresses.

Optionally, instead of configuring the name server at the **[edit system]** hierarchy level, you can use a configuration group, as shown in this procedure. This is a recommended best practice for configuring the name server. This procedure uses a group called **global** as an example.

Before you begin, configure your DNS servers with the hostname and an IP address for your Junos OS device. It does not matter which IP address you assign as the address of your Junos OS device in the DNS server, as long it is an address that reaches your device. Normally, you would use the management interface IP address, but you can choose the loopback interface IP address, or a network interface IP address, or even configure multiple addresses on the DNS server.

To configure the router or switch to resolve hostnames into addresses:

1. Reference the IP addresses of your DNS servers.

   ```
   [edit groups group-name system]
   name-server {
     address;
   }
   ```

   The following example shows how to reference two DNS servers:

   ```
   [edit groups global system]
   user@host# set name-server 192.168.1.253
   user@host# set name-server 192.168.1.254


   user@host# show
   ```


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```
name server {
  192.168.1.253;
  192.168.1.254;
}
```

2. (Optional) Configure the name of the domain in which the device itself is located.

   This is a good practice. Junos OS then uses this configured domain name as the default domain name to append to hostnames that are not fully qualified.

   ```
   [edit system]
   domain-name domain-name;
   ```

   The following example shows how to configure the domain name:

   ```
   [edit groups global system]
   user@host# set domain-name company.net


   user@host# show
   domain-name company.net;
   ```

3. (Optional) Configure a list of domains to be searched.

   If your device can reach several different domains, you can configure these as a list of domains to be searched. Junos OS then uses this list to set an order in which it appends domain names when searching for the IP address of a host.

   ```
   [edit groups global system]
   domain-search [ domain-list ];
   ```

   The domain list can contain up to six domain names, with a total of up to 256 characters.

   The following example shows how to configure two domains to be searched. This example configures Junos OS to search the company.net domain and then the domainone.net domain and then the domainonealternate.com domain when attempting to resolve unqualified hosts.

   ```
   [edit groups global system]
   domain-search [ company.net domainone.net domainonealternate.com ]
   ```

4. If you used a configuration group, apply the configuration group, substituting **global** with the appropriate group name.

   ```
   [edit]
   user@host# set apply-groups global
   ```

5. Commit the configuration.

   ```
   user@host# commit
   ```

6. Verify the configuration.

   If you have configured your DNS server with the hostname and an IP address for your Junos OS device, you can issue the following commands to confirm that DNS is working and reachable. You can either use the configured hostname to confirm resolution to the IP address or use the IP address of your device to confirm resolution to the configured hostname.

   ```
   user@host> show host host-name
   user@host> show host host-ip-address
   ```

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For example:

```
user@host> show host san-jose-router1
san-jose-router1.company.net
san-jose-router1.company.net has address 192.168.187.1

user@host> show host 192.168.187.1
1.187.168.192.in-addr.arpa domain name pointer san-jose-router1.company.net.
```

Related Documentation

- Understanding DNS on page 29

Example: Configuring the TTL Value for DNS Server Caching

This example shows how to configure the TTL value for a DNS server cache to define the period for which DNS query results are cached.

Requirements

No special configuration beyond device initialization is required before performing this task.

Overview

The DNS name server stores DNS query responses in its cache for the TTL period specified in the TTL field of the resource record. When the TTL value expires, the name server sends a fresh DNS query and updates the cache. You can configure the TTL value from 0 to 604,800 seconds. You can also configure the TTL value for cached negative responses. Negative caching is the storing of the record that a value does not exist. In this example, you set the maximum TTL value for cached (and negative cached) responses to 86,400 seconds.

Configuration

Step-by-Step Procedure

To configure the TTL value for a DNS server cache:

1. Specify the maximum TTL value for cached responses, in seconds.

   ```
   [edit]
   user@host# set system services dns max-cache-ttl 86400
   ```

2. Specify the maximum TTL value for negative cached responses, in seconds.

   ```
   [edit]
   user@host# set system services dns max-ncache-ttl 86400
   ```

3. If you are done configuring the device, commit the configuration.

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


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Verification

To verify the configuration is working properly, enter the **show system services** command.

Related Documentation

- Understanding DNS on page 29

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CHAPTER 5

Configuring Management and Loopback Interfaces

Understanding Management Ethernet Interfaces

Management interfaces are the primary interfaces for accessing the device remotely. Typically, a management interface is not connected to the in-band network, but is connected instead to the device's internal network. Through a management interface you can access the device over the network using utilities such as **ssh** and **telnet** and configure the device from anywhere, regardless of its physical location. SNMP can use the management interface to gather statistics from the device.

A management interface lets authorized users and management systems connect to the device over the network. Some Juniper Networks devices have a dedicated management port on the front panel. For other types of platforms, you can configure a management interface on one of the network interfaces. This interface can be dedicated to management or shared with other traffic. Before users can access the management interface, you must configure it. Information required to set up the management interface includes its IP address and prefix. In many types of Junos OS devices (or recommended configurations), it is not possible to route traffic between the management interface and the other ports. Therefore, you should select an IP address in a separate (logical) network, with a separate prefix (netmask).

For devices with dedicated management ports, Junos OS automatically configures the router's management Ethernet interface, as either em0 or fxp0. You can use the **show interfaces terse | match fxp0** or **show interfaces terse | match em0** command to display management interface information.

To use the management Ethernet interface as a management port, you must configure its logical port, em0.0 or fxp0.0, with a valid IP address.

For some SRX Series Services Gateways and J Series Services Routers, you can use any of the built-in Ethernet ports as a management interface. To use a built-in interface as

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a management Ethernet interface, configure it with a valid IP address. The factory configuration for the J4350 and J6350 Services Routers automatically enables the J-Web user interface on the ge-0/0/0, ge-0/0/1, ge-0/0/2, and ge-0/0/3 interfaces. To manually configure J-Web access, include the **interface *interface-name*** statement at the **[edit system services web-management http]** hierarchy level.

For PTX Series Packet Transport Routers, the Junos OS automatically creates the router's management Ethernet interface, **em0**. To use **em0** as an out-of-band management port, you must configure its logical port (for example, **em0.0**) with a valid IP address.

Internal Ethernet interfaces are automatically created to connect the Routing Engines to the Packet Forwarding Engines in the FPCs.

When you enter the **show interfaces** command on a PTX Series Packet Transport Router, the management Ethernet interface and internal Ethernet interfaces (and logical interfaces) are displayed:

```
user@host> show interfaces ?
...
em0
  em0.0
  ixgbe0
  ixgbe0.0
  ixgbe1
  ixgbe1.0
...
```


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NOTE: *Routing Engine upgrade considerations*—When upgrading to a Routing Engine that supports em0 from a Routing Engine that supports fxp0, you must convert existing management Ethernet interface references in the router configuration files from fxp0, fxp1, or fxp2 interfaces to em0 interfaces. Whether you use an automated script or edit the configuration files manually, you must revise any command lines that reference the fxp0 management Ethernet interface by replacing "fxp0" with "em0."

Reusing scripts for standalone T1600 routers on T1600 routers in a routing matrix—Automated scripts that you have developed for standalone T1600 routers (T1600 routers that are not in a routing matrix) might contain references to the fxp0 management Ethernet interface. Before reusing the scripts on T1600 routers in a routing matrix, edit the command lines that reference the fxp0 management Ethernet interface so that the commands reference the em0 management Ethernet interface instead.

Restricted load-sharing next hops with fxp0—On M Series Multiservices Edge Routers and T Series Core Routers running Junos OS later than Release 7.0R2.7 or Release 7.1R2.2, the fxp0 interface does not support load-sharing next hops. This restriction only affects fxp0 routes.

CoS not supported on fxp0—The fxp0 interface does not support class of service (CoS).

The Routing Engines in the PTX Series Packet Transport Routers do not support the management Ethernet interface fxp0, or the internal Ethernet interfaces fxp1 or fxp2.

Related Documentation

- *Supported Routing Engines by Router*

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Configuring a Management Interface on a Dedicated Management Port

Management interfaces are the primary interfaces for accessing the device remotely. Typically, a management interface is not connected to the in-band network, but is connected instead to the device's internal network. Through a management interface you can access the device over the network using utilities such as **ssh** and **telnet** and configure the device from anywhere, regardless of its physical location. SNMP can use the management interface to gather statistics from the device.

Many types of Junos OS platforms include a dedicated management port on the front panel. For others, you can configure one of the Ethernet ports to act as the management interface. Platforms that use a network Ethernet interface for management include some SRX Series devices. A network interface can be configured as being dedicated to out-of-band management or as being shared by both management and network traffic.

Even if your device has a dedicated management port, you might prefer to configure a network interface to carry management traffic. For example, your organization might use this approach when cost does not justify a separate management infrastructure.

A dedicated management port supports out-of-band management access with complete physical separation from network traffic within your device. This approach limits access to your device, and thereby the potential for issues. Further, because it only carries management traffic, the management port is fully available to you for analyzing and reacting to issues if your device happens to be under attack.

Configuration of the dedicated management port requires assignment of the IP address that you want to use as the management interface. The interface name that you use depends on the type of device that you are setting up. Some devices use me0, some use fxp0, and some use em0.

To configure a dedicated management port:

1. Run the **show interfaces terse** command to determine the name of the dedicated management port on your device.

   In this example, the device uses fxp0 as its dedicated management port.

   ```
   user@host> show interfaces terse | match me0

   user@host> show interfaces terse | match em0

   user@host> show interfaces terse | match fxp0
   fxp0                    up    up
   ```

2. Configure the IP address for this device's dedicated management port.

   ```
   [edit interfaces fxp0 unit 0 family inet]
   user@host# set address 192.168.187.1/25
   ```

   Optionally, instead of configuring the dedicated management port at the **[edit interfaces]** hierarchy level, you can use configuration groups. This is a recommended best practice, especially if the device has dual Routing Engines.

   ```
   [edit groups re0 interfaces fxp0 unit 0 family inet]
   user@host# set address 192.168.187.1/25
   ```


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```
[edit groups re1 interfaces fxp0 unit 0 family inet]
user@host# set address 192.168.187.2/25

[edit]
user@host# set apply-groups re0
user@host# set apply-groups re1
```

3. Commit the configuration.

```
user@host# commit
```

4. Confirm the configuration by making sure that the IP address is configured.

```
user@host> show interfaces terse | match fxp0
fxp0                    up    up
fxp0.0                  up    up   inet     192.168.187.1/25
```

If **telnet** or **ssh** access is enabled, log in to the device remotely, using the newly configured IP address.

Related Documentation

- Understanding Management Ethernet Interfaces on page 35
- http://www.juniper.net/us/en/local/pdf/implementation-guides/8010010-en.pdf

Understanding the Loopback Interface

Most of the addresses you configure on your device are physical interfaces. However, the loopback interface is a virtual interface—an interface not associated with any hardware or network. While physical interfaces might be removed or their addresses changed, the loopback address never changes. The loopback address has many different uses in the operation and management of the network.

The loopback interface (lo0) has several uses, depending on the particular Junos OS feature being configured. It can perform the following functions:

- Device identification—The loopback interface is used to identify the device. While any interface address can be used to determine if the device is online, the loopback address is the preferred method. Whereas interfaces might be removed or addresses changed based on network topology changes, the loopback interface address never changes and is always up if the device is up.

  When you ping an individual network interface address, the results do not always indicate the health of the device. For example, a subnet mismatch in the configuration of two endpoints on a point-to-point link makes the link appear to be inoperable. Pinging the interface to determine whether the device is online provides a misleading result. An interface might be unavailable because of a problem unrelated to the device's configuration or operation.

- Routing information—The loopback address is used by protocols such as OSPF to determine protocol-specific properties for the device or network. Further, some commands such as **ping mpls** require a loopback address to function correctly.

- Packet filtering—Stateless firewall filters can be applied to the loopback address to filter packets originating from, or destined for, the Routing Engine.

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The Internet Protocol (IP) specifies a loopback network with the (IPv4) address 127.0.0.0/8. Most IP implementations support a loopback interface (lo0) to represent the loopback facility. The most commonly used loopback IP address is 127.0.0.1 for IPv4 and ::1 for IPv6. The standard domain name for the address is localhost. On the lo0.0 interface, it is useful to have the IP address 127.0.0.1 or ::1 (or both) configured, as certain processes such as NTP and MPLS ping use this default host address The 127.0.0.1/32 and ::1 addresses are martian IP addresses. Martian IP addresses are invalid for routing, so are never advertised by the Juniper Networks device.

In addition to the localhost 127.0.0.1 or ::1 address, it is important to configure at least one loopback interface address that is valid for routing and that is unique in your network infrastructure so that it can be used for device identification.

The device also includes an internal loopback address (lo0.16384). The internal loopback address is a particular instance of the loopback address with the logical unit number 16384. Junos OS creates the loopback interface for the internal routing instance. This interface prevents any filter on lo0.0 from disrupting internal traffic.

Related Documentation

- Configuring a Loopback Interface on page 40
- *Junos OS Network Interfaces Library for Routing Devices*

Configuring a Loopback Interface

The loopback interface supports many different network and operational functions and is an *always-up* interface. This means that the loopback interface ensures that the device is reachable, even if some of the physical interfaces are down or removed, or an IP address has changed. In most cases, you always define a loopback interface.

Junos OS follows the IP convention of identifying the loopback interface as lo0.

Junos OS requires that the loopback interface always be configured with a /32 network mask, thus avoiding any unnecessary allocation of address space.

If you are using routing instances, you can configure the loopback interface for the default routing instance or for a specific routing instance. The following procedure adds the loopback interface to the default routing instance.

Optionally, instead of configuring the loopback interface at the **[edit interfaces]** hierarchy level, you can use a configuration group, as shown in this procedure. This is a recommended best practice for configuring the loopback interface. This procedure uses a group called **global** as an example.

To configure a loopback interface:

1. Using the host IP address, assign it to the loopback interface.

   Each host in your network deployment should have a unique loopback interface address. The address used here is only an example.

   ```
   [edit groups global interfaces lo0 unit 0 family inet]
   user@host# set address 192.26.0.110/32
   ```


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2. (Optional) Set the preferred IP address.

   You can configure as many addresses as you need on the lo0 interface, so it is good practice to designate one preferred IP address.

   ```
   [edit groups global interfaces lo0 unit 0 family inet]
   user@host# set address 192.26.0.110/32 preferred
   ```

3. (Optional) Configure additional addresses.

   Only unit 0 is permitted as the master loopback interface. If you want to add more IP addresses to unit 0, you configure them in the normal way under unit 0, without the **preferred** option.

   ```
   [edit groups global interfaces lo0 unit 0 family inet]
   user@host# set address 192.168.1.1/32
   user@host# set address 192.168.2.1/32
   ```

4. Configure the localhost address.

   On the lo0.0 interface, it is useful to have the IP address 127.0.0.1 configured, as certain processes such as NTP and MPLS ping use this default host address. The 127.0.0.1/32 address is a Martian IP address (an address invalid for routing), so it is never advertised by the Juniper Networks device.

   ```
   [edit groups global interfaces lo0 unit 0 family inet]
   user@host# set address 127.0.0.1/32
   ```

5. (Optional) Configure an ISO address.

   Depending on your network configuration, you might also need an ISO address for the IS-IS routing protocol.

   ```
   [edit groups global interfaces lo0 unit 0 family iso]
   user@host# address 49.0026.0000.0000.0110.00
   ```

6. If you used a configuration group, apply the configuration group, substituting **global** with the appropriate group name.

   ```
   [edit]
   user@host# set apply-groups global
   ```

7. Commit the configuration.

   ```
   user@host# commit
   ```

Related Documentation

- Understanding the Loopback Interface on page 39

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CHAPTER 6

Configuring User Accounts

Understanding User Accounts

User accounts provide one way for users to access the device. Users can access the device without accounts if you configured RADIUS or TACACS+ servers. After you have created an account, the device creates a home directory for the user. An account for the user **root** is always present in the configuration. The root account provides full administrative access to your device with complete control over its configuration and operation. The root account is often referred to as the superuser. In new devices, the root account has no password. You must add a password to the root account before you can commit any configuration.

For each user account, you can define the following:

- Username—Name that identifies the user. It must be unique within the device. Do not include spaces, control characters, colons, or commas in the username.
- User's full name—If the full name contains spaces, enclose it in quotation marks (“ ”). Do not include colons or commas.
- User identifier (UID)—Numeric identifier that is associated with the user account name. The identifier range is from 100 through 64,000 and must be unique within the device. If you do not assign a UID to a username, the software assigns one when you commit the configuration, preferring the lowest available number.
- User's access privilege—You can create login classes with specific permission bits or use one of the predefined classes.
- Authentication method or methods and passwords that the user can use to access the device—You can use SSH or an MD5 password, or you can enter a plain-text password that Junos OS encrypts using MD5-style encryption before entering it in the password database. If you configure a plain-text-password, you are prompted to enter and confirm the password.

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The stronger you make the password, the harder it is for others to discover it and use it to break into the account. Junos OS helps to enforce the use of strong passwords. For example, password requirements are as follows:

- Be a minimum length of 6 characters.
- Contain at least one change of case or character class.
- Use at least three of the five defined character classes (uppercase letters, lowercase letters, numbers, punctuation marks, and other special characters).

BEST PRACTICE: Increase the length of the password and the minimum number of case, digit, and punctuation changes to set up safer passwords. An example of a good password would be: t3aMX*u7rS.

In addition to the root user, it is highly recommended that you create at least one other local user. You can log in as this user when you need to perform administration or maintenance tasks on the device.

NOTE: Junos-FIPS software 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 or switch, you cannot configure passwords unless they meet this standard.

Related Documentation

- *Junos OS User Accounts Overview*
- *Example: Configuring User Accounts*

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Configuring Junos OS User Accounts by Using a Configuration Group

User accounts provide a way for users to access a router or switch. Junos OS requires that all users have a predefined user account before they can log in to the device. For each user account, you define the login name for the user and, optionally, information that identifies the user. After you have created an account, the software creates a home directory for the user.

It is a common practice to use remote authentication servers to centrally store information about users. Even so, it is also a good practice to configure at least one nonroot user directly on each device, in case access to the remote authentication server is disrupted. This one nonroot user commonly has a generic name, such as **admin**.

Because user accounts are configured on multiple devices, they are commonly configured inside of a configuration group. As such, the examples shown here are in a configuration group called **global**. Using a configuration group for your user accounts is optional.

To create a user account:

1. Add a new user, using the user's assigned account login name.

   [edit groups global]
   user@host# **edit system login user user *username***

2. (Optional) Configure a full descriptive name for the account.

   If the full name includes spaces, enclose the entire name in quotation marks.

   [edit groups global system login user *user-name*]
   user@host# **set full-name *complete-name***

   For example:

   ```
   user@host# show groups
   global {
       system {
           login {
               user admin {
                   full-name "general administrator";
               }
           }
       }
   }
   ```

3. (Optional) Set the user identifier (UID) for the account.

   As with UNIX systems, the UID enforces user permissions and file access. If you do not set the UID, Junos OS assigns one for you. The format of the UID is a number in the range of 100 to 64000.

   [edit groups global system login user *user-name*]
   user@host# **set uid *uid-value***

   For example:

   ```
   user@host# show groups
   global {
   ```

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```
system {
    login {
        user admin {
            uid 9999;
        }
    }
}
```

4. Assign the user to a login class.

   You can define your own login classes or assign one of the predefined Junos OS login classes.

   The predefined login classes are as follows:

   - super-user—all permissions
   - operator—clear, network, reset, trace, and view permissions
   - read-only— view permissions
   - unauthorized—no permissions

   ```
   [edit groups global system login user user-name]
   user@host# set class class-name
   ```

   For example:

   ```
   user@host# show groups
   global {
       system {
           login {
               user admin {
                   class super-user;
               }
           }
       }
   }
   ```

5. Use one of the following methods to configure the user password.

   - To enter a clear-text password that the system encrypts for you, use the following command to set the user password:

     ```
     [edit groups global system login user user-name]
     user@host# set authentication plain-text-password password
     New Password: type password here
     Retype new password: retype password here
     ```

     As you enter the password in plain text, Junos OS encrypts it immediately. You do not have to configure Junos OS to encrypt the password as in some other systems. Plain-text passwords are therefore hidden and marked as ## SECRET-DATA in the configuration.

   - To enter a password that is already encrypted, use the following command to set the user password:

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CAUTION: Do not use the **encrypted-password** option unless the password is *already* encrypted, and you are entering the encrypted version of the password.

If you accidentally configure the **encrypted-password** option with a plain-text password or with blank quotation marks (" "), you will not be able to log in to the device as this user.

[edit groups global system login user *user-name*]
user@host# **set authentication encrypted-password "*password*"**
New Password: *type password here*
Retype new password: *retype password here*

- To load previously generated public keys from a named file at a specified URL location, use the following command to set the user password:

  [edit groups global system login user *user-name*]
  user@host# **set authentication load-key-file *URL filename***

- To enter an ssh public string, use the following command to set the user password:

  [edit groups global system login user *user-name*]
  user@host# **set authentication (ssh-dsa | ssh-ecdsa | ssh-rsa) *authorized-key***

6. At the top level of the configuration, apply the configuration group.

   If you use a configuration group, you must apply it for it to take effect.

   [edit]
   user@host# **set apply-groups global**

7. Commit the configuration.

   user@host# **commit**

8. To verify the configuration, log out and log back in as the new user.

Related Documentation

- *Defining Junos OS Login Classes*
- *Creating Login Classes with Specific Privileges*
- *Junos OS User Accounts Overview*
- *Limiting the Number of User Login Attempts for SSH and Telnet Sessions*
- *User Access and Authentication Feature Guide for Routing Devices*

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Enabling Remote Access

SSH, telnet, and FTP are widely used standards for remotely logging into network devices, and exchanging files between systems. Before authorized users can access your device, or your device can exchange data with other systems, you must configure one or more of these enabling services. They are all disabled by default in Junos OS.

SSH is a protocol that uses strong authentication and encryption for remote access across a nonsecure network. SSH provides remote login, remote program execution, file copy, and other functions. SSH is telnet's successor and is the recommended method for remote access. SSH encrypts all traffic, including passwords, to effectively eliminate eavesdropping, connection hijacking, and other attacks. The SSH utility includes SCP (secure copy), a file transfer program that uses SSH and is the recommended method for secure file exchange.

Because both telnet and FTP are legacy applications that use clear text passwords (therefore creating a potential security vulnerability), we recommend that you use SSH (and SCP). If you do not intend to use FTP or telnet, you do not need to configure them on your device. However, do not forget to consider that some users might use FTP to store configuration templates, retrieve software, or other administrative tasks.

To set up remote access and file transfer services:

1. Enable SSH access.

   ```
   [edit groups global]
   user@host# set system services ssh
   ```

2. Enable telnet access.

   ```
   [edit groups global]
   user@host# set system services telnet
   ```

3. Enable FTP.

   ```
   [edit groups global]
   user@host# set system services ftp
   ```

4. At the top level of the configuration, apply the configuration group.

   If you use a configuration group, you must apply it for it to take effect.

   ```
   [edit]
   user@host# set apply-groups global
   ```

5. Commit the configuration.

   ```
   user@host# commit
   ```

Related Documentation

- *Configuring SSH Service for Remote Access to the Router or Switch*
- *Configuring Telnet Service for Remote Access to a Router or Switch*
- *Configuring FTP Service for Remote Access to the Router or Switch*

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CHAPTER 7

Configuring Backup Routers

Understanding Backup Routers

If Junos OS is running on a routing device, you might want to specify a backup router. The purpose of the backup router is not to forward transit traffic. It is for local management of the routing device, by way of the out-of-band management interface (fxp0 or me0, for example). Traffic is not forwarded between the Packet Forwarding Engine and the management interface. You cannot route traffic between the management interface and the physical interfaces in the chassis.

The Junos OS process responsible for establishing routes is known as the routing protocol process (rpd). The backup router allows the routing device to install a route to a management network, before the routing protocol process is up and running. A backup router can be used during the initial boot process of Junos OS, before any routing protocols have converged. It allows the device to establish a Layer 3 connection quickly, thus keeping management unavailability to a minimum. In selecting a backup router, it is common practice to choose the default gateway of the management network that is directly connected to your routing device.

It is important to make sure that the specified backup router address is reachable and directly connected. The backup router address should be an address that is directly connected to the management interface.

NOTE: **Router A can be the backup router for Router B, and Router B can be the backup router for Router A if the management interface of each router is connected to an interface on the other router, thus providing the necessary reachability.**

When the routing protocol process starts, the backup route (the route created by the backup router) is removed, and any default, static, or protocol-learned routes are installed.

If the routing device has a backup Routing Engine (usually RE1), the backup router remains active, unless nonstop active routing is configured.

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Related Documentation

- Configuring a Backup Router on page 50

Configuring a Backup Router

The backup router allows the routing device to install a route to the management network, before the routing protocol process (rpd) is up and running. This allows the device to establish a Layer 3 connection quickly, thus keeping management unavailability to a minimum.

When a routing device is booting, the routing protocol process is not running. Therefore, the router or switch has no routes. To ensure that the router or switch is reachable for management purposes while it boots or if the routing protocol process fails to start properly, configure a backup router, which is a router that is directly connected to the local router or switch (that is, on the same subnet) through its private management interface (for example, fxp0 or me0).

To achieve network reachability while loading, configuring, and recovering the router or switch, but without installing a default route in the forwarding table, include the **destination** option, specifying an address that is reachable through the backup router. Specify the address in the format ***network/mask-length***.

Any destinations defined by the backup router are not visible in the routing table. They are only visible in the local forwarding table when the routing protocol process is not running. Therefore, a recommended best practice is to also include the destinations of the backup router configured as static routes with the **retain** option. The **retain** option is necessary to allow the static route to remain in the forwarding table when the routing protocol process stops running, because the routing table does not exist if the routing protocol process is not running.

On systems with dual redundant Routing Engines, the backup Routing Engine's reachability through the private management interface is based only on the functionality of the **backup-router** configuration. It is not based on whether the routing protocol process is running. The backup router adds the destination prefix upon bootup, whereas configuring a static route requires the routing protocol process to run first before installing the destination prefix. If the routing protocol process is allowed to run on the backup Routing Engine, then a destination can be added in the routing table and the forwarding table by configuring static route with the **retain** option.

Due to a system limitation, do not configure the destination address specified in the backup-router as 0.0.0.0/0 or ::/0. The mask has to be a nonzero value.

Active routes and more specific routes take precedence over destination prefixes defined with the **backup-router** statement.

If you have a backup router configuration in which multiple static routes point to a gateway from the management Ethernet interface, you must configure prefixes that are more specific than the static routes or include the **retain** option at the **[edit routing-options static route]** hierarchy level.

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For example, if you configure the static route 172.16.0.0/12 from the management Ethernet interface for management purposes, you must specify the backup router configuration as follows:

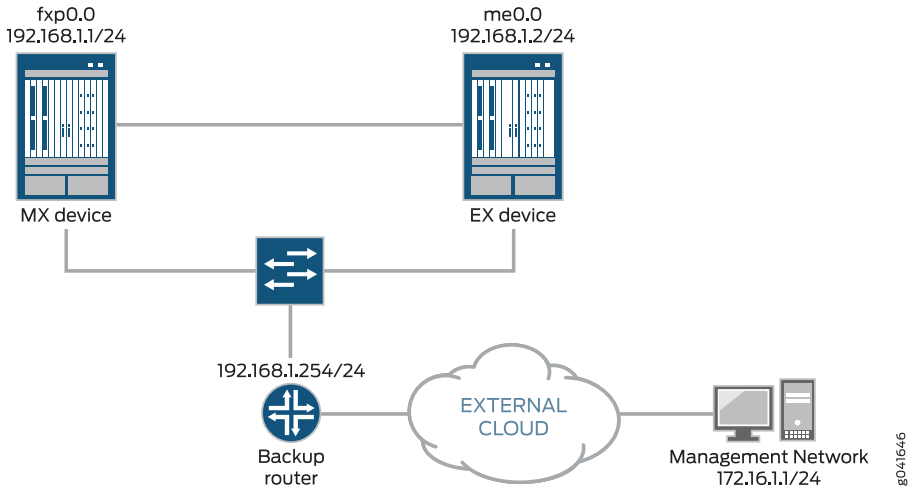
```
backup-router 172.29.201.62 destination [172.16.0.0/13 172.16.128.0/13]
```

Configuring a Backup Router Running IPv4

In the example shown in Figure 2 on page 51, the backup router is the default gateway of the management network.

As required, the backup router address is reachable and directly connected to the management interfaces on the two routing devices (fxp0 and me0).

Figure 2: Backup Router Sample Topology



Optionally, instead of configuring the backup router at the **[edit system]** hierarchy level, you can use a configuration group, as shown in this procedure. This is a recommended best practice for configuring the backup router, especially if the device has dual Routing Engines. This procedure uses groups called **re0** and **re1** as an example.

To configure a backup router running IPv4:

1. Include the **backup-router** statement at the **[edit system]** hierarchy level.

   ```
   [edit groups group-name system]
   backup-router address <destination destination-address>;
   ```

   For example:

   ```
   [edit groups re0 system]
   backup-router 192.168.1.254 destination 172.16.1.0/24;

   [edit groups re1 system]
   backup-router 192.168.1.254 destination 172.16.1.0/24;
   ```

2. (Optional) Configure a static route to the management network.

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Junos OS only uses the backup router during the boot sequence. If you want to configure a backup router for use after startup, you can set up a static route. The static route goes into effect when the routing protocol process is running.

```
routing-options {
    static {
        route 172.16.1.0/24 {
            next-hop 192.168.1.254;
            retain;
        }
    }
}
```

3. If you used one or more configuration groups, apply the configuration groups, substituting the appropriate group names.

   For example:

   ```
   [edit]
   user@host# set apply-groups [re0 re1]
   ```

4. Commit the changes:

   ```
   [edit]
   root@# commit
   ```

Configuring a Backup Router Running IPv6

To configure a backup router running IPv6:

1. Include the **inet6-backup-router** statement at the **[edit system]** hierarchy level.

   ```
   [edit groups group-name system]
   inet6-backup-router address <destination destination-address>;
   ```

   For example:

   ```
   [edit groups re0 system]
   inet6-backup-router 8:3::1 destination abcd::/48;

   [edit groups re1 system]
   inet6-backup-router 8:3::1 destination abcd::/48;
   ```

2. (Optional) Configure a static route to the management network.

   Junos OS only uses the backup router during the boot sequence. If you want to configure a backup router for use after startup, you can set up a static route. The static route goes into effect when the routing protocol process is running.

   ```
   routing-options {
       rib inet6.0 {
           static {
               route abcd::/48 {
                   next-hop 8:3::1;
                   retain;
               }
           }
       }
   }
   ```


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3. If you used one or more configuration groups, apply the configuration groups, substituting the appropriate group names.

   For example:

   ```
   [edit]
   user@host# set apply-groups [re0 re1]
   ```

4. Commit the changes:

   ```
   [edit]
   root@# commit
   ```

Related Documentation

- Understanding Backup Routers on page 49
- *Configuring Junos OS for the First Time on a Router or Switch with a Single Routing Engine*
- *Configuring Junos OS for the First Time on a Device with Dual Routing Engines*
- *Requirements for Routers with a Backup Router Configuration*.

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CHAPTER 8

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