JUNIPER NETWORKS

Junos® OS

IPv6 Neighbor Discovery Feature Guide for Security Devices

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Documentation and Release Notes

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

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Supported Platforms

For the features described in this document, the following platforms are supported:

- J Series
- LN Series
- SRX Series

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
   ```

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 xiii 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 xiii 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`

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

Convention	Description	Examples
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*
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**.

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 post-sales 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.

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- Search for known bugs: http://www2.juniper.net/kb/
- Find product documentation: http://www.juniper.net/techpubs/
- Find solutions and answer questions using our Knowledge Base: http://kb.juniper.net/
- Download the latest versions of software and review release notes: http://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://www.juniper.net/alerts/

- Join and participate in the Juniper Networks Community Forum: http://www.juniper.net/company/communities/
- Open a case online in the CSC Case Management tool: http://www.juniper.net/cm/

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

Opening a Case with JTAC

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

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

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

PART 1

Overview

CHAPTER 1

Feature Overview

Neighbor Discovery Overview

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Neighbor discovery is a protocol that allows different nodes on the same link to advertise their existence to their neighbors, and to learn about the existence of their neighbors.

A router periodically multicasts a router advertisement from each of its multicast interfaces, announcing its availability. Hosts listen for these advertisements for address autoconfiguration and discovery of link-local addresses of the neighboring routers. When a host starts, it multicasts a router solicitation to ask for immediate advertisements.

The router discovery messages do not constitute a routing protocol. They enable hosts to discover the existence of neighboring routers, but are not used to determine which router is best to reach a particular destination.

Neighbor discovery uses the following Internet Control Message Protocol version 6 (ICMPv6) messages: router solicitation, router advertisement, neighbor solicitation, neighbor advertisement, and redirect.

Neighbor discovery for IPv6 replaces the following IPv4 protocols: router discovery (RDISC), Address Resolution Protocol (ARP), and ICMPv4 redirect.

Junos OS Release 9.3 and later supports Secure Neighbor Discovery (SEND). SEND enables you to secure Neighbor Discovery protocol (NDP) messages. It is applicable in environments where physical security on a link is not assured and attacks on NDP messages are a concern. The Junos OS secures NDP messages through cryptographically generated addresses (CGAs).

This section discusses the following topics:

Router Discovery

Router advertisements can contain a list of prefixes. These prefixes are used for address autoconfiguration, to maintain a database of onlink (on the same data link) prefixes, and for duplication address detection. If a node is onlink, the router forwards packets to that node. If the node is not onlink, the packets are sent to the next router for consideration. For IPv6, each prefix in the prefix list can contain a prefix length, a valid lifetime for the prefix, a preferred lifetime for the prefix, an onlink flag, and an autoconfiguration flag. This information enables address autoconfiguration and the setting of link parameters such as maximum transmission unit (MTU) size and hop limit.

Address Resolution

For IPv6, ICMPv6 neighbor discovery replaces Address Resolution Protocol (ARP) for resolving network addresses to link-level addresses. Neighbor discovery also handles changes in link-layer addresses, inbound load balancing, anycast addresses, and proxy advertisements.

Nodes requesting the link-layer address of a target node multicast a neighbor solicitation message with the target address. The target sends back a neighbor advertisement message containing its link-layer address.

Neighbor solicitation and advertisement messages are used for detecting duplicate unicast addresses on the same link. Autoconfiguration of an IP address depends on whether there is a duplicate address on that link. Duplicate address detection is a requirement for autoconfiguration.

Neighbor solicitation and advertisement messages are also used for neighbor unreachability detection. Neighbor unreachability detection involves detecting the presence of a target node on a given link.

Redirect

Redirect messages are sent to inform a host of a better next-hop router to a particular destination or an onlink neighbor. This is similar to ICMPv4 redirect.

PART 2

Configuration

CHAPTER 2

Configuration Guidelines

Example: Configuring IPv6 Interfaces and Enabling Neighbor Discovery

Supported Platforms M Series, MX Series, PTX Series, T Series

This example shows how to configure the router to send IPv6 neighbor discovery messages.

Requirements

In this example, no special configuration beyond device initialization is required.

Overview

In this example, all of the interfaces in the sample topology are configured with IPv6 addresses. If you plan to extend IPv6 functionality into your LAN, datacenter, or customer networks, you might want to use Stateless Address Auto-Configuration (SLAAC) and that means configuring router advertisements. SLAAC is an IPv6 protocol that provides some similar functionality to DHCP in IPv4. Using SLAAC, network hosts can autoconfigure a globally unique IPv6 address based on the prefix provided by a nearby router in a router advertisement. This removes the need to explicitly configure every interface in a given section of the network. Router advertisement messages are disabled by default, and you must enable them to take advantage of SLAAC.

To configure the router to send router advertisement messages, you must include at least the following statements in the configuration. All other router advertisement configuration statements are optional.

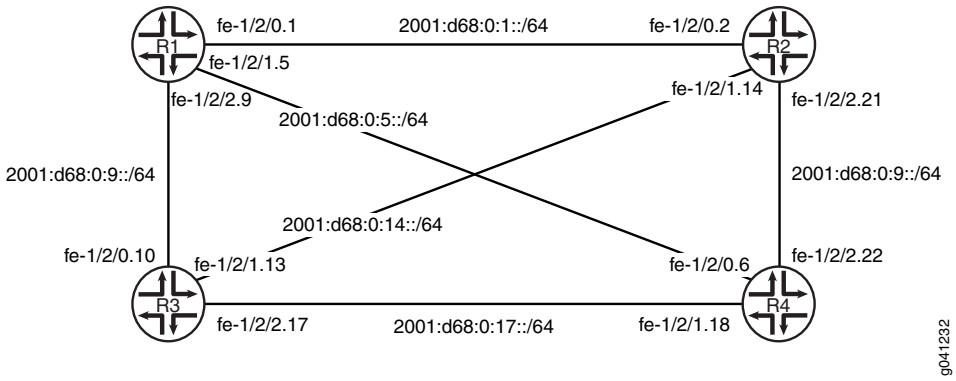
```
protocols {
  router-advertisement {
    interface interface-name {
      prefix prefix;
    }
  }
}
```

To configure neighbor discovery, include the following statements. You configure router advertisement on a per-interface basis.

```
protocols {
  router-advertisement {
    interface interface-name {
      current-hop-limit number;
      default-lifetime seconds;
      (link-mtu | no-link-mtu);
      (managed-configuration | no-managed-configuration);
      max-advertisement-interval seconds;
      min-advertisement-interval seconds;
      (other-stateful-configuration | no-other-stateful-configuration);
      prefix prefix {
        (autonomous | no-autonomous);
        (on-link | no-on-link);
        preferred-lifetime seconds;
        valid-lifetime seconds;
      }
      reachable-time milliseconds;
      retransmit-timer milliseconds;
      virtual-router-only;
    }
    traceoptions {
      file filename <files number> <size maximum-file-size> <world-readable |
        no-world-readable>;
      flag flag;
    }
  }
}
```

Figure 1 on page 9 shows a simplified sample topology.

Figure 1: ICMP Router Discovery Topology



This example shows how to make sure that all of the IPv6 hosts attached to the subnets in the sample topology can auto-configure a local EUI-64 address.

"CLI Quick Configuration" on page 9 shows the configuration for all of the devices in Figure 1 on page 9. "Step-by-Step Procedure" on page 10 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 description to-P2
set interfaces fe-1/2/0 unit 1 family inet6 address 2001:db8:0:1::/64 eui-64
set interfaces fe-1/2/1 unit 5 description to-P4
set interfaces fe-1/2/1 unit 5 family inet6 address 2001:db8:0:5::/64 eui-64
set interfaces fe-1/2/2 unit 9 description to-P3
set interfaces fe-1/2/2 unit 9 family inet6 address 2001:db8:0:9::/64 eui-64
set interfaces lo0 unit 1 family inet6 address 2001:db8::1/128
set protocols router-advertisement interface fe-1/2/0.1 prefix 2001:db8:0:1::/64
set protocols router-advertisement interface fe-1/2/1.5 prefix 2001:db8:0:5::/64
set protocols router-advertisement interface fe-1/2/2.9 prefix 2001:db8:0:9::/64
```

Device R2

```
set interfaces fe-1/2/0 unit 2 description to-P1
set interfaces fe-1/2/0 unit 2 family inet6 address 2001:db8:0:1::/64 eui-64
set interfaces fe-1/2/1 unit 14 description to-P3
set interfaces fe-1/2/1 unit 14 family inet6 address 2001:db8:0:14::/64 eui-64
set interfaces fe-1/2/2 unit 21 description to-P4
set interfaces fe-1/2/2 unit 21 family inet6 address 2001:db8:0:21::/64 eui-64
set interfaces lo0 unit 2 family inet6 address 2001:db8::2/128
set protocols router-advertisement interface fe-1/2/0.2 prefix 2001:db8:0:1::/64
set protocols router-advertisement interface fe-1/2/1.14 prefix 2001:db8:0:14::/64
set protocols router-advertisement interface fe-1/2/2.21 prefix 2001:db8:0:21::/64
```

Device R3

```
set interfaces fe-1/2/0 unit 10 description to-P1
set interfaces fe-1/2/0 unit 10 family inet6 address 2001:db8:0:9::/64 eui-64
```

```
set interfaces fe-1/2/1 unit 13 description to-P2
set interfaces fe-1/2/1 unit 13 family inet6 address 2001:db8:0:14::/64 eui-64
set interfaces fe-1/2/2 unit 17 description to-P4
set interfaces fe-1/2/2 unit 17 family inet6 address 2001:db8:0:17::/64 eui-64
set interfaces lo0 unit 3 family inet6 address 2001:db8::3/128
set protocols router-advertisement interface fe-1/2/0.10 prefix 2001:db8:0:9::/64
set protocols router-advertisement interface fe-1/2/1.13 prefix 2001:db8:0:14::/64
set protocols router-advertisement interface fe-1/2/2.17 prefix 2001:db8:0:17::/64
```

Device R4

```
set interfaces fe-1/2/0 unit 6 description to-P1
set interfaces fe-1/2/0 unit 6 family inet6 address 2001:db8:0:5::/64 eui-64
set interfaces fe-1/2/1 unit 18 description to-P3
set interfaces fe-1/2/1 unit 18 family inet6 address 2001:db8:0:17::/64 eui-64
set interfaces fe-1/2/2 unit 22 description to-P2
set interfaces fe-1/2/2 unit 22 family inet6 address 2001:db8:0:21::/64 eui-64
set interfaces lo0 unit 4 family inet6 address 2001:db8::4/128
set protocols router-advertisement interface fe-1/2/0.6 prefix 2001:db8:0:5::/64
set protocols router-advertisement interface fe-1/2/1.18 prefix 2001:db8:0:17::/64
set protocols router-advertisement interface fe-1/2/2.22 prefix 2001:db8:0:21::/64
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For instructions on how to do that, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure a IPv6 neighbor discovery:

1. Configure the network interfaces.

   This example shows multiple loopback interface addresses to simulate attached networks.

   ```
   [edit interfaces]
   user@R1# set fe-1/2/0 unit 1 description to-P2
   user@R1# set fe-1/2/0 unit 1 family inet6 address 2001:db8:0:1::/64 eui-64

   user@R1# set fe-1/2/1 unit 5 description to-P4
   user@R1# set fe-1/2/1 unit 5 family inet6 address 2001:db8:0:5::/64 eui-64

   user@R1# set fe-1/2/2 unit 9 description to-P3
   user@R1# set fe-1/2/2 unit 9 family inet6 address 2001:db8:0:9::/64 eui-64

   user@R1# set lo0 unit 1 family inet6 address 2001:db8::1/128
   ```

2. Enable neighbor discovery.

   ```
   [edit protocols router-advertisement]
   user@R1# set interface fe-1/2/0.1 prefix 2001:db8:0:1::/64
   user@R1# set interface fe-1/2/1.5 prefix 2001:db8:0:5::/64
   user@R1# set interface fe-1/2/2.9 prefix 2001:db8:0:9::/64
   ```

Results

From configuration mode, confirm your configuration by entering the **show interfaces** and **show protocols** commands. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show interfaces
```

```
fe-1/2/0 {
    unit 1 {
        description to-P2;
        family inet6 {
            address 2001:db8:0:1::/64 {
                eui-64;
            }
        }
    }
}
fe-1/2/1 {
    unit 5 {
        description to-P4;
        family inet6 {
            address 2001:db8:0:5::/64 {
                eui-64;
            }
        }
    }
}
fe-1/2/2 {
    unit 9 {
        description to-P3;
        family inet6 {
            address 2001:db8:0:9::/64 {
                eui-64;
            }
        }
    }
}
lo0 {
    unit 1 {
        family inet6 {
            address 2001:db8::1/128;
        }
    }
}
```

```
user@R1# show protocols
router-advertisement {
    interface fe-1/2/0.1 {
        prefix 2001:db8:0:1::/64;
    }
    interface fe-1/2/1.5 {
        prefix 2001:db8:0:5::/64;
    }
    interface fe-1/2/2.9 {
        prefix 2001:db8:0:9::/64;
    }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

To confirm that the configuration is working properly, perform this task:

Checking the Interfaces

Purpose Verify that the interfaces are up, and view the assigned EUI-64 addresses.

Action From operational mode, enter the **show interfaces terse** command.

```
user@R1> show interfaces terse
Interface               Admin Link Proto    Local                 Remote
fe-1/2/0
fe-1/2/0.1              up    up   inet6    2001:db8:0:1:2a0:a514:0:14c/64
                                            fe80::2a0:a514:0:14c/64
fe-1/2/1.5              up    up   inet6    2001:db8:0:5:2a0:a514:0:54c/64
                                            fe80::2a0:a514:0:54c/64
fe-1/2/2.9              up    up   inet6    2001:db8:0:9:2a0:a514:0:94c/64
                                            fe80::2a0:a514:0:94c/64
lo0
lo0.1                   up    up   inet6    2001:db8::1
                                            fe80::2a0:a50f:fc56:14c
```

Meaning The output shows that all interfaces are configured with the IPv6 (inet6) address family. Each IPv6-enabled interface has two IPv6 addresses; one link-local address, and one global address. The global addresses match those shown in Figure 1 on page 9. Junos OS automatically creates a link-local address for any interface that is enabled for IPv6 operation. All link-local addresses begin with the fe80::/64 prefix. The host portion of the address is a full 64 bits long and matches the link-local interface identifier. When an interface address is configured using the **eui-64** statement, its interface identifier matches the interface identifier of the link-local address. This is because link-local addresses are coded according to the EUI-64 specification.

Pinging the Interfaces

Purpose Verify connectivity between the directly connected interfaces.

Action

1. Determine the remote router's IPv6 interface address.

   On Device R2, run the **show interfaces terse** command for the interface that is directly connected to Device R1, and copy the global address into the capture buffer of your terminal emulator.

   ```
   user@R2> show interfaces fe-1/2/0.2 terse
   Interface               Admin Link Proto    Local                 Remote
   fe-1/2/0.2              up    up   inet6    2001:db8:0:1:2a0:a514:0:24c/64
                                               fe80::2a0:a514:0:24c/64
   ```

2. On Device R1, run the **ping** command, using the global address that you copied.

```
user@R1> ping 2001:db8:0:1:2a0:a514:0:24c
PING6(56=40+8+8 bytes) 2001:db8:0:1:2a0:a514:0:14c -->
2001:db8:0:1:2a0:a514:0:24c
16 bytes from 2001:db8:0:1:2a0:a514:0:24c, icmp_seq=0 hlim=64 time=20.412 ms
16 bytes from 2001:db8:0:1:2a0:a514:0:24c, icmp_seq=1 hlim=64 time=18.897 ms
16 bytes from 2001:db8:0:1:2a0:a514:0:24c, icmp_seq=2 hlim=64 time=1.389 ms
```

Meaning Junos OS uses the same ping command for both IPv4 and IPv6 testing. The lack of any interior gateway protocol (IGP) in the network limits the ping testing to directly-connected neighbors. Repeat the ping test for other directly connected neighbors.

Checking the IPv6 Neighbor Cache

Purpose Display information about the IPv6 neighbors.

After conducting ping testing, you can find an entries for interface addresses in the IPv6 neighbor cache.

Action From operational mode, enter the ***show ipv6 neighbors*** command.

```
user@R1> show ipv6 neighbors
IPv6 Address                 Linklayer Address  State       Exp Rtr Secure
Interface
2001:db8:0:1:2a0:a514:0:24c  00:05:85:8f:c8:bd  stale       546 yes no
fe-1/2/0.1
fe80::2a0:a514:0:24c         00:05:85:8f:c8:bd  stale       258 yes no
fe-1/2/0.1
fe80::2a0:a514:0:64c         00:05:85:8f:c8:bd  stale       111 yes no
fe-1/2/1.5
fe80::2a0:a514:0:a4c         00:05:85:8f:c8:bd  stale       327 yes no
fe-1/2/2.9
```

Meaning In IPv6, the Address Resolution Protocol (ARP) has been replaced by the Neighbor Discovery Protocol (NDP). The IPv4 command **show arp** is replaced by the IPv6 command **show ipv6 neighbors**. The key pieces of information displayed by this command are the IP address, the MAC (Link Layer) address, and the interface.

Verifying IPv6 Router Advertisements

Purpose Confirm that devices can be added to the network using SLAAC by ensuring that router advertisements are working properly.

Action From operational mode, enter the ***show ipv6 router-advertisement*** command.

```
user@R1> show ipv6 router-advertisement
Interface: fe-1/2/0.1
  Advertisements sent: 37, last sent 00:01:41 ago
  Solicits received: 0
  Advertisements received: 38
  Advertisement from fe80::2a0:a514:0:24c, heard 00:05:46 ago
    Managed: 0
    Other configuration: 0
    Reachable time: 0 ms
```

```
    Default lifetime: 1800 sec
    Retransmit timer: 0 ms
    Current hop limit: 64
    Prefix: 2001:db8:0:1::/64
      Valid lifetime: 2592000 sec
      Preferred lifetime: 604800 sec
      On link: 1
      Autonomous: 1
Interface: fe-1/2/1.5
  Advertisements sent: 36, last sent 00:05:49 ago
  Solicits received: 0
  Advertisements received: 37
  Advertisement from fe80::2a0:a514:0:64c, heard 00:00:54 ago
    Managed: 0
    Other configuration: 0
    Reachable time: 0 ms
    Default lifetime: 1800 sec
    Retransmit timer: 0 ms
    Current hop limit: 64
    Prefix: 2001:db8:0:5::/64
      Valid lifetime: 2592000 sec
      Preferred lifetime: 604800 sec
      On link: 1
      Autonomous: 1
Interface: fe-1/2/2.9
  Advertisements sent: 36, last sent 00:01:37 ago
  Solicits received: 0
  Advertisements received: 38
  Advertisement from fe80::2a0:a514:0:a4c, heard 00:01:00 ago
    Managed: 0
    Other configuration: 0
    Reachable time: 0 ms
    Default lifetime: 1800 sec
    Retransmit timer: 0 ms
    Current hop limit: 64
    Prefix: 2001:db8:0:9::/64
      Valid lifetime: 2592000 sec
      Preferred lifetime: 604800 sec
      On link: 1
      Autonomous: 1
```

Meaning The output shows that router advertisements are being sent and received on Device R1's interfaces, indicating that both Device R1 and its directly connected neighbors are configured to generate router-advertisements.

Tracing Neighbor Discovery Events

Purpose Perform additional validation by tracing router advertisements.

Action 1. Configure trace operations.

```
[edit protocols router-advertisement traceoptions]
user@R1# set file ipv6-nd-trace
user@R1# set traceoptions flag all
user@R1# commit
```

2. Run the **show log** command.

```
user@R1> show log ipv6-nd-trace
```

```
Mar 29 14:07:16 trace_on: Tracing to "/var/log/P1/ipv6-nd-trace" started
Mar 29 14:07:16.287229 background dispatch running job
ipv6_ra_delete_interface_config_job for task Router-Advertisement
Mar 29 14:07:16.287452 task_job_delete: delete background job
ipv6_ra_delete_interface_config_job for task Router-Advertisement
Mar 29 14:07:16.287505 background dispatch completed job
ipv6_ra_delete_interface_config_job for task Router-Advertisement
Mar 29 14:07:16.288288 ipv6_ra_iflchange(Router-Advertisement): ifl 0xb904378
 ifl fe-1/2/2.9 104 change 0, intf 0xba140d8
Mar 29 14:07:16.288450 ipv6_ra_iflchange(Router-Advertisement): ifl 0xb904250
 ifl fe-1/2/0.1 85 change 0, intf 0xba14000
Mar 29 14:07:16.288656 ipv6_ra_iflchange(Router-Advertisement): ifl 0xb9044a0
 ifl fe-1/2/1.5 80 change 0, intf 0xba1406c
Mar 29 14:07:16.289293 ipv6_ra_ifachange(Router-Advertisement): ifa 0xba002bc
 fe80::2a0:a514:0:54c ifl fe-1/2/1.5 80 change 0, intf 0xba1406c
Mar 29 14:07:16.289358 -- nochange/add
Mar 29 14:07:16.289624 ipv6_ra_ifachange(Router-Advertisement): ifa 0xba00230
 2001:db8:0:5:2a0:a514:0:54c ifl fe-1/2/1.5 80 change 0, intf 0xba1406c
Mar 29 14:07:16.289682 -- nochange/add
Mar 29 14:07:16.289950 ipv6_ra_ifachange(Router-Advertisement): ifa 0xba001a4
 fe80::2a0:a514:0:14c ifl fe-1/2/0.1 85 change 0, intf 0xba14000
Mar 29 14:07:16.290009 -- nochange/add
Mar 29 14:07:16.290302 ipv6_ra_ifachange(Router-Advertisement): ifa 0xba00118
 2001:db8:0:1:2a0:a514:0:14c ifl fe-1/2/0.1 85 change 0, intf 0xba14000
Mar 29 14:07:16.290365 -- nochange/add
Mar 29 14:07:16.290634 ipv6_ra_ifachange(Router-Advertisement): ifa 0xba003d4
 fe80::2a0:a514:0:94c ifl fe-1/2/2.9 104 change 0, intf 0xba140d8
Mar 29 14:07:16.290694 -- nochange/add
Mar 29 14:07:16.290958 ipv6_ra_ifachange(Router-Advertisement): ifa 0xba00348
 2001:db8:0:9:2a0:a514:0:94c ifl fe-1/2/2.9 104 change 0, intf 0xba140d8
Mar 29 14:07:16.291017 -- nochange/add
Mar 29 14:07:20.808516 task_job_create_foreground: create job ipv6 ra for task
 Router-Advertisement
Mar 29 14:07:20.808921 foreground dispatch running job ipv6 ra for task
Router-Advertisement
Mar 29 14:07:20.809027 ipv6_ra_send_advertisement: sending advertisement for
ifl 104 to ff02::1
Mar 29 14:07:20.809087 (4810916) sending advertisement for ifl 104
Mar 29 14:07:20.809170  ifa 0xba00348 2001:db8:0:9:2a0:a514:0:94c/64
Mar 29 14:07:20.809539  --> sent 56 bytes
Mar 29 14:07:20.809660 task_timer_reset: reset Router-Advertisement_ipv6ra
Mar 29 14:07:20.809725 task_timer_set_oneshot_latest: timer
Router-Advertisement_ipv6ra interval set to 7:07
Mar 29 14:07:20.809772 foreground dispatch completed job ipv6 ra for task
Router-Advertisement
```

Related Documentation

-
- Neighbor Discovery Overview on page 3

Minimum Neighbor Discovery Configuration

Supported Platforms M Series, MX Series, T Series

To configure the router to send router advertisement messages, you must include at least the following statements in the configuration. All other router advertisement configuration statements are optional.

```
protocols {
  router-advertisement {
    interface interface-name {
      prefix prefix;
    }
  }
}
```

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

NOTE: When you configure neighbor discovery router advertisement on an interface, you must also include the **family inet6** statement at the **[edit interfaces** *interface-name* **unit** *logical-unit-number***]** hierarchy level.

Configuring an Interface to Send Neighbor Discovery Advertisements

Supported Platforms M Series, MX Series, T Series

To configure an interface to send router advertisement messages, include the **interface** statement:

```
interface interface-name;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Specify the interface name in the following format:

```
physical<:channel>.logical
```

NOTE: The Junos OS enters the Neighbor Discovery Protocol (NDP) packets into the routing platform cache even if there is no known route to the source.

NOTE: If you are using Virtual Router Redundancy Protocol (VRRP) for IPv6, you must include the **virtual-router-only** statement on both the master and backup VRRP on the IPv6 router.

Configuring the Hop Count in Outgoing Neighbor Discovery Packets

Supported Platforms M Series, MX Series, T Series

The current hop limit field in the router advertisement messages indicates the default value placed in the hop count field of the IP header for outgoing packets. To configure the hop limit, include the **current-hop-limit** statement:

```
current-hop-limit number;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

The default hop limit is 64.

Configuring the Lifetime for the Default Neighbor Discovery Router

Supported Platforms M Series, MX Series, T Series

The default lifetime in router advertisement messages indicates the lifetime associated with the default router. To modify the default lifetime timer, include the **default-lifetime** statement:

```
default-lifetime seconds;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

By default, the default router lifetime is three times the maximum advertisement interval. For more information about the maximum advertisement interval, see "Configuring the Frequency of Neighbor Discovery Advertisements" on page 18.

Configuring the MTU Option for Neighbor Discovery Advertisements

Supported Platforms M Series, MX Series, T Series

In Junos OS Release 10.3 and later, you can configure the **link-mtu** statement to include the maximum transmission unit (MTU) option in router advertisement messages. The MTU option included in router advertisement messages ensures that all nodes on a link use the same MTU value in situations where the link MTU is not well known.

By default, the MTU option field is not included in router advertisement messages.

To include the MTU option in router advertisement messages, include the **link-mtu** statement:

```
link-mtu;
```

To stop including the MTU option in router advertisement messages, include the **no-link-mtu** statement:

```
no link-mtu;
```

To configure the MTU option for neighbor discovery advertisements:

1. Assign a 128-bit IPv6 address to the interface.

   ```
   [edit]
   user@host# set interfaces ge-2/0/0 unit 0 family inet6 address 2001:DB8::/32
   ```

2. Configure the interface to send router advertisement messages that include the MTU option.

   ```
   [edit]
   user@host# set protocols router-advertisement interface ge-2/0/0 link-mtu
   ```


Related Documentation

- Neighbor Discovery Overview on page 3

Enabling Stateful Autoconfiguration with Neighbor Discovery

Supported Platforms M Series, MX Series, T Series

You can set two fields in the router advertisement message to enable stateful autoconfiguration on a host: the managed configuration field and the other stateful configuration field. Setting the managed configuration field enables the host to use a stateful autoconfiguration protocol for address autoconfiguration, along with any stateless autoconfiguration already configured. Setting the other stateful configuration field enables autoconfiguration of other nonaddress-related information.

By default, stateful autoconfiguration is disabled.

To set the managed configuration field and enable address autoconfiguration, include the **managed-configuration** statement:

```
managed-configuration;
```

To disable managed configuration field, include the **no-managed-configuration** statement:

```
nomanaged-configuration;
```

To set the other stateful configuration field and enable autoconfiguration of other types of information, include the **other-stateful-configuration** statement:

```
other-stateful-configuration;
```

To disable other stateful configuration, include the **no-other-stateful-configuration** statement:

```
no-other-stateful-configuration;
```

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

Configuring the Frequency of Neighbor Discovery Advertisements

Supported Platforms M Series, MX Series, T Series

The router sends router advertisements on each interface configured to transmit messages. The advertisements include route information and indicate to network hosts that the router is operational. The router sends these messages periodically, with a time range defined by minimum and maximum values.

To modify the router advertisement interval, include the **min-advertisement-interval** and **max-advertisement-interval** statements:

```
min-advertisement-interval seconds;
max-advertisement-interval seconds;
```

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

By default, the maximum advertisement interval is 600 seconds and the minimum advertisement interval is one-third the maximum interval, or 200 seconds.

Configuring the Delay Before Neighbor-Discovery Neighbors Mark the Router as Down

Supported Platforms M Series, MX Series, T Series

After receiving a reachability confirmation from a neighbor, a node considers that neighbor reachable for a certain amount of time without receiving another confirmation. This mechanism is used for neighbor unreachability detection, a mechanism for finding link failures to a target node.

To modify the reachable time limit, include the **reachable-time** statement:

```
reachable-time milliseconds;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

By default, the reachable time period is 0 milliseconds.

Configuring the Frequency of Neighbor Solicitation Messages

Supported Platforms M Series, MX Series, T Series

The retransmit timer determines the retransmission frequency of neighbor solicitation messages. This timer is used to detect when a neighbor has become unreachable and to resolve addresses. To modify the retransmit timer, include the **retransmit-timer** statement:

```
retransmit-timer milliseconds;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

By default, the retransmit timer is 0 milliseconds.

Configuring the Prefix Information Included in Neighbor Discovery Advertisements

Supported Platforms M Series, MX Series, T Series

Router advertisement messages carry prefixes and information about them. A prefix is onlink when it is assigned to an interface on a specified link. The prefixes specify whether they are onlink or not onlink. A node considers a prefix to be onlink if it is represented by one of the link's prefixes, a neighboring router specifies the address as the target of a redirect message, a neighbor advertisement message is received for the (target) address, or any neighbor discovery message is received from the address. These prefixes are also used for address autoconfiguration. The information about the prefixes specifies the lifetime of the prefixes, whether the prefix is autonomous, and whether the prefix is onlink.

You can perform the following tasks when configuring the prefix information:

Setting the Prefix for Onlink Determination

You can specify prefixes in the router advertisement messages as onlink. When set as onlink, the prefixes are used for onlink determination. By default, prefixes are onlink.

To explicitly set prefixes as onlink, include the **on-link** statement:

```
on-link;
```

To set prefixes as not onlink, include the **no-on-link** statement:

```
no-on-link;
```

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

Setting the Prefix for Stateless Address Autoconfiguration

You can specify prefixes in the router advertisement messages as autonomous. When set as autonomous, the prefixes are used for stateless address autoconfiguration. By default, prefixes are autonomous.

To explicitly specify prefixes as autonomous, include the **autonomous** statement:

```
autonomous;
```

To specify prefixes as not autonomous, include the **no-autonomous** statement:

```
no-autonomous;
```

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

Configuring the Preferred Lifetime

The preferred lifetime for the prefixes in the router advertisement messages specifies how long the prefix generated by stateless autoconfiguration remains preferred. By default, the preferred lifetime is set to 604,800 seconds.

To configure the preferred lifetime, include the **preferred-lifetime** statement:

```
preferred-lifetime seconds;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

If you set the preferred lifetime to **0xffffffff**, the lifetime is infinite.

The preferred lifetime value must never exceed the valid lifetime value.

Configuring the Valid Lifetime

The valid lifetime for the prefixes in the router advertisement messages specifies how long the prefix remains valid for onlink determination. By default, the valid lifetime is set to 2,592,000 seconds.

To configure the valid lifetime, include the **valid-lifetime** statement:

valid-lifetime *seconds*;

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

If you set the valid lifetime to **0xffffffff**, the lifetime is infinite.

The valid lifetime value must never be smaller than the preferred lifetime value.

Tracing Neighbor Discovery Protocol Traffic

Supported Platforms M Series, MX Series, T Series

You can trace various Neighbor Discovery protocol traffic to help debug Neighbor Discovery protocol issues. To trace Neighbor Discovery protocol traffic include the **traceoptions** statement at the **[edit protocols router-advertisement]** hierarchy level:

```
traceoptions {
   file filename <files number> <size size> <world-readable | no-world-readable>;
   flag flag <flag-modifier> <disable>;
}
```

Global tracing options are inherited from the configuration set by the **traceoptions** statement at the **[edit routing-options]** hierarchy level. You can override the following global trace options for the Neighbor Discovery protocol using the **traceoptions flag** statement included at the **[edit protocols router-advertisement]** hierarchy level:

- **all**—All tracing operations
- **general**—All normal operations and routing table changes (a combination of the normal and route trace operations)
- **normal**—Normal events
- **policy**—Policy processing
- **route**—Routing information
- **state**—State transitions
- **task**—Routing protocol task processing
- **timer**—Routing protocol timer processing

NOTE: Use the trace flag all with caution as this may cause the CPU to become very busy.

Related Documentation

- traceoptions on page 33 statement
- For more information about tracing and global tracing options, see *Example: Tracing Global Routing Protocol Operations*.

CHAPTER 3

Configuration Statements

autonomous

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax (autonomous | no-autonomous);

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name* prefix *prefix*],
[edit protocols router-advertisement interface *interface-name* prefix *prefix*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify whether prefixes in the router advertisement messages are used for stateless address autoconfiguration:

- **autonomous**—Use prefixes for address autoconfiguration.
- **no-autonomous**—Do not use prefixes for address autoconfiguration.

Default autonomous

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Setting the Prefix for Stateless Address Autoconfiguration on page 20

current-hop-limit

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax current-hop-limit *number*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Default value placed in the hop count field of the IP header for outgoing packets.

Options *number*—Hop limit. A value of 0 means the limit is unspecified by this router.
Range: 0 through 255
Default: 64

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring the Hop Count in Outgoing Neighbor Discovery Packets on page 16

default-lifetime

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax default-lifetime *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Lifetime associated with a default router.

Options *seconds*—Default lifetime. A value of 0 means this router is not the default router.
Range: Maximum advertisement interval value through 9000 seconds
Default: Three times the maximum advertisement interval value

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- max-advertisement-interval on page 27
- Configuring the Lifetime for the Default Neighbor Discovery Router on page 17

interface

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax

```
interface interface-name {
  current-hop-limit number;
  default-lifetime seconds;
  (link-mtu | no-link-mtu);
  (managed-configuration | no-managed-configuration);
  max-advertisement-interval seconds;
  min-advertisement-interval seconds;
  (other-stateful-configuration | no-other-stateful-configuration);
  prefix prefix {
    (autonomous | no-autonomous);
    (on-link | no-on-link);
    preferred-lifetime seconds;
    valid-lifetime seconds;
  }
  reachable-time milliseconds;
  retransmit-timer milliseconds;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement],
[edit protocols router-advertisement]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure router advertisement properties on an interface. To configure more than one interface, include the **interface** statement multiple times.

Options *interface-name*—Name of an interface. Specify the full interface name, including the physical and logical address components.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring an Interface to Send Neighbor Discovery Advertisements on page 16

link-mtu

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax (link-mtu | no-link-mtu);

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced in Junos OS 10.3.

Description Specify whether to include the maximum transmission unit (MTU) option in router advertisement messages:

- **link-mtu**—Includes the MTU option in router advertisements.
- **no-link-mtu**—Does not include the MTU option in router advertisements.

Default Router advertisement messages do not include the MTU option.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring the MTU Option for Neighbor Discovery Advertisements on page 17

managed-configuration

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax (managed-configuration | no-managed-configuration);

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify whether to enable the host to use a stateful autoconfiguration protocol for address autoconfiguration, along with any stateless autoconfiguration already configured:

- **managed-configuration**—Enable host to use stateful autoconfiguration.
- **no-managed-configuration**—Disable host from using stateful autoconfiguration.

Default The configured object is disabled unless explicitly enabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Enabling Stateful Autoconfiguration with Neighbor Discovery on page 18

max-advertisement-interval

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax max-advertisement-interval *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Maximum interval between each router advertisement message.

Options *seconds*—Maximum interval.

Range: 4 through 1800 seconds

Default: 600 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- min-advertisement-interval on page 28
- Configuring the Frequency of Neighbor Discovery Advertisements on page 18

min-advertisement-interval

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax min-advertisement-interval *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Minimum interval between each router advertisement message.

Options *seconds*—Minimum interval.

Range: 3 seconds through three-quarter times the maximum advertisement interval value

Default: One-third the maximum advertisement interval value

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- max-advertisement-interval on page 27
- Configuring the Frequency of Neighbor Discovery Advertisements on page 18

on-link

Supported Platforms LN Series, M Series, MX Series, T Series

Syntax (on-link | no-on-link);

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name* prefix *prefix*],
[edit protocols router-advertisement interface *interface-name* prefix *prefix*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify whether to enable prefixes to be used for onlink determination:

- **no-on-link**—Disable prefixes from being used for onlink determination.
- **on-link**—Enable prefixes to be used for onlink determination.

Default The configured object is enabled unless explicitly disabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Prefix Information Included in Neighbor Discovery Advertisements on page 19

other-stateful-configuration

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax (other-stateful-configuration | no-other-stateful-configuration);

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify whether to enable autoconfiguration of other nonaddress-related information:

- **no-other-stateful-configuration**—Disable autoconfiguration of other nonaddress-related information.
- **other-stateful-configuration**—Enable autoconfiguration of other nonaddress-related information.

Default The configured object is disabled unless explicitly enabled.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Enabling Stateful Autoconfiguration with Neighbor Discovery on page 18

preferred-lifetime

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax preferred-lifetime *seconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name* prefix *prefix*],
[edit protocols router-advertisement interface *interface-name* prefix *prefix*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify how long the prefix generated by stateless autoconfiguration remains preferred.

Options *seconds*—Preferred lifetime, in seconds. If you set the preferred lifetime to **0xffffffff**, the lifetime is infinite. The preferred lifetime is never greater than the valid lifetime.

Default: 604,800 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- valid-lifetime on page 34
- Configuring the Preferred Lifetime on page 20

prefix

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax

```
prefix prefix {
  (autonomous | no-autonomous);
  (on-link | no-on-link);
  preferred-lifetime seconds;
  valid-lifetime seconds;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure prefix properties in router advertisement messages.

Options ***prefix***—Prefix name.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Prefix Information Included in Neighbor Discovery Advertisements on page 19

reachable-time

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax reachable-time *milliseconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Set the length of time that a node considers a neighbor reachable until another reachability confirmation is received from that neighbor.

Options ***milliseconds***—Reachability time limit.

Range: 0 through 3,600,000 milliseconds

Default: 0 milliseconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Delay Before Neighbor-Discovery Neighbors Mark the Router as Down on page 19

retransmit-timer

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax retransmit-timer *milliseconds*;

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name*],
[edit protocols router-advertisement interface *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Set the retransmission frequency of neighbor solicitation messages.

Options ***milliseconds***—Retransmission frequency.

Default: 0 milliseconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Frequency of Neighbor Solicitation Messages on page 19

router-advertisement

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax router-advertisement {...}

Hierarchy Level [edit logical-systems *logical-system-name* protocols],
[edit protocols]

Release Information Statement introduced before Junos OS Release 7.4.

Description Enable router advertisement.

The remaining statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring an Interface to Send Neighbor Discovery Advertisements on page 16

traceoptions

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <disable>;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols router-advertisement], [edit protocols router-advertisement]

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify router advertisement protocol-level tracing options.

Default The default trace options are inherited from the global **traceoptions** statement.

Options

disable—(Optional) Disable the tracing operation. One use of this option is to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file *filename*—Name of the file to receive the output of the tracing operation. Enclose the name in quotation marks. We recommend that you place router advertisement tracing output in the file **/var/log/router-advertisement-log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named ***trace-file*** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 10 files

flag *flag*—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

- **all**—All tracing operations
- **general**—A combination of the **normal** and **route** trace operations
- **normal**—All normal operations.

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **policy**—Policy operations and actions
- **route**—Routing table changes
- **state**—State transitions
- **task**—Interface transactions and processing
- **timer**—Timer usage

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB) or megabytes (MB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum file size, you must also specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 128 KB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Tracing Neighbor Discovery Protocol Traffic on page 21

valid-lifetime

Supported Platforms LN Series, M Series, MX Series, PTX Series, T Series

Syntax valid-lifetime *seconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols router-advertisement interface *interface-name* prefix *prefix*],
[edit protocols router-advertisement interface *interface-name* prefix *prefix*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify how long the prefix remains valid for onlink determination.

Options ***seconds***—Valid lifetime, in seconds. If you set the valid lifetime to **0xffffffff**, the lifetime is infinite.

Default: 2,592,000 seconds

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- preferred-lifetime on page 29
- Configuring the Valid Lifetime on page 21

PART 3

Administration

CHAPTER 4

Standards

Neighbor Discovery Standards

Supported Platforms M Series, MX Series, PTX Series, T Series

The Junos OS substantially supports the following RFCs, which define standards for neighbor discovery:

- RFC 4443, *Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 Specification*
- RFC 4861, *Neighbor Discovery for IP Version 6*
- RFC 4862, *IPv6 Stateless Address Autoconfiguration*

To access Internet RFCs and drafts, go to the Internet Engineering Task Force (IETF) website at **http://www.ietf.org**.

PART 4

Troubleshooting

CHAPTER 5

Routing Protocol Process Memory FAQ

Routing Protocol Process Memory FAQ Overview

Supported Platforms LN Series

The Juniper Networks Junos operating system (Junos OS) is based on the FreeBSD Unix operating system. The open source software is modified and hardened to operate in the device's specialized environment. For example, some executables have been deleted while other utilities have been de-emphasized. Additionally, certain software processes have been added to enhance the routing functionality. The result of this transformation is the kernel, the heart of the Junos OS software.

The kernel is responsible for generating multiple processes that perform the actual functions of the device. Each process operates in its own protected memory space, providing isolation between the processes and resiliency in the event of a process failure. This is important in a core routing platform because a single process failure does not cause the entire device to cease functioning.

Some of the common software processes include the routing protocol process (rpd) that controls the device's protocols, the device control process (dcd) that controls the device's interfaces, the management process (mgd) that controls user access to the device, the chassis process (chassisd) that controls the device's properties itself, and the Packet Forwarding Engine process (pfed) that controls the communication between the device's Packet Forwarding Engine and the Routing Engine. Besides the above processes, there are other specialized processes that support additional functionality, such as the Simple Network Management Protocol (SNMP), Virtual Router Redundancy Protocol (VRRP), and Class of Service (CoS).

The routing protocol process is a software process within the Routing Engine software that controls the routing protocols that run on the device. Its functionality includes all protocol messages, routing table updates, and implementation of routing policies.

The routing protocol process starts all configured routing protocols and handles all routing messages. It maintains one or more routing tables, which consolidate the routing information learned from all routing protocols. From this routing information, the routing protocol process determines the active routes to network destinations and installs these

routes into the Routing Engine's forwarding table. Finally, it implements the routing policy, which allows you to control the routing information that is transferred between the routing protocols and the routing table. Using the routing policy, you can filter and limit the transfer of information as well as set properties associated with specific routes.

Related Documentation

- Routing Protocol Process Memory FAQs on page 42

Routing Protocol Process Memory FAQs

Supported Platforms LN Series

The following sections present the most frequently asked questions and answers related to the routing protocol process memory utilization, operation, interpretation of related command outputs, and troubleshooting the software process.

Routing Protocol Process Memory Utilization FAQs

This section presents frequently asked questions and answers related to the memory usage of the routing protocol process.

Why does the routing protocol process use excessive memory?

The routing protocol process uses hundreds of megabytes of RAM in the Routing Engine to store information needed for the operation of routing and related protocols, such as BGP, OSPF, ISIS, RSVP, LDP, and MPLS. Such huge consumption of memory is common for the process, as the information it stores includes routes, next hops, interfaces, routing policies, labels, and label-switched paths (LSPs). Because access to the RAM memory is much faster than access to the hard disk, most of the routing protocol process information is stored in the RAM memory instead of using the hard disk space. This ensures that the performance of the routing protocol process is maximized.

How can I check the amount of memory the routing protocol process is using?

You can check the routing protocol process memory usage by entering the **show system processes** and the **show task memory** Junos OS command-line interface (CLI) operational mode commands.

The **show system processes** command displays information about software processes that are running on the device. You can check the routing protocol process memory usage by using the **show system processes** command with the **extensive** option.

The **show task memory** command displays a report generated by the routing protocol process on the memory utilization for routing protocol tasks on the Routing Engine. Although the report generated by the routing protocol process is on its own memory usage, it does not display all the memory used by the process. The value reported by the routing protocol process does not account for the memory used for the **TEXT** and **STACK** segments, or the memory used by the process's internal memory manager. The **show task memory** command also does not include the memory which has been deactivated by the routing protocol process, although some or all of that deactivated memory has not actually been freed by the kernel.

For more information about checking the routing protocol process memory usage, see *Check Routing Protocol Process (rpd) Memory Usage* .

I just deleted many routes from the routing protocol process. Why is the routing protocol process still using so much memory?

The **show system processes extensive** command displays a **RES** value measured in kilobytes. This value represents the amount of process memory resident in the physical memory. This is also known as RSS or Resident Set Size. Any amount of memory deactivated by the process might still be considered part of the **RES** value. Generally, the kernel defers the actual freeing of deactivated memory until there is a memory shortage. This can lead to large discrepancies between the values reported by the routing protocol process and the kernel, even after the routing protocol process has deactivated a large amount of memory.

Interpreting Routing Protocol Process-Related Command Outputs FAQs

This section presents frequently asked questions and answers about the routing protocol process-related Junos OS CLI command outputs that are used to display the memory usage of the routing protocol process.

How do I interpret memory numbers displayed in the show system processes extensive command output?

The **show system processes extensive** command displays exhaustive system process information about software processes that are running on the device. This command is equivalent to the UNIX **top** command. However, the UNIX **top** command shows real-time memory usage, with the memory values constantly changing, while the **show system processes extensive** command provides a snapshot of memory usage in a given moment.

To check overall CPU and memory usage, enter the **show system processes extensive** command. Refer to Table 3 on page 44 for information about the **show system processes extensive** command output fields.

```
user@host> show system processes extensive
last pid:   544;  load averages:  0.00,  0.00,  0.00    18:30:33
37 processes:  1 running, 36 sleeping

Mem: 25M Active, 3968K Inact, 19M Wired, 184K Cache, 8346K Buf, 202M Free
Swap: 528M Total, 64K Used, 528M Free
  PID USERNAME PRI NICE SIZE    RES STATE    TIME   WCPU    CPU COMMAND
  544 root      30   0   604K   768K RUN      0:00  0.00%  0.00% top
    3 root      28   0     0K    12K psleep   0:00  0.00%  0.00% vmdaemon
    4 root      28   0     0K    12K update   0:03  0.00%  0.00% update
  528 aviva     18   0   660K   948K pause    0:00  0.00%  0.00% tcsh
  204 root      18   0   300K   544K pause    0:00  0.00%  0.00% csh
  131 root      18   0   332K   532K pause    0:00  0.00%  0.00% cron
  186 root      18   0   196K    68K pause    0:00  0.00%  0.00% watchdog
   27 root      10   0   512M 16288K mfsidl   0:00  0.00%  0.00% mount_mfs
    1 root      10   0   620K   344K wait     0:00  0.00%  0.00% init
  304 root       3   0   884K   900K ttyin    0:00  0.00%  0.00% bash
  200 root       3   0   180K   540K ttyin    0:00  0.00%  0.00% getty
  203 root       3   0   180K   540K ttyin    0:00  0.00%  0.00% getty
  202 root       3   0   180K   540K ttyin    0:00  0.00%  0.00% getty
  201 root       3   0   180K   540K ttyin    0:00  0.00%  0.00% getty
  194 root       2   0  2248K  1640K select   0:11  0.00%  0.00% rpd
```

```
  205 root      2   0   964K   800K select   0:12  0.00%  0.00% tnp.chassisd
  189 root      2 -12   352K   740K select   0:03  0.00%  0.00% xntpd
  114 root      2   0   296K   612K select   0:00  0.00%  0.00% amd
  188 root      2   0   780K   600K select   0:00  0.00%  0.00% dcd
  527 root      2   0   176K   580K select   0:00  0.00%  0.00% rlogind
  195 root      2   0   212K   552K select   0:00  0.00%  0.00% inetd
  187 root      2   0   192K   532K select   0:00  0.00%  0.00% tnetd
   83 root      2   0   188K   520K select   0:00  0.00%  0.00% syslogd
  538 root      2   0  1324K   516K select   0:00  0.00%  0.00% mgd
   99 daemon    2   0   176K   492K select   0:00  0.00%  0.00% portmap
  163 root      2   0   572K   420K select   0:00  0.00%  0.00% nsrexecd
  192 root      2   0   560K   400K select   0:10  0.00%  0.00% snmpd
  191 root      2   0  1284K   376K select   0:00  0.00%  0.00% mgd
  537 aviva     2   0   636K   364K select   0:00  0.00%  0.00% cli
  193 root      2   0   312K   204K select   0:07  0.00%  0.00% mib2d
    5 root      2   0     0K    12K pfesel   0:00  0.00%  0.00% if_pfe
    2 root    -18   0     0K    12K psleep   0:00  0.00%  0.00% pagedaemon
    0 root    -18   0     0K     0K sched    0:00  0.00%  0.00% swapper
```

Table 3 on page 44 describes the output fields that represent the memory values for the **show system processes extensive** command. Output fields are listed in the approximate order in which they appear.

Table 3: show system processes extensive Output Fields

Field Name	Field Description
Mem	Information about physical and virtual memory allocation.
Active	Memory allocated and actively used by the process.
Inact	Memory allocated but not recently used, or memory deactivated by the processes. Inactive memory remains mapped in the address space of one or more processes and, therefore, counts toward the RSS value of those processes.
Wired	Memory that is not eligible to be swapped, usually used for in-kernel memory structure, memory physically locked by a process, or both.
Cache	Freed memory that is no longer associated with any process but still has valid contents that correspond to some file system blocks. Cache pages can be reclaimed as is when the corresponding file system blocks are accessed again. However, when the system is under memory pressure, the contents of Cache pages could be erased by the kernel and the pages reused to service any memory allocation requests.
Buf	Size of the virtual memory buffer used to hold data recently called from the disk.
Free	Free memory that is neither associated with any process nor contains any valid contents.
Swap	Information about swap memory. • Total—Total space on the swap device. • Used—Memory swapped to disk. • Free—Unused space available on the swap device.

The rest of the command output displays information about the memory usage of each process. The **SIZE** field indicates the size of the virtual address space, and the **RES** field

indicates the amount of the process in physical memory, which is also known as RSS or Resident Set Size. For more information, see the *show system processes* command.

What is the difference between Active and Inact memory that is displayed by the show system processes extensive command?

When the system is under memory pressure, the pageout process can free up memory from the **Inact** and, if necessary, **Active** pools after first preserving the contents of those pages on the swap device or backing file systems if necessary. When the pageout process runs, it scans memory to see which pages are good candidates to be unmapped and freed up. Thus, the distinction between **Active** and **Inact** memory is only used by the pageout process to determine which pool of pages to free first at the time of a memory shortage.

The pageout process first scans the **Inact** list and checks whether the pages on this list have been accessed since the time they have been listed here. The pages that have been accessed are moved from the **Inact** list to the **Active** list. On the other hand, pages that have not been accessed become prime candidates to be freed by the pageout process. If the pageout process cannot produce enough free pages from the **Inact** list, pages from the **Active** list are freed up.

Because the pageout process runs only when the system is under memory pressure, the pages on the **Inact** list remain untouched – even if they have not been accessed recently – when the amount of **Free** memory is adequate.

How do I interpret memory numbers displayed in the show task memory command output?

The **show task memory** command provides a comprehensive picture of the memory utilization for routing protocol tasks on the Routing Engine. The routing protocol process is the main task that uses Routing Engine memory.

To check routing process memory usage, enter the **show task memory** command.

```
user@host> show task memory
Memory                 Size (kB)  %Available  When
  Currently In Use:        29417          3%  now
  Maximum Ever Used:       33882          4%  00/02/11 22:07:03
  Available:              756281        100%  now
```

Table 4 on page 45 describes the output fields for the **show task memory** command. Output fields are listed in the approximate order in which they appear.

Table 4: show task memory Output Fields

Field Name	Field Description
Memory Currently In Use	Memory currently in use. Dynamically allocated memory plus the **DATA** segment memory in kilobytes.
Memory Maximum Ever Used	Maximum memory ever used.
Memory Available	Memory currently available.

The **show task memory** command does not display all the memory used by the routing protocol process. This value does not account for the memory used for the **TEXT** and **STACK** segments, or the memory used by the routing protocol process's internal memory manager. The **show task memory** command also does not include the memory which has been deactivated by the routing protocol process, although some or all of that deactivated memory has not actually been freed by the kernel.

Why is the Memory Currently In Use value less than the RES value?

The **show task memory** command displays a **Memory Currently In Use** value measured in kilobytes. This value is the dynamically allocated memory plus the **DATA** segment memory. The **show system processes extensive** command displays a **RES** value measured in kilobytes. This value represents the amount of process memory resident in the physical memory. This is also known as RSS or Resident Set Size.

The **Memory Currently In Use** value does not account for all of the memory that the routing protocol process uses. This value does not include the memory used for the **TEXT** and the **STACK** segments, and a small percentage of memory used by the routing protocol process's internal memory manager. The **show task memory** command also does not include the memory which has been deactivated by the routing protocol process, although some or all of that deactivated memory has not actually been freed by the kernel.

Any amount of memory deactivated by the routing protocol process might still be considered part of the **RES** value. Generally, the kernel defers the actual freeing of deactivated memory until there is a memory shortage This can lead to large discrepancies between the **Memory Currently In Use** value and the **RES** value.

Routing Protocol Process Memory Swapping FAQs

This section presents frequently asked questions and answers related to the memory swapping of the routing protocol process from the Routing Engine memory to the hard disk memory.

Why does the system start swapping when I try to perform a core dump using the request system core-dumps command?

The **request system core-dumps** command displays a list of system core files created when the device has failed. This command can be useful for diagnostic purposes. Each list item includes the file permissions, number of links, owner, group, size, modification date, path, and filename. You can use the **core-filename** option and the **core-file-info**, **brief**, and **detail** options to display more information about the specified core dump files.

You can use the **request system core-dumps** command to perform a non-fatal core dump without aborting the routing protocol process. To do this, the routing protocol process is forked, generating a second copy, and then aborted. This process can double the memory consumed by the two copies of the routing protocol process, pushing the system into swap.

Why does the show system processes extensive command show that memory is swapped to disk even though there is plenty of free memory?

Memory can remain swapped out indefinitely if it is not accessed again. Therefore, the **show system processes extensive** command shows that memory is swapped to disk even though there is plenty of free memory. Such a situation is not unusual.

Troubleshooting the Routing Protocol Process FAQs

This section presents frequently asked questions and answers related to a shortage of memory and memory leakage by the routing protocol process.

What does the RPD_OS_MEMHIGH message mean?

The **RPD_OS_MEMHIGH** message is written into the system message file if the routing protocol process is running out of memory. This message alerts you that the routing protocol process is using the indicated amount and percentage of Routing Engine memory, which is considered excessive. This message is generated either because the routing protocol process is leaking memory or the use of system resources is excessive, perhaps because routing filters are not configured properly or the configured network topology is very complex.

When the memory utilization for the routing protocol process is using all available Routing Engine DRAM memory or reaches the maximum memory limit, a message of the following form is written every minute in the syslog message file:

```
RPD_OS_MEMHIGH: Using 188830 KB of memory, 100 percent of available
```

This message includes the amount (in kilobytes), the percentage, or both of the available memory in use.

This message should not appear under normal conditions, as any further memory allocations usually require a portion of existing memory to be written to swap. As a recommended solution, increase the amount of RAM in the Routing Engine. For more information, see http://kb.juniper.net/InfoCenter/index?page=content&id=KB14186 .

What can I do when there is a memory shortage even after a swap?

We do not recommend that the system operate in this state, notwithstanding the existence of swap. The protocols that run in the routing protocol process usually have a real-time requirement that cannot reliably withstand the latency of being swapped to hard disk. If the memory shortage has not resulted from a memory leak, then either a reduction in the memory usage or an upgrade to a higher memory-capacity Routing Engine is required.

What is the task_timer?

The source of a routing protocol process memory leak can usually be identified by dumping the timers for each task. You can use the **show task** ***task-name*** command to display routing protocol tasks on the Routing Engine. Tasks can be baseline tasks performed regardless of the device's configuration, and other tasks that depend on the device configuration.

For more information, see the *show task* command.

Related Documentation

- Routing Protocol Process Memory FAQ Overview on page 41

PART 5

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