



JUNOS® Software Guide for EX Series Ethernet Switches

**JUNOS® Software Guide for EX Series Ethernet Switches,
Release 9.6: Device Security**

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Table of Contents

	About This Topic Collection	ix
	How to Use This Guide	ix
	List of EX Series Guides for JUNOS Release 9.6	ix
	Downloading Software	xi
	Documentation Symbols Key	xi
	Documentation Feedback	xiii
	Requesting Technical Support	xiii
	Self-Help Online Tools and Resources	xiii
	Opening a Case with JTAC	xiv
Part 1	Rate Limiting	
Chapter 1	Rate Limiting	3
	Understanding Storm Control on EX Series Switches	3
	Understanding Unknown Unicast Forwarding on EX Series Switches	4
Chapter 2	Example: Rate Limiting Configuration	5
	Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches	5
Chapter 3	Configuring Rate Limiting	9
	Configuring Unknown Unicast Forwarding (CLI Procedure)	9
	Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)	10
Chapter 4	Verifying Rate Limiting Configuration	11
	Verifying That Unknown Unicast Packets Are Forwarded to a Trunk Interface	11
	Verifying That the Port Error Disable Setting Is Working Correctly	12

Chapter 5	Configuration Statements for Rate Limiting	13
	[edit ethernet-switching-options] Configuration Statement Hierarchy	13
	action-shutdown	16
	bandwidth	17
	disable-timeout	18
	ethernet-switching-options	19
	interface	22
	interface	23
	no-broadcast	23
	no-unknown-unicast	24
	storm-control	25
	unknown-unicast-forwarding	26
	vlan	27
 Chapter 6	 Operational Mode Commands for Rate Limiting	 29
	show ethernet-switching interfaces	30
	show ethernet-switching table	33

About This Topic Collection

- How to Use This Guide on page ix
- List of EX Series Guides for JUNOS Release 9.6 on page ix
- Downloading Software on page xi
- Documentation Symbols Key on page xi
- Documentation Feedback on page xiii
- Requesting Technical Support on page xiii

How to Use This Guide

Complete documentation for the EX Series product family is provided on web pages at http://www.juniper.net/techpubs/en_US/release-independent/information-products/pathway-pages/ex-series/product/index.html. We have selected content from these web pages and created a number of EX Series guides that collect related topics into a book-like format so that the information is easy to print and easy to download to your local computer.

The release notes are at

http://www.juniper.net/techpubs/en_US/junos9.6/information-products/topic-collections/release-notes/9.6/junos-release-notes-9.6.pdf.

List of EX Series Guides for JUNOS Release 9.6

Title	Description
<i>Complete Hardware Guide for EX3200 and EX4200 Ethernet Switches</i>	Component descriptions, site preparation, installation, replacement, and safety and compliance information for EX3200 and EX4200 switches
<i>Complete Hardware Guide for EX8208 Ethernet Switches</i>	Component descriptions, site preparation, installation, replacement, and safety and compliance information for EX8208 switches
<i>Complete Hardware Guide for EX8216 Ethernet Switches</i>	Component descriptions, site preparation, installation, replacement, and safety and compliance information for EX8216 switches





Title	Description
<i>Complete Software Guide for JUNOS® Software for EX Series Ethernet Switches, Release 9.6</i>	Software feature descriptions, configuration examples, and tasks for JUNOS Software for EX Series switches and reference pages for configuration statements and operational commands
Software Topic Collections	Software feature descriptions, configuration examples and tasks, and reference pages for configuration statements and operational commands. (This information also appears in the <i>Complete Software Guide for JUNOS® Software for EX Series Ethernet Switches, Release 9.6.</i>)
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Access Control</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Alarms and System Log Messages</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Configuration and File Management</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Class of Service</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Device Security</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Ethernet Switching</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Interfaces</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Layer 3 Protocols</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: MPLS</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Multicast</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Network Management and Monitoring</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Port Security</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Routing Policy and Packet Filtering</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Spanning-Tree Protocols</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: System Setup</i>	

Title	Description
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: User and Access Management</i>	
<i>JUNOS® Software Guide for EX Series Ethernet Switches, Release 9.6: Virtual Systems</i>	
<i>J-Web User Interface Guide for JUNOS Software for EX Series Ethernet Switches</i>	How to use the J-Web graphical user interface (GUI) with JUNOS Software for EX Series switches

Downloading Software

You can download the JUNOS Software for EX Series switches from the Download Software area at <http://www.juniper.net/customers/support/>. To download the software, you must have a Juniper Networks user account. For information about obtaining an account, see <http://www.juniper.net/entitlement/setupAccountInfo.do>.

Documentation Symbols Key

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.

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

Text and Syntax Conventions		
Convention	Description	Examples
<i>Italic text like this</i>	<ul style="list-style-type: none"> ■ Introduces important new terms. ■ Identifies book names. ■ Identifies RFC and Internet draft titles. 	<ul style="list-style-type: none"> ■ A policy <i>term</i> is a named structure that defines match conditions and actions. ■ <i>JUNOS System Basics Configuration Guide</i> ■ RFC 1997, <i>BGP Communities Attribute</i>
<i>Italic text like this</i>	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# set system domain-name <i>domain-name</i>
Plain text like this	Represents names of configuration statements, commands, files, and directories; IP addresses; configuration hierarchy levels; or labels on routing platform components.	<ul style="list-style-type: none"> ■ To configure a stub area, include the stub statement at the [edit protocols ospf area area-id] hierarchy level. ■ The console port is labeled CONSOLE.
< > (angle brackets)	Enclose optional keywords or variables.	stub <default-metric <i>metric</i> >;
(pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	broadcast multicast (<i>string1</i> <i>string2</i> <i>string3</i>)
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	rsvp { # Required for dynamic MPLS only
[] (square brackets)	Enclose a variable for which you can substitute one or more values.	community name members [<i>community-ids</i>]
Indentation and braces ({ })	Identify a level in the configuration hierarchy.	[edit] routing-options { static { route default { nexthop <i>address</i> ; retain; } } }
;(semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
J-Web GUI Conventions		
Bold text like this	Represents J-Web graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"> ■ In the Logical Interfaces box, select All Interfaces. ■ To cancel the configuration, click Cancel.

Text and Syntax Conventions		
Convention	Description	Examples
> (bold right angle bracket)	Separates levels in a hierarchy of J-Web selections.	In the configuration editor hierarchy, select Protocols > Ospf .

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We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. Send e-mail to techpubs-comments@juniper.net with the following:

- Document URL or title
- Page number if applicable
- Software version
- Your name and company

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- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the JTAC User Guide located at <http://www.juniper.net/customers/support/downloads/710059.pdf>.
- Product warranties—For product warranty information, visit <http://www.juniper.net/support/warranty/>.
- JTAC Hours of Operation —The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

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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 located at <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

Rate Limiting

- Rate Limiting on page 3
- Example: Rate Limiting Configuration on page 5
- Configuring Rate Limiting on page 9
- Verifying Rate Limiting Configuration on page 11
- Configuration Statements for Rate Limiting on page 13
- Operational Mode Commands for Rate Limiting on page 29

Chapter 1

Rate Limiting

- Understanding Storm Control on EX Series Switches on page 3
- Understanding Unknown Unicast Forwarding on EX Series Switches on page 4

Understanding Storm Control on EX Series Switches

A traffic storm is generated when messages are broadcast on a network and each message prompts a receiving node to respond by broadcasting its own messages on the network. This, in turn, prompts further responses, creating a snowball effect. The LAN is suddenly flooded with packets, creating unnecessary traffic that leads to poor network performance or even a complete loss of network service. Storm control enables the switch to monitor traffic levels and drop broadcast and unknown unicast packets when a specified traffic level—called the *storm control level*—is exceeded, thus preventing packets from proliferating and degrading the LAN. Alternatively, you can configure the switch to shut down interfaces (see [action-shutdown](#)) or temporarily disable interfaces (see [port-error-disable](#)) when the storm control level is exceeded.

By default, storm control is enabled on all switch interfaces at a level of 50 percent of the combined broadcast and unknown unicast streams. You can change the storm control level either by configuring it as a bandwidth value for the combined broadcast and unknown unicast traffic streams or by configuring it as a percentage of the combined broadcast and unknown unicast streams.



NOTE: The `level` configuration statement, which allows you to configure the storm control level as a percentage of the combined broadcast and unknown unicast streams, has been deprecated and might be removed from future product releases. We strongly recommend that you phase out its use and replace it with the `bandwidth` statement, which allows you to configure the storm control level as a bandwidth value for the combined broadcast and unknown unicast traffic streams.

Broadcast, multicast, and unicast packets are part of normal LAN operation, so to recognize a storm, you must be able to identify when traffic has reached a level that is abnormal for your LAN. Suspect a storm when operations begin timing out and network response times slow down. As more packets flood the LAN, network users might be unable to access servers or e-mail.

Monitor the percentage of broadcast and unknown unicast traffic in the LAN when it is operating normally. This data can then be used as a benchmark to determine

when traffic levels are too high. You can then configure storm control to set the level at which you want to drop broadcast and unknown unicast traffic.

- Related Topics**
- Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5
 - Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure) on page 10

Understanding Unknown Unicast Forwarding on EX Series Switches

Unknown unicast traffic consists of unicast packets with unknown destination MAC addresses. By default, the switch floods these unicast packets that are traveling in a VLAN to all interfaces that are members of the VLAN. Forwarding this type of traffic to interfaces on the switch can trigger a security issue. The LAN is suddenly flooded with packets, creating unnecessary traffic that leads to poor network performance or even a complete loss of network service. This is known as a traffic storm.

To prevent a storm, you can disable the flooding of unknown unicast packets to all interfaces by configuring one VLAN or all VLANs to forward and unknown unicast traffic to a specific trunk interface. This channels the unknown unicast traffic to a single interface.

- Related Topics**
- Understanding Storm Control on EX Series Switches on page 3
 - Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5
 - Configuring Unknown Unicast Forwarding (CLI Procedure) on page 9

Chapter 2

Example: Rate Limiting Configuration

- Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5

Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches

Storm control enables you to prevent network outages caused by broadcast storms on the LAN. You can configure storm control on the EX Series switch to rate limit broadcast traffic and unknown unicast traffic at a specified level and to drop packets when the specified traffic level is exceeded, thus preventing packets from proliferating and degrading the LAN.

This example shows how to configure storm control on a single EX Series switch:

- Requirements on page 5
- Overview and Topology on page 5
- Configuration of the Storm Control Level Based on the Traffic Rate of the Controlled Traffic Types on page 6
- Configuration of the Storm Control Level Based on a Percentage of the Controlled Traffic Types (Deprecated Method) on page 7

Requirements

This example uses the following hardware and software components:

- One Juniper Networks EX3200 switch
- JUNOS Release 9.1 or later for EX Series switches

Overview and Topology

A storm is generated when messages are broadcast on a network and each message prompts a receiving node to respond by broadcasting its own messages on the network. This, in turn, prompts further responses, creating a snowball effect and resulting in a broadcast storm that can cause network outages.

You can use storm control to prevent broadcast storms by specifying the amount, also known as the storm control level, of broadcast traffic and unknown unicast traffic to be allowed on an interface. This level is given either as the traffic rate in

kilobits per second of the combined broadcast and unknown unicast streams or as a percentage of the combined broadcast and unknown unicast streams.



NOTE: By default, storm control is enabled on all interfaces. The default level is 50 percent of the combined broadcast and unknown unicast streams.

Storm control monitors the incoming broadcast traffic and unknown unicast traffic and compares it with the level that you specify. If broadcast traffic and unknown unicast traffic exceed the specified level, the switch drops packets for the controlled traffic types.



NOTE: Alternatively, you can configure the switch to shut down or temporarily disable the interface when the storm control limit is exceeded. See “Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)” on page 10.

The topology used in this example consists of one EX3200 switch with 24 ports. The switch is connected to various network devices. This example shows how to configure the storm control level on interface `ge-0/0/0` by using one of two different configuration methods:

- Setting the level to a traffic rate of 15000 Kbps, based on the traffic rate of the combined broadcast and unknown unicast streams
- Setting the level to 40 (plus or minus 2) percent, based on the combined broadcast and unknown unicast streams

If broadcast traffic and unknown unicast traffic exceeds these levels, the switch drops packets for the controlled traffic types to prevent a network outage.

Configuration of the Storm Control Level Based on the Traffic Rate of the Controlled Traffic Types

CLI Quick Configuration To quickly configure storm control based on the traffic rate in kilobits per second of the combined broadcast and unknown unicast streams, copy the following command and paste it into the switch terminal window:

```
[edit]
set ethernet-switching-options storm-control interface ge-0/0/0 bandwidth 15000
```

Step-by-Step Procedure To configure storm control based on the traffic rate in kilobits per second of the combined broadcast and unknown unicast streams:

1. Specify the level of allowed broadcast traffic and unknown unicast traffic on a specific interface:

```
[edit ethernet-switching-options]
user@switch# set storm-control interface ge-0/0/0 bandwidth 15000
```

Results Display the results of the configuration:

```
[edit ethernet-switching-options]
user@switch# show storm-control
interface ge-0/0/0.0 {
  bandwidth 15000;
}
```

Configuration of the Storm Control Level Based on a Percentage of the Controlled Traffic Types (Deprecated Method)

CLI Quick Configuration To quickly configure storm control based on the percentage of the combined broadcast and unknown unicast streams, copy the following command and paste it into the switch terminal window:

```
[edit]
set ethernet-switching-options storm-control interface ge-0/0/0 level 40
```



NOTE: The level configuration statement has been deprecated and might be removed from future product releases. We strongly recommend that you phase out its use and replace it with the `bandwidth` statement.

Step-by-Step Procedure To configure storm control based on a percentage of the combined broadcast and unknown unicast streams:

1. Specify the level of allowed broadcast traffic and unknown unicast traffic on a specific interface:

```
[edit ethernet-switching-options]
user@switch# set storm-control interface ge-0/0/0 level 40
```



NOTE: The `level` configuration statement has been deprecated and might be removed from future product releases. We strongly recommend that you phase out its use and replace it with the `bandwidth` statement.

Results Display the results of the configuration:

```
[edit ethernet-switching-options]
user@switch# show storm-control
interface ge-0/0/0.0 {
  level 40; ## Warning: 'level' is deprecated
}
```

Related Topics ■ [Understanding Storm Control on EX Series Switches on page 3](#)

Chapter 3

Configuring Rate Limiting

- Configuring Unknown Unicast Forwarding (CLI Procedure) on page 9
- Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure) on page 10

Configuring Unknown Unicast Forwarding (CLI Procedure)

Unknown unicast traffic consists of packets with unknown destination MAC addresses. By default, the switch floods these packets to all interfaces associated with a VLAN. Forwarding such traffic to interfaces on the switch can create a security issue.

To prevent flooding unknown unicast traffic across the switch, configure unknown unicast forwarding to direct all unknown unicast packets within a VLAN out to a specific trunk interface. From there, the destination MAC address can be learned and added to the Ethernet switching table. You can configure each VLAN to divert unknown unicast traffic to different trunk interfaces or use one trunk interface for multiple VLANs.

To configure unknown unicast forwarding options using the CLI:



NOTE: Before you can configure unknown unicast forwarding within a VLAN, you must first configure that VLAN.

1. Configure unknown unicast forwarding for a specific VLAN (here, the VLAN name is `employee`):

```
[edit ethernet-switching-options]
user@switch# set unknown-unicast-forwarding vlan employee
```

2. Specify the trunk interface to which all unknown unicast traffic will be forwarded:

```
[edit ethernet-switching-options ]
user@switch# set unknown-unicast-forwarding vlan employee interface ge-0/0/3.0
```

- Related Topics**
- Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5
 - Configuring VLANs for EX Series Switches (CLI Procedure)

- Configuring VLANs for EX Series Switches (J-Web Procedure)
- Verifying That Unknown Unicast Packets Are Forwarded to a Trunk Interface on page 11
- Understanding Unknown Unicast Forwarding on EX Series Switches on page 4
- Understanding Storm Control on EX Series Switches on page 3

Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)

An Ethernet switching access interface on an EX Series switch might shut down or be disabled as a result of one of the following port-security or storm-control configurations:

- MAC limiting—`mac-limit` statement is configured with action `shutdown`.
- MAC move limiting—`mac-move-limit` statement is configured with action `shutdown`.
- Storm control—`storm-control` statement is configured with the action `shutdown`.

You can configure the switch to automatically restore the disabled interfaces to service after a specified period of time. Autorecovery applies to all the interfaces that have been disabled due to MAC limiting, MAC move limiting, or storm control errors.



NOTE: You must specify the disable timeout value for the interfaces to recover automatically. There is no default disable timeout. If you do not specify a timeout value, you need to use the `clear ethernet-switching port-error` command to clear the errors and restore the interfaces or the specified interface to service.

To configure autorecovery from the disabled state due to MAC limiting, MAC move limiting, or storm control shutdown actions:

```
[edit ethernet-switching-options]
user@switch# set port-error-disable disable-timeout 60
```

- Related Topics**
- Example: Configuring Port Security, with DHCP Snooping, DAI, MAC Limiting, and MAC Move Limiting, on an EX Series Switch
 - Configuring MAC Limiting (CLI Procedure)
 - Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5
 - Understanding MAC Limiting and MAC Move Limiting for Port Security on EX Series Switches
 - Understanding Storm Control on EX Series Switches on page 3

Chapter 4

Verifying Rate Limiting Configuration

- Verifying That Unknown Unicast Packets Are Forwarded to a Trunk Interface on page 11
- Verifying That the Port Error Disable Setting Is Working Correctly on page 12

Verifying That Unknown Unicast Packets Are Forwarded to a Trunk Interface

Purpose Verify that a VLAN is forwarding all unknown unicast packets (those with unknown destination MAC addresses) to a single trunk interface instead of flooding unknown unicast packets across all interfaces that are members of the same VLAN.

Action Display the forwarding interface for unknown unicast packets for a VLAN (here, the VLAN name is v1):

```
user@switch> show configuration ethernet-switching-options

unknown-unicast-forwarding {
    vlan v1 {
        interface ge-0/0/7.0;
    }
}
```

Display the Ethernet switching table:

```
user@switch> show ethernet-switching table vlan v1
Ethernet-switching table: 3 unicast entries
VLAN      MAC address      Type      Age Interfaces
v1        *                Flood     - All-members
v1        00:01:09:00:00:00 Learn     24 ge-0/0/7.0
v1        00:11:09:00:01:00 Learn     37 ge-0/0/3.0
```

Meaning The sample output from the `show configuration ethernet-switching-options` command shows that the unknown unicast forwarding interface for VLAN v1 is interface ge-0/0/7. The `show ethernet-switching table` command shows that an unknown unicast packet is received on interface ge-0/0/3 with the destination MAC address (DMAC) 00:01:09:00:00:00 and the source MAC address (SMAC) of 00:11:09:00:01:00. This shows that the SMAC of the packet is learned in the normal way (through the interface ge-0/0/3.0), while the DMAC is learned on interface ge-0/0/7.

Related Topics ■ Configuring Unknown Unicast Forwarding (CLI Procedure) on page 9

Verifying That the Port Error Disable Setting Is Working Correctly

Purpose Verify that the port error disable setting is working as expected on MAC limited, MAC move limited and rate-limited interfaces on an EX Series switch.

Action Display information about interfaces:

```
user@switch> show ethernet-switching interfaces
Interface  State  VLAN members  Blocking
ge-0/0/0.0  up    T1122         unblocked
ge-0/0/1.0  down  default       MAC limit exceeded
ge-0/0/2.0  down  default       MAC move limit exceeded
ge-0/0/3.0  down  default       Storm control in effect
ge-0/0/4.0  down  default       unblocked
ge-0/0/5.0  down  default       unblocked
ge-0/0/6.0  down  default       unblocked
ge-0/0/7.0  down  default       unblocked
ge-0/0/8.0  down  default       unblocked
ge-0/0/9.0  up    T111         unblocked
ge-0/0/10.0 down  default       unblocked
ge-0/0/11.0 down  default       unblocked
ge-0/0/12.0 down  default       unblocked
ge-0/0/13.0 down  default       unblocked
ge-0/0/14.0 down  default       unblocked
ge-0/0/15.0 down  default       unblocked
ge-0/0/16.0 down  default       unblocked
ge-0/0/17.0 down  default       unblocked
ge-0/0/18.0 down  default       unblocked
ge-0/0/19.0 up    T111         unblocked
ge-0/1/0.0  down  default       unblocked
ge-0/1/1.0  down  default       unblocked
ge-0/1/2.0  down  default       unblocked
ge-0/1/3.0  down  default       unblocked
```

Meaning The sample output from the `show ethernet-switching interfaces` command shows that three of the down interfaces specify the reason that the interface is disabled:

- **MAC limit exceeded**—The interface is temporarily disabled due to a `mac-limit` error. The disabled interface is automatically restored to service when the `disable-timeout` expires.
- **MAC move limit exceeded**—The interface is temporarily disabled due to a `mac-move-limit` error. The disabled interface is automatically restored to service when the `disable-timeout` expires.
- **Storm control in effect** —The interface is temporarily disabled due to a `storm-control` error. The disabled interface is automatically restored to service when the `disable-timeout` expires.

Related Topics ■ Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure) on page 10

Chapter 5

Configuration Statements for Rate Limiting

- [edit ethernet-switching-options] Configuration Statement Hierarchy on page 13

[edit ethernet-switching-options] Configuration Statement Hierarchy

```
ethernet-switching-options {
  analyzer {
    name {
      loss-priority priority;
      ratio number;
      input {
        ingress {
          interface (all | interface-name);
          vlan (vlan-id | vlan-name);
        }
        egress {
          interface (all | interface-name);
        }
      }
      output {
        interface interface-name;
        vlan (vlan-id | vlan-name);
      }
    }
  }
  bpdu-block {
    disable-timeout timeout;
    interface (all | [interface-name]);
  }
  dot1q-tunneling {
    ether-type (0x8100 | 0x88a8 | 0x9100) ;
  }
  interfaces interface-name {
    no-mac-learning;
  }
  mac-table-aging-time seconds;
  port-error-disable {
    disable-timeout timeout;
  }
  redundant-trunk-group {
    group-name name {
      interface interface-name <primary>;
    }
  }
}
```

```

    }
  }
  secure-access-port {
    dhcp-snooping-file {
      location local_pathname | remote_URL;
      timeout seconds;
      write-interval seconds;
    }
    interface (all | interface-name) {
      allowed-mac {
        mac-address-list;
      }
      (dhcp-trusted | no-dhcp-trusted );
      mac-limit limit action action;
      no-allowed-mac-log;
      static-ip ip-address {
        vlan vlan-name;
        mac mac-address;
      }
    }
  }
  vlan (all | vlan-name) {
    (arp-inspection | no-arp-inspection );
    dhcp-option82 {
      circuit-id {
        prefix hostname;
        use-interface-description;
        use-vlan-id;
      }
      remote-id {
        prefix hostname | mac | none;
        use-interface-description;
        use-string string;
      }
      vendor-id [string];
    }
    (examine-dhcp | no-examine-dhcp );
    (ip-source-guard | no-ip-source-guard);
    mac-move-limit limit action action;
  }
}
storm-control {
  interface (all | interface-name) {
    bandwidth bandwidth;
    no-broadcast;
    no-unknown-unicast;
  }
}
traceoptions {
  file filename <files number> <no-stamp> <replace> <size size> <world-readable
  | no-world-readable>;
  flag flag <disable>;
}
unknown-unicast-forwarding {
  vlan (all | vlan-name) {
    interface interface-name;
  }
}

```

```

}
voip {
  interface (all | [interface-name | access-ports]) {
    vlan vlan-name ;
    forwarding-class <assured-forwarding | best-effort | expedited-forwarding |
    network-control>;
  }
}
}

```

- Related Topics**
- Port Mirroring on EX Series Switches Overview
 - Port Security for EX Series Switches Overview
 - Understanding BPDU Protection for STP, RSTP, and MSTP on EX Series Switches
 - Understanding Redundant Trunk Links on EX Series Switches
 - Understanding Storm Control on EX Series Switches on page 3
 - Understanding 802.1X and VoIP on EX Series Switches
 - Understanding Q-in-Q Tunneling on EX Series Switches
 - Understanding Unknown Unicast Forwarding on EX Series Switches on page 4

action-shutdown

Syntax	action-shutdown;
Hierarchy Level	[edit ethernet-switching-options storm-control]
Release Information	Statement introduced in JUNOS Release 9.6 for EX Series switches.
Description	<p>Shut down or disable interfaces when the storm control level is exceeded, as follows:</p> <ul style="list-style-type: none"> ■ If you set both the action-shutdown and the port-error-disable statements, the interfaces are disabled temporarily and recover automatically when the disable timeout expires. ■ If you set the action-shutdown statement and do not specify the port-error-disable statement, the interfaces that are enabled for storm control are shut down when the storm control level is exceeded and they do not recover automatically from that port-error condition. You must issue the clear ethernet-switching port-error command to clear the port error and restore the interfaces to service.
Default	The action-shutdown option is not enabled. When the storm control level is exceeded, the switch drops unknown unicast and broadcast messages on the specified interfaces.
Required Privilege Level	<p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>
Related Topics	<ul style="list-style-type: none"> ■ port-error-disable ■ disable-timeout ■ clear ethernet-switching port-error ■ Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5 ■ Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure) on page 10 ■ Understanding Storm Control on EX Series Switches on page 3

bandwidth

Syntax	bandwidth <i>bandwidth</i> ;
Hierarchy Level	[edit ethernet-switching-options storm-control interface (all <i>interface-name</i>)]
Release Information	Statement introduced in JUNOS Release 9.5 for EX Series switches.
Description	For interfaces configured for storm control, configure the storm control level as the bandwidth in kilobits per second of the combined broadcast and unknown unicast streams.
Default	None.
Options	<p>bandwidth—Traffic rate in kilobits per second of the combined broadcast and unknown unicast streams.</p> <p>Range: 100 through 10000000 Kbps</p> <p>Default: None</p>
Required Privilege Level	<p>routing—To view this statement in the configuration.</p> <p>routing-control—To add this statement to the configuration.</p>
Related Topics	<ul style="list-style-type: none"> ■ Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5 ■ Understanding Storm Control on EX Series Switches on page 3

disable-timeout

Syntax	disable-timeout <i>timeout</i> ;
Hierarchy Level	[edit ethernet-switching-options port-error-disable]
Release Information	Statement introduced in JUNOS Release 9.6 for EX Series switches.
Description	Specify how long the Ethernet-switching interfaces remain in a disabled state due to the MAC limiting, MAC move limiting, or storm control errors.
Default	The disable timeout is not enabled.
Options	<i>timeout</i> —Amount of time, in seconds, that the disabled state remains in effect. The disabled interface is automatically restored to service when the specified timeout is reached. Range: 10 through 3600 seconds
Required Privilege Level	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
Related Topics	<ul style="list-style-type: none">■ Configuring Port Security (CLI Procedure)■ Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure) on page 10■ Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5

ethernet-switching-options

```

Syntax ethernet-switching-options {
    analyzer {
        name {
            loss-priority priority;
            ratio number;
            input {
                ingress {
                    interface (all | interface-name);
                    vlan (vlan-id | vlan-name);
                }
                egress {
                    interface (all | interface-name);
                }
            }
            output {
                interface interface-name;
                vlan (vlan-id | vlan-name);
            }
        }
    }
    bpdu-block {
        disable-timeout timeout;
        interface (all | [interface-name]);
    }
    dot1q-tunneling {
        ether-type (0x8100 | 0x88a8 | 0x9100)
    }
    interfaces interface-name {
        no-mac-learning;
    }
    mac-table-aging-time seconds;
    port-error-disable {
        disable-timeout timeout;
    }
    redundant-trunk-group {
        group-name name {
            interface interface-name <primary>;
            interface interface-name;
        }
    }
    secure-access-port {
        dhcp-snooping-file {
            location local_pathname | remote_URL;
            timeout seconds;
            write-interval seconds;
        }
        interface (all | interface-name) {
            allowed-mac {
                mac-address-list;
            }
            (dhcp-trusted | no-dhcp-trusted);
            mac-limit limit action action;
        }
    }
}

```

```

        no-allowed-mac-log;
        static-ip ip-address {
            vlan vlan-name;
            mac mac-address;
        }
    }
    vlan (all | vlan-name) {
        (arp-inspection | no-arp-inspection);
        dhcp-option82 {
            circuit-id {
                prefix hostname;
                use-interface-description;
                use-vlan-id;
            }
            remote-id {
                prefix hostname | mac | none;
                use-interface-description;
                use-string string;
            }
            vendor-id [string];
        }
        (examine-dhcp | no-examine-dhcp);
        (ip-source-guard | no-ip-source-guard);
        mac-move-limit limit action action;
    }
}
storm-control {
    interface (all | interface-name) {
        level level;
        no-broadcast;
        no-unknown-unicast;
    }
}
traceoptions {
    file filename <files number> <no-stamp> <replace> <size size> <world-readable |
    no-world-readable>;
    flag flag <disable>;
}
unknown-unicast-forwarding {
    vlan (all | vlan-name) {
        interface interface-name;
    }
}
voip {
    interface (all | [interface-name | access-ports]) {
        vlan vlan-name ;
        forwarding-class <assured-forwarding | best-effort | expedited-forwarding |
        network-control>;
    }
}
}

```

Hierarchy Level [edit]

Release Information Statement introduced in JUNOS Release 9.0 for EX Series switches.
 Support for storm control and BPDU protection added in JUNOS Release 9.1 for EX Series switches.
 Option `ip-source-guard` added in JUNOS Release 9.2 for EX Series switches.
 Options `dhcp-option82`, `dot1q-tunneling`, and `no-allowed-mac-log` added in JUNOS Release 9.3 for EX Series switches.
 Options `dhcp-snooping-file` and `mac-table-aging-time` introduced in JUNOS Release 9.4 for EX Series switches.
 Options `interfaces` and `no-mac-learning` introduced in JUNOS Release 9.5 for EX Series switches.
 Options `port-error-disable` and `disable-timeout` introduced in JUNOS Release 9.6 for EX Series switches.

Description Configure Ethernet switching options.

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 Topics

- Port Mirroring on EX Series Switches Overview
- Port Security for EX Series Switches Overview
- Understanding BPDU Protection for STP, RSTP, and MSTP on EX Series Switches
- Understanding Redundant Trunk Links on EX Series Switches
- Understanding Storm Control on EX Series Switches on page 3
- Understanding 802.1X and VoIP on EX Series Switches
- Understanding Q-in-Q Tunneling on EX Series Switches
- Understanding Unknown Unicast Forwarding on EX Series Switches on page 4

interface

Syntax interface (all | *interface-name*) {
 bandwidth *bandwidth*;
 no-broadcast;
 no-unknown-unicast;
 }

Hierarchy Level [edit ethernet-switching-options storm-control]

Release Information Statement introduced in JUNOS Release 9.1 for EX Series switches.

Description Apply storm control to all interfaces or to the specified interface.

The statements are explained separately.

Default Storm control is enabled on all switch interfaces at a level of 50 percent of the combined broadcast and unknown unicast streams.

Options all—Apply storm control to all interfaces.

interface-name—Apply storm control to the specified interface.

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 Topics**
- Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5
 - Understanding Storm Control on EX Series Switches on page 3

interface

Syntax	<code>interface interface-name;</code>
Hierarchy Level	[edit ethernet-switching-options unknown-unicast-forwarding vlan(all vlan-name)]
Release Information	Statement introduced in JUNOS Release 9.3 for EX Series switches.
Description	Specify the interface to which unknown unicast packets will be forwarded.
Required Privilege Level	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
Related Topics	<ul style="list-style-type: none"> ■ show vlans ■ show ethernet-switching table ■ Configuring Unknown Unicast Forwarding (CLI Procedure) on page 9 ■ Understanding Unknown Unicast Forwarding on EX Series Switches on page 4

no-broadcast

Syntax	<code>no-broadcast;</code>
Hierarchy Level	[edit ethernet-switching-options storm-control interface (all interface-name)]
Release Information	Statement introduced in JUNOS Release 9.1 for EX Series switches. Statement deprecated in JUNOS Release 9.4 for EX Series switches.
	NOTE: If you configure this statement, it has no effect. This statement has been deprecated and might be removed from future product releases.
Description	For interfaces configured for storm control, disable broadcast traffic storm control on the interface.
Default	When storm control is enabled on an interface, it is enabled for both unknown unicast traffic and broadcast traffic.
Required Privilege Level	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
Related Topics	<ul style="list-style-type: none"> ■ Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5 ■ Understanding Storm Control on EX Series Switches on page 3

no-unknown-unicast

Syntax no-unknown-unicast;

Hierarchy Level [edit ethernet-switching-options storm-control interface (all | *interface-name*)]

Release Information Statement introduced in JUNOS Release 9.1 for EX Series switches.
Statement deprecated in JUNOS Release 9.4 for EX Series switches.



NOTE: If you configure this statement, it has no effect. This statement has been deprecated and might be removed from future product releases.

Description For interfaces configured for storm control, disable unknown unicast traffic storm control on the interface.

Default When storm control is enabled on an interface, it is enabled for both unknown unicast traffic and broadcast traffic.

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

- Related Topics**
- Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5
 - Understanding Storm Control on EX Series Switches on page 3

storm-control

Syntax storm-control {
 action-shutdown;
 interface (all | *interface-name*) {
 bandwidth *bandwidth*;
 no-broadcast;
 no-unknown-unicast;
 }
 }

Hierarchy Level [edit ethernet-switching-options]

Release Information Statement introduced in JUNOS Release 9.1 for EX Series switches.
 Option `action-shutdown` introduced in JUNOS Release 9.6 for EX Series switches.

Description Apply storm control to all interfaces or to the specified interfaces.

The statements are explained separately.

Default By default, storm control is enabled on all switch interfaces at a level of 50 percent of the combined broadcast and unknown unicast streams. You can change the storm control level either by configuring it as a bandwidth value for the combined broadcast and unknown unicast traffic streams or by configuring it as a percentage of the combined broadcast and unknown unicast streams.

When you configure storm control bandwidth on an aggregated Ethernet interface, each member of the aggregated Ethernet interface is set with that bandwidth. For example, if you configure 15000 Kbps on `ae1`, and `ae1` has two members, `ge-0/0/0` and `ge-0/0/1`, each member is allowed a bandwidth level of 15000 Kbps. Thus, the storm control bandwidth on `ae1` could be up to 30000 Kbps of combined broadcast and unknown unicast traffic streams.

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

- Related Topics**
- Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 5
 - Understanding Storm Control on EX Series Switches on page 3

unknown-unicast-forwarding

Syntax unknown-unicast-forwarding {
 vlan (all | *vlan-name*){
 interface *interface-name*;
 }
 }

Hierarchy Level [edit ethernet-switching-options]

Release Information Statement introduced in JUNOS Release 9.3 for EX Series switches.

Description Configure the switch to forward all unknown unicast packets in a VLAN or on all VLANs to a particular interface.



NOTE: Before you can configure unknown unicast forwarding within a VLAN, you must first configure that VLAN.

The remaining statements are explained separately.

Default Unknown unicast packets are flooded to all interfaces that belong to the same VLAN.

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

- Related Topics**
- show vlans
 - show ethernet-switching table
 - Configuring Unknown Unicast Forwarding (CLI Procedure) on page 9
 - Understanding Unknown Unicast Forwarding on EX Series Switches on page 4

vlan

Syntax `vlan (all | vlan-name) {
 interface interface-name;
}`

Hierarchy Level [edit ethernet-switching-options unknown-unicast-forwarding]

Release Information Statement introduced in JUNOS Release 9.3 for EX Series switches. Statement updated with enhanced ? (CLI completion feature) functionality in JUNOS Release 9.5 for EX Series switches.

Description Specify a VLAN from which unknown unicast packets will be forwarded or specify that the packets will be forwarded from all VLANs. Unknown unicast packets are forwarded from a VLAN to a specific trunk interface.

The `interface` statement is explained separately.



TIP: To display a list of all configured VLANs on the system, including VLANs that are configured but not committed, type ? after `vlan` or `vlangs` in your configuration mode command line. Note that only one VLAN is displayed for a VLAN range.

Options `all`—All VLANs.

`vlan-name`—Name of a VLAN.

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

- Related Topics**
- `show vlans`
 - `show ethernet-switching table`
 - Configuring Unknown Unicast Forwarding (CLI Procedure) on page 9
 - Verifying That Unknown Unicast Packets Are Forwarded to a Trunk Interface on page 11
 - Understanding Unknown Unicast Forwarding on EX Series Switches on page 4

Chapter 6

Operational Mode Commands for Rate Limiting

show ethernet-switching interfaces

- Syntax** show ethernet-switching interfaces
 <brief | detail | summary>
 <interface *interface-name*>
- Release Information** Command introduced in JUNOS Release 9.0 for EX Series switches. In JUNOS Release 9.6 for EX Series switches, the following updates were made:
- Blocking field output updated.
 - The default view updated to include information about 802.1Q-tags.
 - The detail view updated to include information VLAN mapping.
- Description** Display information about switched Ethernet interfaces.
- Options** none—(Optional) Display brief information for Ethernet switching interfaces.
- brief | detail | summary—(Optional) Display the specified level of output.
- interface *interface-name*—(Optional) Display Ethernet switching information for a specific interface.
- Required Privilege Level** view
- Related Topics**
- show ethernet-switching mac-learning-log
 - show ethernet-switching table
 - Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure) on page 10
- List of Sample Output**
- show ethernet-switching interfaces on page 31
 - show ethernet-switching interfaces ge-0/0/15 brief on page 32
 - show ethernet-switching interfaces ge-0/0/2 detail (Blocked by RTG rtggroup) on page 32
 - show ethernet-switching interfaces ge-0/0/15 detail (Blocked by STP) on page 32
 - show ethernet-switching interfaces ge-0/0/17 detail (Disabled by bpdu-control) on page 32
 - show ethernet-switching interfaces detail (C-VLAN to S-VLAN Mapping) on page 32
- Output Fields** Table 1 on page 30 lists the output fields for the show ethernet-switching interfaces command. Output fields are listed in the approximate order in which they appear.

Table 1: show ethernet-switching interfaces Output Fields

Field Name	Field Description	Level of Output
Interface	Name of a switching interface.	All levels
State	Interface state. Values are up and down.	none, brief, detail, summary

Table 1: show ethernet-switching interfaces Output Fields (continued)

Field Name	Field Description	Level of Output
VLAN members	Name of a VLAN.	none, brief, detail, summary
Tag	Number of the 802.1Q-tag.	All levels
Tagging	Specifies whether the interface forwards 802.1Q-tagged or untagged traffic.	All levels
Blocking	The forwarding state of the interface: <ul style="list-style-type: none"> ■ unblocked—Traffic is forwarded on the interface. ■ blocked—Traffic is not being forwarded on the interface. ■ Disabled by bpd control—The interface is disabled due to receiving BPDUs on a protected interface. If the <code>disable-timeout</code> statement has been included in the BPDU configuration, the interface automatically returns to service after the timer expires. ■ blocked by RTG—The specified redundant trunk group is disabled. ■ blocked by STP—The interface is disabled due to a spanning tree protocol error. ■ MAC limit exceeded—The interface is temporarily disabled due to a MAC limiting error. The disabled interface is automatically restored to service when the disable timeout expires. ■ MAC move limit exceeded—The interface is temporarily disabled due to a MAC move limiting error. The disabled interface is automatically restored to service when the disable timeout expires. ■ Storm control in effect—The interface is temporarily disabled due to a storm control error. The disabled interface is automatically restored to service when the disable timeout expires. 	none, brief, detail, summary
Index	The VLAN index internal to JUNOS Software.	detail
mapping	The C-VLAN to S-VLAN mapping information: <ul style="list-style-type: none"> ■ dot1q-tunneled—The interface maps all traffic to the S-VLAN (all-in-one bundling). ■ native—The interface maps untagged and priority tagged packets to the S-VLAN. ■ push—The interface maps packets to a firewall filter to an S-VLAN. ■ policy-mapped—The interface maps packets to a specifically defined S-VLAN. ■ integer—The interface maps packets to the specified S-VLAN. 	detail

```

show ethernet-switching interfaces user@switch> show ethernet-switching interfaces
Interface   State  VLAN members      Tag  Tagging  Blocking
-----
ae0.0      up    default          300  untagged unblocked
ge-0/0/2.0 up    vlan300          300  untagged blocked by RTG (rtggroup)
ge-0/0/3.0 up    default          300  untagged blocked by STP
ge-0/0/4.0 down  default          300  untagged MAC limit exceeded
ge-0/0/5.0 down  default          300  untagged MAC move limit exceeded
ge-0/0/6.0 down  default          300  untagged Storm control in effect

```

```

ge-0/0/7.0 down default unblocked
ge-0/0/13.0 up default untagged unblocked
ge-0/0/14.0 up vlan100 100 tagged unblocked
                vlan200 200 tagged unblocked
ge-0/0/15.0 up vlan100 100 tagged blocked by STP
                vlan200 200 tagged blocked by STP
ge-0/0/16.0 down default untagged unblocked
ge-0/0/17.0 down vlan100 100 tagged Disabled by bpdu-control
                vlan200 200 tagged Disabled by bpdu-control

```

```

show ethernet-switching user@switch> show ethernet-switching interfaces ge-0/0/15 brief
interfaces ge-0/0/15 Interface State VLAN members Tag Tagging Blocking
brief
ge-0/0/15.0 up vlan100 100 tagged blocked by STP
                vlan200 200 tagged blocked by STP

```

```

show ethernet-switching user@switch> show ethernet-switching interfaces ge-0/0/2 detail
interfaces ge-0/0/2 Interface: ge-0/0/2.0, Index: 65, State: up, Port mode: Access
detail (Blocked by RTG VLAN membership:
rtggroup)      vlan300, 802.1Q Tag: 300, untagged, msti-id: 0, blocked by RTG(rtggroup)
Number of MACs learned on IFL: 0

```

```

show ethernet-switching user@switch> show ethernet-switching interfaces ge-0/0/15 detail
interfaces ge-0/0/15 Interface: ge-0/0/15.0, Index: 70, State: up, Port mode: Trunk
detail (Blocked by STP) VLAN membership:
                vlan100, 802.1Q Tag: 100, tagged, msti-id: 0, blocked by STP
                vlan200, 802.1Q Tag: 200, tagged, msti-id: 0, blocked by STP
Number of MACs learned on IFL: 0

```

```

show ethernet-switching user@switch> show ethernet-switching interfaces ge-0/0/17 detail
interfaces ge-0/0/17 Interface: ge-0/0/17.0, Index: 71, State: down, Port mode: Trunk
detail (Disabled by VLAN membership:
bpdu-control)      vlan100, 802.1Q Tag: 100, tagged, msti-id: 1, Disabled by bpdu-control
                vlan200, 802.1Q Tag: 200, tagged, msti-id: 2, Disabled by bpdu-control
Number of MACs learned on IFL: 0

```

```

show ethernet-switching user@switch> show ethernet-switching interfaces ge-0/0/6.0 detail
interfaces detail Interface: ge-0/0/6.0, Index: 73, State: up, Port mode: Access
(C-VLAN to S-VLAN VLAN membership:
Mapping)      map, 802.1Q Tag: 134, Mapped Tag: native, push, dot1q-tunneled, unblocked
                map, 802.1Q Tag: 134, Mapped Tag: 20, push, dot1q-tunneled, unblocked

```

show ethernet-switching table

Syntax	show ethernet-switching table <brief detail extensive summary> <interface <i>interface-name</i> > <management-vlan> <vlan (<i>vlan-name</i>)>
Release Information	Command introduced in JUNOS Release 9.0 for EX Series switches. Options <i>summary</i> , <i>management-vlan</i> , and <i>vlan vlan-name</i> introduced in JUNOS Release 9.6 for EX Series switches.
Description	Displays the Ethernet switching table.
Options	<p><i>none</i>—(Optional) Display brief information about the Ethernet switching table.</p> <p><i>brief detail extensive summary</i>—(Optional) Display the specified level of output.</p> <p><i>management-vlan</i>—(Optional) Display the Ethernet switching table for a management VLAN.</p> <p><i>interface-name</i>—(Optional) Display the Ethernet switching table for a specific interface.</p> <p><i>vlan vlan-name</i>—(Optional) Display the Ethernet switching table for a specific VLAN.</p>
Required Privilege Level	view
Related Topics	<ul style="list-style-type: none"> ■ Example: Setting Up Basic Bridging and a VLAN for an EX Series Switch ■ Example: Setting Up Bridging with Multiple VLANs for EX Series Switches ■ Example: Configure Automatic VLAN Administration Using GVRP ■ Example: Setting Up Q-in-Q Tunneling on EX Series Switches
List of Sample Output	<p>show ethernet-switching table on page 34</p> <p>show ethernet-switching table brief on page 34</p> <p>show ethernet-switching table detail on page 35</p> <p>show ethernet-switching table extensive on page 36</p> <p>show ethernet-switching table interface ge-0/0/1 on page 38</p>
Output Fields	Table 2 on page 33 lists the output fields for the <code>show ethernet-switching table</code> command. Output fields are listed in the approximate order in which they appear.

Table 2: show ethernet-switching table Output Fields

Field Name	Field Description	Level of Output
VLAN	The name of a VLAN.	All levels
MAC address	The MAC address associated with the VLAN.	All levels

Table 2: show ethernet-switching table Output Fields (continued)

Field Name	Field Description	Level of Output
Type	The type of MAC address. Values are: <ul style="list-style-type: none"> ■ static—The MAC address is manually created. ■ learn—The MAC address is learned dynamically from a packet's source MAC address. ■ flood—The MAC address is unknown and flooded to all members. 	All levels
Age	The time remaining before the entry ages out and is removed from the Ethernet switching table.	All levels
Interfaces	Interface associated with learned MAC addresses or All-members (flood entry).	All levels
Learned	For learned entries, the time which the entry was added to the Ethernet-switching table.	detail, extensive

```

show ethernet-switching table user@switch> show ethernet-switching table
Ethernet-switching table: 57 entries, 17 learned
VLAN      MAC address      Type      Age Interfaces
F2         *                Flood     - All-members
F2         00:00:05:00:00:03 Learn     0 ge-0/0/44.0
F2         00:19:e2:50:7d:e0 Static    - Router
Linux     *                Flood     - All-members
Linux     00:19:e2:50:7d:e0 Static    - Router
Linux     00:30:48:90:54:89 Learn     0 ge-0/0/47.0
T1        *                Flood     - All-members
T1        00:00:05:00:00:01 Learn     0 ge-0/0/46.0
T1        00:00:5e:00:01:00 Static    - Router
T1        00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
T1        00:19:e2:50:7d:e0 Static    - Router
T10       *                Flood     - All-members
T10       00:00:5e:00:01:09 Static    - Router
T10       00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
T10       00:19:e2:50:7d:e0 Static    - Router
T111     *                Flood     - All-members
T111     00:19:e2:50:63:e0 Learn     0 ge-0/0/15.0
T111     00:19:e2:50:7d:e0 Static    - Router
T111     00:19:e2:50:ac:00 Learn     0 ge-0/0/15.0
T2        *                Flood     - All-members
T2        00:00:5e:00:01:01 Static    - Router
T2        00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
T2        00:19:e2:50:7d:e0 Static    - Router
T3        *                Flood     - All-members
T3        00:00:5e:00:01:02 Static    - Router
T3        00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
T3        00:19:e2:50:7d:e0 Static    - Router
T4        *                Flood     - All-members
T4        00:00:5e:00:01:03 Static    - Router
T4        00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
[output truncated]
    
```

```

show ethernet-switching table brief user@switch> show ethernet-switching table brief
Ethernet-switching table: 57 entries, 17 learned
VLAN      MAC address      Type      Age Interfaces
F2         *                Flood     - All-members
    
```

```

F2          00:00:05:00:00:03 Learn      0 ge-0/0/44.0
F2          00:19:e2:50:7d:e0 Static    - Router
Linux       *                Flood     - All-members
Linux       00:19:e2:50:7d:e0 Static    - Router
Linux       00:30:48:90:54:89 Learn    0 ge-0/0/47.0
T1          *                Flood     - All-members
T1          00:00:05:00:00:01 Learn    0 ge-0/0/46.0
T1          00:00:5e:00:01:00 Static    - Router
T1          00:19:e2:50:63:e0 Learn    0 ge-0/0/46.0
T1          00:19:e2:50:7d:e0 Static    - Router
T10         *                Flood     - All-members
T10         00:00:5e:00:01:09 Static    - Router
T10         00:19:e2:50:63:e0 Learn    0 ge-0/0/46.0
T10         00:19:e2:50:7d:e0 Static    - Router
T111        *                Flood     - All-members
T111        00:19:e2:50:63:e0 Learn    0 ge-0/0/15.0
T111        00:19:e2:50:7d:e0 Static    - Router
T111        00:19:e2:50:ac:00 Learn    0 ge-0/0/15.0
T2          *                Flood     - All-members
T2          00:00:5e:00:01:01 Static    - Router
T2          00:19:e2:50:63:e0 Learn    0 ge-0/0/46.0
T2          00:19:e2:50:7d:e0 Static    - Router
T3          *                Flood     - All-members
T3          00:00:5e:00:01:02 Static    - Router
T3          00:19:e2:50:63:e0 Learn    0 ge-0/0/46.0
T3          00:19:e2:50:7d:e0 Static    - Router
T4          *                Flood     - All-members
T4          00:00:5e:00:01:03 Static    - Router
T4          00:19:e2:50:63:e0 Learn    0 ge-0/0/46.0

```

[output truncated]

**show ethernet-switching
table detail**

```

user@switch> show ethernet-switching table detail
Ethernet-switching table: 57 entries, 17 learned

```

```

F2, *
  Interface(s): ge-0/0/44.0
  Type: Flood
  Nexthop index: 0

F2, 00:00:05:00:00:03
  Interface(s): ge-0/0/44.0
  Type: Learn, Age: 0, Learned: 2:03:09
  Nexthop index: 0

F2, 00:19:e2:50:7d:e0
  Interface(s): Router
  Type: Static
  Nexthop index: 0

Linux, *
  Interface(s): ge-0/0/47.0
  Type: Flood
  Nexthop index: 0

Linux, 00:19:e2:50:7d:e0
  Interface(s): Router
  Type: Static
  Nexthop index: 0

Linux, 00:30:48:90:54:89
  Interface(s): ge-0/0/47.0
  Type: Learn, Age: 0, Learned: 2:03:08

```

```

    Nexthop index: 0

T1, *
  Interface(s): ge-0/0/46.0
  Type: Flood
  Nexthop index: 0

T1, 00:00:05:00:00:01
  Interface(s): ge-0/0/46.0
  Type: Learn, Age: 0, Learned: 2:03:07
  Nexthop index: 0

T1, 00:00:5e:00:01:00
  Interface(s): Router
  Type: Static
  Nexthop index: 0

T1, 00:19:e2:50:63:e0
  Interface(s): ge-0/0/46.0
  Type: Learn, Age: 0, Learned: 2:03:07
  Nexthop index: 0

T1, 00:19:e2:50:7d:e0
  Interface(s): Router
  Type: Static
  Nexthop index: 0

T10, *
  Interface(s): ge-0/0/46.0
  Type: Flood
  Nexthop index: 0

T10, 00:00:5e:00:01:09
  Interface(s): Router
  Type: Static
  Nexthop index: 0

T10, 00:19:e2:50:63:e0
  Interface(s): ge-0/0/46.0
  Type: Learn, Age: 0, Learned: 2:03:08
  Nexthop index: 0

T10, 00:19:e2:50:7d:e0
  Interface(s): Router
  Type: Static
  Nexthop index: 0

T111, *
  Interface(s): ge-0/0/15.0
  Type: Flood
  Nexthop index: 0
[output truncated]

```

show ethernet-switching table extensive

```

user@switch> show ethernet-switching table extensive
Ethernet-switching table: 57 entries, 17 learned
F2, *
  Interface(s): ge-0/0/44.0
  Type: Flood
  Nexthop index: 0

F2, 00:00:05:00:00:03

```

```

Interface(s): ge-0/0/44.0
Type: Learn, Age: 0, Learned: 2:03:09
Nexthop index: 0

F2, 00:19:e2:50:7d:e0
Interface(s): Router
Type: Static
Nexthop index: 0

Linux, *
Interface(s): ge-0/0/47.0
Type: Flood
Nexthop index: 0

Linux, 00:19:e2:50:7d:e0
Interface(s): Router
Type: Static
Nexthop index: 0

Linux, 00:30:48:90:54:89
Interface(s): ge-0/0/47.0
Type: Learn, Age: 0, Learned: 2:03:08
Nexthop index: 0

T1, *
Interface(s): ge-0/0/46.0
Type: Flood
Nexthop index: 0

T1, 00:00:05:00:00:01
Interface(s): ge-0/0/46.0
Type: Learn, Age: 0, Learned: 2:03:07
Nexthop index: 0

T1, 00:00:5e:00:01:00
Interface(s): Router
Type: Static
Nexthop index: 0

T1, 00:19:e2:50:63:e0
Interface(s): ge-0/0/46.0
Type: Learn, Age: 0, Learned: 2:03:07
Nexthop index: 0

T1, 00:19:e2:50:7d:e0
Interface(s): Router
Type: Static
Nexthop index: 0

T10, *
Interface(s): ge-0/0/46.0
Type: Flood
Nexthop index: 0

T10, 00:00:5e:00:01:09
Interface(s): Router
Type: Static
Nexthop index: 0

T10, 00:19:e2:50:63:e0
Interface(s): ge-0/0/46.0

```

```

Type: Learn, Age: 0, Learned: 2:03:08
Nexthop index: 0

T10, 00:19:e2:50:7d:e0
Interface(s): Router
Type: Static
Nexthop index: 0

T111, *
Interface(s): ge-0/0/15.0
Type: Flood
Nexthop index: 0
[output truncated]

```

**show ethernet-switching
table interface ge-0/0/1**

```

user@switch> show ethernet-switching table interface ge-0/0/1
Ethernet-switching table: 1 unicast entries
VLAN          MAC address      Type      Age Interfaces
V1            *                Flood     - All-members
V1            00:00:05:00:00:05 Learn     0 ge-0/0/1.0

```