



**JUNOS® Software for EX-series Switches**

## **JUNOS® Software for EX-series Switches, Release 9.3: Device Security**

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## Part 1

### **Rate Limiting**

#### Chapter 1

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# About This Topic Collection

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## How To Use This Guide

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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](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.

For release-specific information, see the release notes at [http://www.juniper.net/techpubs/en\\_US/junos9.3/information-products/pathway-pages/ex-series/software/index.html](http://www.juniper.net/techpubs/en_US/junos9.3/information-products/pathway-pages/ex-series/software/index.html).

## List of EX-series Guides for JUNOS 9.3

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Title	Description
<i>Complete Hardware Guide for EX 3200 and EX 4200 Switches</i>	Component descriptions, site preparation, installation, replacement, and safety and compliance
<i>Complete Software Guide for JUNOS® Software for EX Series Switches, Release 9.3</i>	Software feature descriptions, configuration examples and tasks, and reference pages for configuration statements and operational commands for JUNOS Software for EX Series switches
<b>Software Topic Collections</b>	Software feature descriptions, configuration examples and tasks, and reference pages for configuration statements and operational commands
<i>JUNOS® Software for EX-series Switches, Release 9.3: Access Control</i>	

Title	Description
<i>JUNOS® Software for EX-series Switches, Release 9.3: Configuration and File Management</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Class of Service</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Device Security</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Ethernet Switching</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Interfaces</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Layer 3 Protocols</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Multicast</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Network Management and Monitoring</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Port Security</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Routing Policy and Packet Filtering</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: Spanning-Tree Protocols</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: System Setup</i>	
<i>JUNOS® Software for EX-series Switches, Release 9.3: User and Access Management</i>	
<i>JUNOS® Software Guide for EX-series Switches, Release 9.3: Virtual Systems</i>	
<i>J-Web User Interface Guide for JUNOS Software for EX-series Switches</i>	How to use the J-Web graphical user interface (GUI) with JUNOS for EX-series software
<i>JUNOS Software for EX-series Switches Release Notes, Release 9.3</i>	Summary of hardware and software features and known problems with the software and hardware

## Downloading Software

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## 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 <code>configure</code> command:  user@host> <b>configure</b>
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> <b>show chassis alarms</b> No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none"> <li>■ Introduces important new terms.</li> <li>■ Identifies book names.</li> <li>■ Identifies RFC and Internet draft titles.</li> </ul>	<ul style="list-style-type: none"> <li>■ A policy <i>term</i> is a named structure that defines match conditions and actions.</li> <li>■ <i>JUNOS System Basics Configuration Guide</i></li> <li>■ RFC 1997, <i>BGP Communities Attribute</i></li> </ul>
<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@# <b>set system domain-name</b> <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"> <li>■ To configure a stub area, include the <code>stub</code> statement at the [edit protocols ospf area area-id] hierarchy level.</li> <li>■ The console port is labeled CONSOLE.</li> </ul>

Text and Syntax Conventions		
Convention	Description	Examples
< > (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		
<b>Bold text like this</b>	Represents J-Web graphical user interface (GUI) items you click or select.	<ul style="list-style-type: none"> <li>■ In the Logical Interfaces box, select <b>All Interfaces</b>.</li> <li>■ To cancel the configuration, click <b>Cancel</b>.</li> </ul>
> (bold right angle bracket)	Separates levels in a hierarchy of J-Web selections.	In the configuration editor hierarchy, select <b>Protocols &gt; Ospf</b> .

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

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## Part 1

# Rate Limiting

- Rate Limiting on page 3



## Chapter 1

# Rate Limiting

- Rate Limiting Overview on page 3
- Example: Rate Limiting Configuration on page 4
- Configuring Rate Limiting on page 6
- Verifying Rate Limiting Configuration on page 7
- Configuration Statements for Rate Limiting on page 8
- Operational Mode Commands for Rate Limiting on page 18

### Rate Limiting Overview

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- 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. Enable storm control to permit the switch to monitor traffic levels and drop packets when a specified traffic level is exceeded, thus preventing packets from proliferating and degrading the LAN.

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 use storm control to set the level at which you want to drop broadcast traffic, unknown unicast traffic, or both.

- Related Topics**
- Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 4

## **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 4
  - Configuring Unknown Unicast Forwarding (CLI Procedure) on page 6

## **Example: Rate Limiting Configuration**

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- Example: Configuring Storm Control to Prevent Network Outages on EX-series Switches on page 4

## **Example: Configuring Storm Control to Prevent Network Outages on EX-series Switches**

Storm control enables you to prevent network outage 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 4
- Overview and Topology on page 5
- Configuration on page 5

### **Requirements**

This example uses the following hardware and software components:

- One Juniper Networks EX-series 3200 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 level, of broadcast traffic or unknown unicast traffic or both to be allowed on a port interface. This level is a percentage of the total available bandwidth of the port. For example, if the level is set to 20, up to 20 (plus or minus two) percent of the total available bandwidth of the port can be used for transmitting broadcast traffic or unknown unicast traffic or both.



**NOTE:** If you do not specify the level, the default level will be applied. The default level is 80.

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

The topology used in this example consists of one EX 3200 switch with 24 ports. The switch is connected to various network devices. In this example, storm control is configured to rate limit both broadcast and unknown unicast traffic on port interface `ge-0/0/0`. The rate limit level is set to 40. Therefore, if broadcast traffic or unknown unicast traffic or both exceed 40 (plus or minus two) percent of the total available bandwidth of the port, packets for the controlled traffic types are dropped to prevent network outage.



**NOTE:** When you configure storm control on an interface, both broadcast traffic and unknown unicast traffic are rate limited, by default. You can exempt either type of traffic from rate limiting by using the `no-broadcast` or `no-unknown-unicast` statement.

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## Configuration

### CLI Quick Configuration

To quickly configure storm control, copy the following commands and paste them into the switch terminal window:

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

**Step-by-Step Procedure** To configure storm control:

1. Enable storm control on the interface and specify the level of allowed broadcast traffic and unknown unicast traffic:

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

**Results** Display the results of the configuration:

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

**Related Topics** ■ Understanding Storm Control on EX Series Switches on page 3

## Configuring Rate Limiting

---

- Configuring Unknown Unicast Forwarding (CLI Procedure) on page 6

### 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:

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 4
  - Verifying That Unknown Unicast Packets Are Forwarded to a Trunk Interface on page 7
  - Understanding Unknown Unicast Forwarding on EX Series Switches on page 4
  - Understanding Storm Control on EX Series Switches on page 3

## Verifying Rate Limiting Configuration

---

- Verifying That Unknown Unicast Packets Are Forwarded to a Trunk Interface on page 7

### 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 6](#)

## Configuration Statements for Rate Limiting

---

■ [\[edit ethernet-switching-options\] Configuration Statement Hierarchy on page 8](#)

### **[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 {
    interface (all | [interface-name]);
    disable-timeout timeout;
  }
  dot1q-tunneling {
    ether-type (0x8100 | 0x88a8 | 0x9100)
  }
  redundant-trunk-group {
    group-name name {
      interface interface-name <primary>;
    }
  }
  secure-access-port {
    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>;
  }
}
}
}

```

- Related Topics**
- Understanding Port Mirroring on EX Series Switches
  - Port Security for EX-series Switches Overview
  - Understanding 802.1X and VoIP 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

## 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 {
        interface (all | [interface-name]);
        disable-timeout timeout;
    }
    dot1q-tunneling {
        ether-type (0x8100 | 0x88a8 | 0x9100)
    }
    redundant-trunk-group {
        group-name name {
            interface interface-name <primary>;
            interface interface-name;
        }
    }
    secure-access-port {
        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. Options `static-ip` and `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.

**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**
- Understanding BPDU Protection for STP, RSTP, and MSTP on EX Series Switches
  - Understanding Port Mirroring on EX Series Switches
  - Port Security for EX-series Switches Overview
  - 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*) {  
    level *level*;  
    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 disabled.

**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 4
  - Understanding Storm Control on EX Series Switches on page 3

## interface

---

<b>Syntax</b>	<code>interface interface-name;</code>
<b>Hierarchy Level</b>	[edit ethernet-switching-options unknown-unicast-forwarding vlan(all vlan-name)]
<b>Release Information</b>	Statement introduced in JUNOS Release 9.3 for EX-series switches.
<b>Description</b>	Specify the interface to which unknown unicast packets will be forwarded.
<b>Required Privilege Level</b>	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
<b>Related Topics</b>	<ul style="list-style-type: none"> <li>■ show vlans</li> <li>■ show ethernet-switching table</li> <li>■ Configuring Unknown Unicast Forwarding (CLI Procedure) on page 6</li> <li>■ Understanding Unknown Unicast Forwarding on EX Series Switches on page 4</li> </ul>

## level

---

<b>Syntax</b>	<code>level level;</code>
<b>Hierarchy Level</b>	[edit ethernet-switching-options storm-control interface (all   interface-name)]
<b>Release Information</b>	Statement introduced in JUNOS Release 9.1 for EX-series switches.
<b>Description</b>	For interfaces configured for storm control, configure the storm control level as a percentage of the combined broadcast and unknown unicast streams. The level set to 100% means no traffic storm control.
<b>Default</b>	When storm control is enabled on an interface, the storm control level is 80%.
<b>Options</b>	<p><i>level</i>—Percentage of the combined broadcast and unknown unicast streams.</p> <p><b>Range:</b> 0 through 100 %</p> <p><b>Default:</b> 80 %</p> <p>The remaining statements are explained separately.</p>
<b>Required Privilege Level</b>	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
<b>Related Topics</b>	<ul style="list-style-type: none"> <li>■ Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 4</li> <li>■ Understanding Storm Control on EX Series Switches on page 3</li> </ul>

## no-broadcast

---

<b>Syntax</b>	no-broadcast;
<b>Hierarchy Level</b>	[edit ethernet-switching-options storm-control interface (all   <i>interface-name</i> )]
<b>Release Information</b>	Statement introduced in JUNOS Release 9.1 for EX-series switches.
<b>Description</b>	For interfaces configured for storm control, disable broadcast traffic storm control on the interface.
<b>Default</b>	When storm control is enabled on an interface, it is enabled for both unknown unicast traffic and broadcast traffic.
<b>Required Privilege Level</b>	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
<b>Related Topics</b>	<ul style="list-style-type: none"> <li>■ Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 4</li> <li>■ Understanding Storm Control on EX Series Switches on page 3</li> </ul>

## no-unknown-unicast

---

<b>Syntax</b>	no-unknown-unicast;
<b>Hierarchy Level</b>	[edit ethernet-switching-options storm-control interface (all   <i>interface-name</i> )]
<b>Release Information</b>	Statement introduced in JUNOS Release 9.1 for EX-series switches.
<b>Description</b>	For interfaces configured for storm control, disable unknown unicast traffic storm control on the interface.
<b>Default</b>	When storm control is enabled on an interface, it is enabled for both unknown unicast traffic and broadcast traffic.
<b>Required Privilege Level</b>	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
<b>Related Topics</b>	<ul style="list-style-type: none"> <li>■ Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches on page 4</li> <li>■ Understanding Storm Control on EX Series Switches on page 3</li> </ul>

## storm-control

---

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

**Hierarchy Level** [edit ethernet-switching-options]

**Release Information** Statement introduced in JUNOS Release 9.1 for EX-series switches.

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

The statements are explained separately.

**Default** Storm control is disabled.

**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 4
  - 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.

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 6
- 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.

**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.

**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 6
  - Verifying That Unknown Unicast Packets Are Forwarded to a Trunk Interface on page 7
  - Understanding Unknown Unicast Forwarding on EX Series Switches on page 4

## Operational Mode Commands for Rate Limiting

---

## show ethernet-switching table

<b>Syntax</b>	show ethernet-switching table <brief   detail   extensive> <interface <i>interface-name</i> > <vlan ( <i>vlan-id</i>   <i>vlan-name</i> )>
<b>Release Information</b>	Command introduced in JUNOS Release 9.0 for EX-series switches.
<b>Description</b>	Displays the Ethernet switching table. If a VLAN range has been configured for any of the VLANs on the switch, the output displays the MAC addresses for the entire series of VLANs.
<b>Options</b>	<p>none—(Optional) Display brief information about the Ethernet switching table for all VLANs on the switch.</p> <p>brief   detail   extensive—(Optional) Display the specified level of output.</p> <p><i>interface-name</i> —(Optional) Display the Ethernet switching table for a specific interface.</p> <p>vlan (<i>vlan-id</i>   <i>vlan-name</i>)—(Optional) Display the Ethernet switching table for the specified VLAN ID or VLAN name. If a VLAN range has been configured for this VLAN name, the output displays the MAC addresses for the entire series of VLANs that were created for that name.</p>
<b>Required Privilege Level</b>	view
<b>Related Topics</b>	<ul style="list-style-type: none"> <li>■ Example: Setting Up Basic Bridging and a VLAN for an EX Series Switch</li> <li>■ Example: Setting Up Bridging with Multiple VLANs for EX Series Switches</li> <li>■ Example: Configure Automatic VLAN Administration Using GVRP</li> <li>■ Example: Setting Up Q-in-Q Tunneling on EX Series Switches</li> </ul>
<b>List of Sample Output</b>	<p>show ethernet-switching table on page 20</p> <p>show ethernet-switching table (where one VLAN is configured with VLAN range and the other is not) on page 21</p> <p>show ethernet-switching table brief on page 21</p> <p>show ethernet-switching table detail on page 22</p> <p>show ethernet-switching table extensive on page 23</p> <p>show ethernet-switching table interface ge-0/0/1 on page 24</p> <p>show ethernet-switching table vlan customer (vlan-name) on page 24</p> <p>show ethernet-switching table vlan employee (vlan-name is vlan-range) on page 24</p>
<b>Output Fields</b>	Table 1 on page 19 lists the output fields for the show ethernet-switching table command. Output fields are listed in the approximate order in which they appear.

**Table 1: show ethernet-switching table Output Fields**

Field Name	Field Description	Level of Output
VLAN	The name of a VLAN.	All levels

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

Field Name	Field Description	Level of Output
MAC address	The MAC address associated with the VLAN. If the If a VLAN range has been configured for a VLAN, the output displays the MAC addresses for the entire series of VLANs that were created with that name.	All levels
Type	The type of MAC address. Values are: <ul style="list-style-type: none"> <li>■ static—The MAC address is manually created.</li> <li>■ learn—The MAC address is learned dynamically from a packet's source MAC address.</li> <li>■ flood—The MAC address is unknown and flooded to all members.</li> </ul>	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     0 ge-0/0/44.0
  F2        00:00:05:00:00:03 Learn     0 ge-0/0/44.0
  F2        00:19:e2:50:7d:e0 Static    0 ge-0/0/44.0
  Linux     *                Flood     0 ge-0/0/44.0
  Linux     00:19:e2:50:7d:e0 Static    0 ge-0/0/44.0
  Linux     00:30:48:90:54:89 Learn     0 ge-0/0/47.0
  T1        *                Flood     0 ge-0/0/46.0
  T1        00:00:05:00:00:01 Learn     0 ge-0/0/46.0
  T1        00:00:5e:00:01:00 Static    0 ge-0/0/46.0
  T1        00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
  T1        00:19:e2:50:7d:e0 Static    0 ge-0/0/46.0
  T10       *                Flood     0 ge-0/0/46.0
  T10       00:00:5e:00:01:09 Static    0 ge-0/0/46.0
  T10       00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
  T10       00:19:e2:50:7d:e0 Static    0 ge-0/0/46.0
  T111     *                Flood     0 ge-0/0/15.0
  T111     00:19:e2:50:63:e0 Learn     0 ge-0/0/15.0
  T111     00:19:e2:50:7d:e0 Static    0 ge-0/0/15.0
  T111     00:19:e2:50:ac:00 Learn     0 ge-0/0/15.0
  T2        *                Flood     0 ge-0/0/46.0
  T2        00:00:5e:00:01:01 Static    0 ge-0/0/46.0
  T2        00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
  T2        00:19:e2:50:7d:e0 Static    0 ge-0/0/46.0
  T3        *                Flood     0 ge-0/0/46.0
  T3        00:00:5e:00:01:02 Static    0 ge-0/0/46.0
  T3        00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
  T3        00:19:e2:50:7d:e0 Static    0 ge-0/0/46.0
  T4        *                Flood     0 ge-0/0/46.0
  T4        00:00:5e:00:01:03 Static    0 ge-0/0/46.0
  T4        00:19:e2:50:63:e0 Learn     0 ge-0/0/46.0
[output truncated]
    
```

**show ethernet-switching table (where one VLAN is configured with VLAN range and the other is not)**

```
user@switch> show ethernet-switching table
Ethernet-switching table: 36 entries, 30 learned
VLAN          MAC address      Type      Age Interfaces
__employee_1__ *                Flood     - All-members
__employee_1__ 00:10:94:00:00:02 Learn     4:35 ge-0/0/6.0
__employee_1__ 00:10:94:00:00:03 Learn     4:27 ge-0/0/6.0
__employee_1__ 00:10:94:00:00:04 Learn     4:30 ge-0/0/6.0
__employee_1__ 00:10:94:00:00:05 Learn     4:23 ge-0/0/6.0
__employee_1__ 00:10:94:00:00:06 Learn     4:34 ge-0/0/6.0
__employee_2__ *                Flood     - All-members
__employee_2__ 00:10:94:00:00:02 Learn     4:27 ge-0/0/6.0
__employee_2__ 00:10:94:00:00:03 Learn     4:35 ge-0/0/6.0
__employee_2__ 00:10:94:00:00:04 Learn     4:22 ge-0/0/6.0
__employee_2__ 00:10:94:00:00:05 Learn     4:31 ge-0/0/6.0
__employee_2__ 00:10:94:00:00:06 Learn     4:26 ge-0/0/6.0
__employee_3__ *                Flood     - All-members
__employee_3__ 00:10:94:00:00:02 Learn     4:23 ge-0/0/6.0
__employee_3__ 00:10:94:00:00:03 Learn     4:31 ge-0/0/6.0
__employee_3__ 00:10:94:00:00:04 Learn     4:26 ge-0/0/6.0
__employee_3__ 00:10:94:00:00:05 Learn     4:35 ge-0/0/6.0
__employee_3__ 00:10:94:00:00:06 Learn     4:38 ge-0/0/6.0
__employee_4__ *                Flood     - All-members
__employee_4__ 00:10:94:00:00:02 Learn     4:23 ge-0/0/6.0
__employee_4__ 00:10:94:00:00:03 Learn     4:31 ge-0/0/6.0
__employee_4__ 00:10:94:00:00:04 Learn     4:26 ge-0/0/6.0
__employee_4__ 00:10:94:00:00:05 Learn     4:35 ge-0/0/6.0
__employee_4__ 00:10:94:00:00:06 Learn     4:38 ge-0/0/6.0
__employee_5__ *                Flood     - All-members
__employee_5__ 00:10:94:00:00:02 Learn     4:27 ge-0/0/6.0
__employee_5__ 00:10:94:00:00:03 Learn     4:35 ge-0/0/6.0
__employee_5__ 00:10:94:00:00:04 Learn     4:22 ge-0/0/6.0
__employee_5__ 00:10:94:00:00:05 Learn     4:31 ge-0/0/6.0
__employee_5__ 00:10:94:00:00:06 Learn     4:26 ge-0/0/6.0
customer      *                Flood     - All-members
customer      00:10:94:00:00:02 Learn     4:23 ge-0/0/6.0
customer      00:10:94:00:00:03 Learn     4:31 ge-0/0/6.0
customer      00:10:94:00:00:04 Learn     4:27 ge-0/0/6.0
customer      00:10:94:00:00:05 Learn     4:35 ge-0/0/6.0
customer      00:10:94:00:00:06 Learn     4:38 ge-0/0/6.0
```

**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

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

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

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

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

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

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

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

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

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

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

T10, *

```

```

Interface(s): ge-0/0/46.0
Type: Flood

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

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

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

T111, *
Interface(s): ge-0/0/15.0
Type: Flood
[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

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

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

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

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

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

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

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

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

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

```

```

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

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

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

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

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

T111, *
  Interface(s): ge-0/0/15.0
  Type: Flood
[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

```

**show ethernet-switching table vlan customer (vlan-name)**

```

user@switch> show ethernet-switching table customer
Ethernet-switching table: 5 unicast entries
VLAN          MAC address      Type      Age Interfaces
customer      *                Flood     - All-members
customer      00:10:94:00:00:02 Learn      1:36 ge-0/0/6.0
customer      00:10:94:00:00:03 Learn      1:44 ge-0/0/6.0
customer      00:10:94:00:00:04 Learn      1:40 ge-0/0/6.0
customer      00:10:94:00:00:05 Learn      1:48 ge-0/0/6.0
customer      00:10:94:00:00:06 Learn      1:51 ge-0/0/6.0

```

**show ethernet-switching table vlan employee (vlan-name is vlan-range)**

```

user@switch> show ethernet-switching table employee
Ethernet-switching table: 25 unicast entries
VLAN          MAC address      Type      Age Interfaces
__employee_1__ *                Flood     - All-members
__employee_1__ 00:10:94:00:00:02 Learn      1:23 ge-0/0/6.0
__employee_1__ 00:10:94:00:00:03 Learn      1:15 ge-0/0/6.0
__employee_1__ 00:10:94:00:00:04 Learn      1:18 ge-0/0/6.0
__employee_1__ 00:10:94:00:00:05 Learn      1:11 ge-0/0/6.0
__employee_1__ 00:10:94:00:00:06 Learn      1:22 ge-0/0/6.0
__employee_2__ *                Flood     - All-members
__employee_2__ 00:10:94:00:00:02 Learn      1:15 ge-0/0/6.0
__employee_2__ 00:10:94:00:00:03 Learn      1:23 ge-0/0/6.0
__employee_2__ 00:10:94:00:00:04 Learn      1:10 ge-0/0/6.0
__employee_2__ 00:10:94:00:00:05 Learn      1:19 ge-0/0/6.0
__employee_2__ 00:10:94:00:00:06 Learn      1:14 ge-0/0/6.0
__employee_3__ *                Flood     - All-members
__employee_3__ 00:10:94:00:00:02 Learn      1:11 ge-0/0/6.0
__employee_3__ 00:10:94:00:00:03 Learn      1:19 ge-0/0/6.0

```

__employee_3__	00:10:94:00:00:04	Learn	1:14	ge-0/0/6.0
__employee_3__	00:10:94:00:00:05	Learn	1:23	ge-0/0/6.0
__employee_3__	00:10:94:00:00:06	Learn	1:26	ge-0/0/6.0
__employee_4__	*	Flood	-	All-members
__employee_4__	00:10:94:00:00:02	Learn	1:11	ge-0/0/6.0
__employee_4__	00:10:94:00:00:03	Learn	1:19	ge-0/0/6.0
__employee_4__	00:10:94:00:00:04	Learn	1:14	ge-0/0/6.0
__employee_4__	00:10:94:00:00:05	Learn	1:23	ge-0/0/6.0
__employee_4__	00:10:94:00:00:06	Learn	1:26	ge-0/0/6.0
__employee_5__	*	Flood	-	All-members
__employee_5__	00:10:94:00:00:02	Learn	1:15	ge-0/0/6.0
__employee_5__	00:10:94:00:00:03	Learn	1:23	ge-0/0/6.0
__employee_5__	00:10:94:00:00:04	Learn	1:10	ge-0/0/6.0
__employee_5__	00:10:94:00:00:05	Learn	1:19	ge-0/0/6.0
__employee_5__	00:10:94:00:00:06	Learn	1:14	ge-0/0/6.0

