

Security Feature Guide for the QFX Series

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Security Feature Guide for the QFX Series

15.1

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Documentation and Release Notes

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at <http://www.juniper.net/techpubs/>.

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

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Supported Platforms

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

- [QFX Series](#)

Using the Examples in This Manual

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

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

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

Merging a Full Example

To merge a full example, follow these steps:

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

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

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

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

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

Merging a Snippet

To merge a snippet, follow these steps:

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

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

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

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

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

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

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

For more information about the **load** command, see [CLI Explorer](#).

Documentation Conventions

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

Table 1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page xv defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the configure command: user@host> configure

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

Convention	Description	Examples
Fixed-width text like this	Represents output that appears on the terminal screen.	user@host> show chassis alarms No alarms currently active
<i>Italic text like this</i>	<ul style="list-style-type: none">Introduces or emphasizes important new terms.Identifies guide names.Identifies RFC and Internet draft titles.	<ul style="list-style-type: none">A policy <i>term</i> is a named structure that defines match conditions and actions.<i>Junos OS CLI User 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>
Text like this	Represents names of configuration statements, commands, files, and directories; 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)	Encloses 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)	Encloses a variable for which you can substitute one or more values.	community name members [<i>community-ids</i>]
Indentation and braces ({ })	Identifies 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.	
GUI Conventions		
Bold text like this	Represents 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.

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

Convention	Description	Examples
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select Protocols>Ospf .

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can provide feedback by using either of the following methods:

- Online feedback rating system—On any page of the Juniper Networks TechLibrary site at <http://www.juniper.net/techpubs/index.html>, simply click the stars to rate the content, and use the pop-up form to provide us with information about your experience. Alternately, you can use the online feedback form at <http://www.juniper.net/techpubs/feedback/>.
- E-mail—Send your comments to techpubs-comments@juniper.net. Include the document or topic name, URL or page number, and software version (if applicable).

Requesting Technical Support

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

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

Self-Help Online Tools and Resources

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

- Find CSC offerings: <http://www.juniper.net/customers/support/>
- 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:
<http://kb.juniper.net/InfoCenter/>
- Join and participate in the Juniper Networks Community Forum:
<http://www.juniper.net/company/communities/>
- Open a case online in the CSC Case Management tool: <http://www.juniper.net/cm/>

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

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

Firewall Filters

- [Configuring Firewall Filters on page 3](#)

CHAPTER 1

Configuring Firewall Filters

- [Overview of Firewall Filters on page 3](#)
- [Understanding How Firewall Filters Are Evaluated on page 6](#)
- [Understanding How Firewall Filters Control Packet Flows on page 8](#)
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Overview of Firewall Filters

Firewall filters provide rules that define whether to accept or discard packets that are transiting an interface. If a packet is accepted, you can configure additional actions to perform on the packet, such as class-of-service (CoS) marking (grouping similar types of traffic together and treating each type of traffic as a class with its own level of service priority) and traffic policing (controlling the maximum rate of traffic sent or received). You configure firewall filters to determine whether to accept or discard a packet before it enters or exits any of these:

- Port
- VLAN
- Layer 3 (routed) interface
- Routed VLAN interface (RVI)

An *ingress* firewall filter is applied to packets that are entering an interface or VLAN, and an *egress* firewall filter is applied to packets that are exiting an interface or VLAN.



NOTE: Firewall filters are sometimes called *access control lists (ACLs)*.

- [Firewall Filter Types on page 4](#)
- [Firewall Filter Components on page 5](#)
- [Firewall Filter Processing on page 5](#)
- [How Many Filters Are Supported? on page 5](#)

Firewall Filter Types

The following firewall filter types are supported:

- Port (Layer 2) firewall filter—Port firewall filters apply to Layer 2 traffic transiting system ports.
- VLAN firewall filter—VLAN firewall filters provide access control for packets that enter a VLAN, are bridged within a VLAN, or leave a VLAN.
- Router (Layer 3) firewall filter—You can apply a router firewall filter in both ingress and egress directions on IPv4 or IPv6 Layer 3 (routed) interfaces, routed VLAN interfaces (RVI) and a loopback interface, which filters traffic sent to the switch itself or generated by the switch. (You apply a filter to a loopback interface in the input direction to protect the switch from unwanted traffic. You also might want to apply a filter to a loopback interface in the output direction so that you can set the forwarding class and DSCP bit value for packets that originate on the switch itself. This feature gives you very fine control over the classification of CPU generated packets. For example, you might want to assign different DSCP values and forwarding classes to traffic generated by different routing protocols so the traffic for those protocols can be treated in a differentiated manner by other devices. You can apply a filter to a loopback interface in the output direction starting with Junos OS 13.2X51-D15.)



NOTE: You can apply a firewall filter to a management interface (for example, `me0`) on a QFX and EX4600 standalone switch. You cannot apply a firewall filter to a management interface on a QFX3000-G or QFX3000-M system.

- MPLS filter—You can apply a firewall filter to an MPLS interface

To apply a firewall filter:

1. Configure the firewall filter.
2. Apply the firewall filter to a port, VLAN, or router interface.



NOTE: You can apply only one firewall filter to a port, VLAN, or interface for a given direction. For example, for interface ge-0/0/6.0, you can apply one filter for the ingress direction and one for the egress direction.

Firewall Filter Components

In a firewall filter, you first define the family address type (ethernet-switching, inet (for IPv4), inet6 (for IPv6), or mpls) and then define one or more terms that specify the filtering criteria and the action to take if a match occurs.

Each term consists of the following components:

- **Match conditions**—Specify values that a packet must contain to be considered a match. You can specify values for most fields in the IP, TCP, UDP, or ICMP headers. You can also match on interface names.
- **Action**—Specifies what to do if a packet matches the match conditions. A filter can accept, discard, or reject a matching packet and then perform additional actions, such as counting, classifying, and policing. If no action is specified for a term, the default is to accept the matching packet.

Firewall Filter Processing

If there are multiple terms in a filter, the order of the terms is important. If a packet matches the first term, the switch executes the action defined by that term, and no other terms are evaluated. If the switch does not find a match between the packet and the first term, it compares the packet to the next term. If no match occurs between the packet and the second term, the system continues to compare the packet to each successive term in the filter until a match is found. If the packet does not match any terms in the filter, the switch discards the packet by default.

How Many Filters Are Supported?

QFX10000 switches support 8K firewall filters and 64K firewall filter terms.

QFX3500, QFX3600, QFX5100, QFX5110, QFX5200, and EX4600 switches, QFabric Node devices, and VCF members support the maximum numbers of firewall filter terms per type of attachment point shown in [Table 3 on page 5](#).

Table 3: Supported Firewall Filter Numbers for Specific Switches

Filter Type	QFX3500, QFX3600	QFX5100, EX4600	QFX5110	QFX5200
Ingress	768	1536	6144	768
Egress	1024	1024	1024	1024

These totals are applied in aggregate. For example, on the QFX3500 and QFX3600 you can apply a total of 768 terms in all your port filters, Layer 3 filters, and VLAN filters that are applied in the input direction and 1024 terms in port filters, Layer 3 filters, and VLAN filters that are applied in the output direction. The actual number of filters that these

switches will support depends on how the filters are stored in ternary content addressable memory (TCAM). See [“Planning the Number of Firewall Filters to Create” on page 30](#) for detailed information about this topic.

**Related
Documentation**

- [Understanding Firewall Filter Planning on page 28](#)
- [Understanding Firewall Filter Processing Points for Bridged and Routed Packets on page 34](#)
- [Understanding How Firewall Filters Are Evaluated on page 6](#)
- [Understanding Firewall Filter Match Conditions on page 9](#)
- [Overview of Policers on page 55](#)
- [Configuring Firewall Filters on page 35](#)

Understanding How Firewall Filters Are Evaluated

A firewall filter consists of one or more terms, and the order of the terms within a filter is important. Before you configure firewall filters, you should understand how switches evaluate the terms within a filter and how packets are evaluated against the terms.

When a firewall filter consists of a single term, the filter is evaluated as follows:

- If the packet matches all the conditions, the action in the **then** statement is taken.
- If the packet matches all the conditions, and no action is specified in the **then** statement, the default action **accept** is taken.
- If the packet does not match all the conditions, the switch discards it.

When a firewall filter consists of more than one term, the filter is evaluated sequentially:

1. The packet is evaluated against the conditions in the **from** statement in the first term.
2. If the packet matches all the conditions in the term, the action in the **then** statement is taken and the evaluation ends. Subsequent terms in the filter are not evaluated.
3. If the packet does not match all the conditions in the term, the packet is evaluated against the conditions in the **from** statement in the second term.

This process continues until the packet matches all the conditions in the **from** statement in one of the subsequent terms or there are no more terms in the filter.

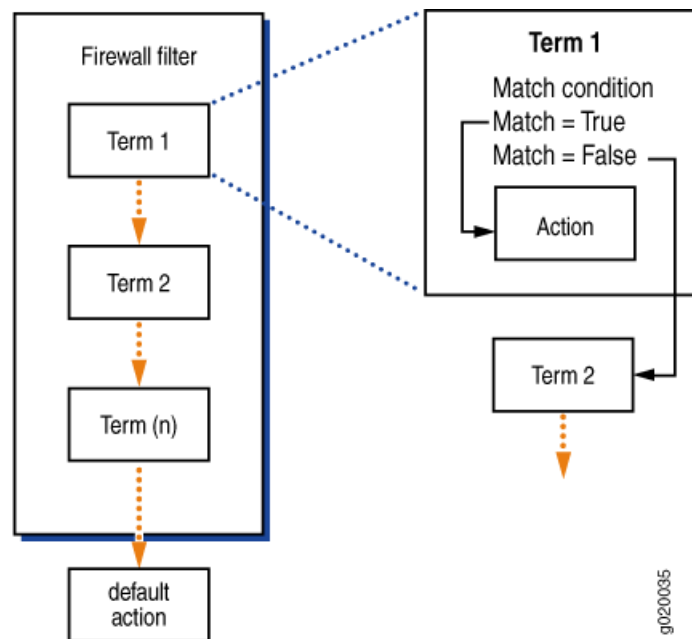
4. If a packet passes through all the terms in the filter without a match, the switch discards it.



NOTE: The order of conditions in a **from** statement is not important because a packet must match all the conditions to be considered a match.

[Figure 1 on page 7](#) shows how switches evaluate the terms within a firewall filter.

Figure 1: Evaluation of Terms Within a Firewall Filter



If you do not include a **from** statement in a term, all packets will match the term and be processed by the **then** statement. If a term does not contain a **then** statement or if an action has not been configured in the **then** statement, the term accepts any matching packets.

Every firewall filter contains an implicit **deny** statement at the end of the filter, which is equivalent to the following explicit filter term:

```
term implicit-rule {
  then discard;
}
```

Consequently, a packet that does not match any of the terms in a firewall filter is discarded. If you configure a filter that has no terms, all packets that pass through the filter are discarded.



NOTE: Firewall filtering is supported on packets that are at least 64 bytes long.

Related Documentation

- [Understanding Firewall Filter Match Conditions on page 9](#)
- [Overview of Policers on page 55](#)
- [Configuring Firewall Filters on page 35](#)

Understanding How Firewall Filters Control Packet Flows

A switch supports firewall filters that allow you to control flows of data packets and local packets. *Data packets* transit a switch as they are forwarded from a source to a destination. *Local packets* are destined for or sent by a Routing Engine (they do not transit a switch). Local packets usually contain routing protocol data, data for IP services such as Telnet or SSH, or data for administrative protocols such as the Internet Control Message Protocol (ICMP).

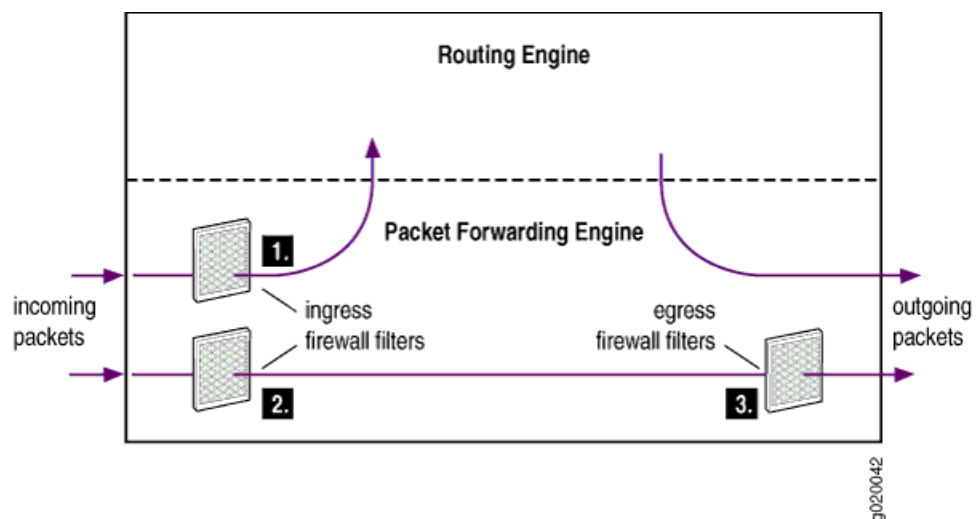
Firewall filters affect packet flows entering into or exiting from a switch as follows:

- Ingress firewall filters affect the flow of data packets that are received on switch interfaces. When a switch receives a data packet, the Packet Forwarding Engine in the system that contains the ingress interface determines where to forward the packet by looking in its Layer 2 or Layer 3 forwarding table for the best route to the destination. Data packets are forwarded to an egress interface. Locally destined packets are forwarded to the Routing Engine.
- Egress firewall filters affect data packets that are transiting a switch but do not affect packets sent by the Routing Engine. These filters are applied by the Packet Forwarding Engine in the system that contains the egress interface.

Figure 2 on page 8 illustrates the application of ingress and egress firewall filters to control the flow of packets through a switch:

1. Ingress firewall filter applied to locally destined packets that are received on switch interfaces and are destined for the Routing Engine.
2. Ingress firewall filter applied to data packets that are received on switch interfaces and will transit the switch.
3. Egress firewall filter applied to data packets that are transiting the switch.

Figure 2: Application of Firewall Filters to Control Packet Flow



Related Documentation

- [Understanding Firewall Filter Processing Points for Bridged and Routed Packets on page 34](#)
- [Understanding How Firewall Filters Are Evaluated on page 6](#)
- [Configuring Firewall Filters on page 35](#)

Understanding Firewall Filter Match Conditions

Before you define terms for firewall filters, you must understand how the conditions in a term are handled and how to specify interface, numeric, address, and bit-field filter match conditions to achieve the desired filter results.

- [Filter Match Conditions on page 9](#)
- [Numeric Filter Match Conditions on page 9](#)
- [Interface Filter Match Conditions on page 10](#)
- [IP Address Filter Match Conditions on page 10](#)
- [MAC Address Filter Match Conditions on page 11](#)
- [Bit-Field Filter Match Conditions on page 11](#)

Filter Match Conditions

In the **from** statement of a firewall filter term, you specify the conditions that the packet must match for the action in the **then** statement to be taken. All conditions must match for the action to be implemented. The order in which you specify match conditions is not important, because a packet must match all the conditions in a term for a match to occur.

If you specify multiple values for the same condition, a match on any one of those values matches that condition. For example, if you specify multiple IP source addresses using the **source-address** statement, a packet that contains any one of those IP source addresses matches the condition. In some cases you can specify multiple values for the same condition by enclosing the possible values in square brackets, as in:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set protocol (icmp | udp)
```

In other cases you must enter multiple statements, as in:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set source-address 10.1.1.1
user@switch# set source-address 10.1.1.2
```

If you specify no match conditions in a term, that term matches all packets.



NOTE: Unlike traditional Junos OS firewall filters, you cannot use **except** in a condition statement to negate the condition.

Numeric Filter Match Conditions

You can specify numeric filter match conditions that are identified by a numeric value, such as port and protocol numbers. For numeric filter match conditions, you specify the

condition and a single value that a field in a packet must contain to be considered a match.

You can specify the numeric value in one of the following ways:

- Single number—A match occurs if the value of the field matches the number. For example, to match Telnet traffic:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set source-port 23
```

- Text synonym for a single number—A match occurs if the value of the field matches the number that corresponds to the synonym. For example, to match Telnet traffic:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set source-port telnet
```

- To specify multiple values for the same match condition in a filter term, enter each value in its own match statement. For example, a match occurs in the following term if the value of the source port in the packet is 22 or 23.

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set source-port 22
user@switch# set source-port 23
```

Interface Filter Match Conditions

You can specify an interface filter match condition to match an interface on which a packet is received or transmitted. For example, if you apply a filter to a VLAN you might want the filter to match on some interfaces that participate in the VLAN and not match on other interfaces in the VLAN. When you specify the name of the interface, you must include a logical unit.

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set interface ge-0/0/6.0
```

In this example, the final character (0) specifies the logical unit. You can include the wildcard (*) as part of the interface name. For example:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set interface ge-0/*/6.0
user@switch# set interface ge-0/1/*0
user@switch# set interface ge-0/0/6.*
```

Note that you must specify a value or a wildcard for the logical unit.

IP Address Filter Match Conditions

You can specify an address filter match condition to match an IP source or destination address or prefix in a packet. Specify the address or prefix type and the address or prefix itself. For example:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-address 10.2.1.0/24;
```

If you omit the prefix length, it defaults to /32. For example:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-address 10
[edit firewall family family-name filter filter-name term term-name from]
user@switch# show
destination-address {
```

```
10.0.0.0/32;
}
```

To specify more than one IP address or prefix in a filter term, enter each address or prefix in its own match statement. For example, a match occurs in the following term if the source address of a packet matches either of the following prefixes:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set source-address 10.1.0.0/16
user@switch# set source-address 10.2.0.0/16
```

MAC Address Filter Match Conditions

You can specify a MAC address filter match condition to match a source or destination MAC address. You specify the address type and value that a packet must contain to be considered a match.

You can specify the MAC address as six hexadecimal bytes in any of the following formats:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-mac-address 00:11:22:33:44:55
```

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-mac-address 0011.2233.4455
```

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set destination-mac-address 001122334455
```

Regardless of the formats you use, the system resolves the address to the standard format, in this case 00:11:22:33:44:55.

To specify more than one MAC address in a filter term, enter each MAC address in its own match statement. For example, a match occurs in the following term if the value of the MAC source address matches either of the following addresses:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set source-mac-address 00:11:22:33:44:55
user@switch# set source-mac-address 00:11:22:33:20:15
```

Bit-Field Filter Match Conditions

You can specify bit-field filter match conditions to match particular bits within certain fields in Ethernet frames and IP, TCP, UDP, and ICMP headers. You usually specify the field and the bit within the field that must be set in a packet to be considered a match.

In most cases you can use a keyword to specify the bit you want to match on. For example, to match on a TCP SYN packet you can enter **syn**, as in:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-flags syn
```

You can also enter **0x02** because the SYN bit is the third least-significant bit of the 8-bit tcp-flags field:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-flags 0x02
```

To match multiple bit-field values, use the logical operators, which are described in [Table 4 on page 12](#). The operators are listed in order from highest precedence to lowest precedence. Operations are evaluated from left to right.

Table 4: Actions for Firewall Filters

Logical Operators	Description
!	Negation
&	Logical AND
	Logical OR

If you use a logical operator, enclose the values in quotation marks and do not include any spaces. For example, the following statement matches the second packet of a TCP handshake:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-flags "syn&ack"
```

To negate a match, precede the value with an exclamation point. For example, the following statement matches only the initial packet of a TCP handshake:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-flags "syn&!ack"
```

You can use text synonyms to specify some common bit-field matches. For example, the following statement also matches the initial packet of a TCP handshake:

```
[edit firewall family family-name filter filter-name term term-name from]
user@switch# set tcp-initial
```

Related Documentation

- [Understanding How a Firewall Filter Tests a Protocol on page 28](#)
- [Firewall Filter Match Conditions and Actions on page 12](#)
- [Configuring Firewall Filters on page 35](#)

Firewall Filter Match Conditions and Actions

Each term in a firewall filter consists of *match conditions* and an *action*. Match conditions are the fields and values that a packet must contain to be considered a match. You can define single or multiple match conditions in *match statements*. You can also include no match statement, in which case the term matches all packets.

When a packet matches a filter, a switch takes the action specified in the term. In addition, you can specify action modifiers to count, mirror, rate-limit, and classify packets. If no match conditions are specified for the term, the switch accepts the packet by default.



NOTE: This topic does not apply to QFX10000 switches. For information about match conditions and actions on those switches, see *Firewall Filter Match Conditions and Actions for QFX10000 Switches*.

This topic describes the various match conditions, actions, and action modifiers that you can define in a firewall filter.

- [Table 5 on page 13](#) describes the match conditions you can specify when configuring a firewall filter. Some of the numeric range and bit-field match conditions allow you to specify a text synonym. To see a list of all the synonyms for a match condition, type `?` at the appropriate place in a statement.
- [Table 6 on page 24](#) shows the actions that you can specify in a term.
- [Table 7 on page 25](#) shows the action modifiers you can use to count, mirror, rate-limit, and classify packets.



NOTE: On switches that do not support Layer 2 features (such as the OCX1100), you can use only those match conditions that are valid for IPv4 and IPv6 interfaces.

Table 5: Supported Match Conditions for Firewall Filters

Match Condition	Description	Direction and Interface
arp-type	ARP request packet or ARP reply packet.	Egress and ingress ports.
destination-address <i>ip-address</i>	IP destination address field, which is the address of the final destination node.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces, and IPv6 (inet6) interfaces.
destination-mac-address <i>mac-address</i>	Destination media access control (MAC) address of the packet.	Ingress ports, VLANs and IPv4 (inet) interfaces. Egress ports and VLANs.

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
destination-port value	<p>TCP or UDP destination port field. Typically, you specify this match in conjunction with the protocol match statement. For the following well-known ports you can specify text synonyms (the port numbers are also listed):</p> <p>afs (1483), bgp (179), biff (512), bootpc (68), bootps (67),</p> <p>cmd (514), cvspserver (2401),</p> <p>dhcp (67), domain (53),</p> <p>eklogin (2105), ekshell (2106), exec (512),</p> <p>finger (79), ftp (21), ftp-data (20),</p> <p>http (80), https (443),</p> <p>ident (113), imap (143),</p> <p>kerberos-sec (88), klogin (543), kpasswd (761), krb-prop (754), krbupdate (760), kshell (544),</p> <p>ldap (389), login (513),</p> <p>mobileip-agent (434), mobileip-mn (435), msdp (639),</p> <p>netbios-dgm (138), netbios-ns (137), netbios-ssn (139), nfsd (2049), nntp (119), ntalk (518), ntp (123),</p> <p>pop3 (110), pptp (1723), printer (515),</p> <p>radacct (1813), radius (1812), rip (520), rkinit (2108),</p> <p>smtp (25), snmp (161), snmptrap (162), snpp (444), socks (1080), ssh (22), sunrpc (111), syslog (514),</p> <p>tacacs-ds (65), talk (517), telnet (23), tftp (69), timed (525),</p> <p>who (513),</p> <p>xdmcp (177),</p> <p>zephyr-clt (2103), zephyr-hm (2104)</p>	<p>Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
destination-port range-optimize <i>range</i>	Match a range of TCP or UDP port ranges while using the available memory more efficiently. Using this condition allows you to configure more firewall filters than if you configure individual destination ports. (Not supported with filter-based forwarding.)	Egress and ingress IPv4 (inet) interfaces.
destination-prefix-list <i>prefix-list</i>	IP destination prefix list field. You can define a list of IP address prefixes under a prefix-list alias for frequent use. Define this list at the [edit policy-options] hierarchy level.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces and IPv6 (inet6) interfaces.
dot1q-tag <i>number</i>	802.1Q VLAN ID field in the Ethernet frame. The tag values can be 1–4094.	Ingress ports and VLANs. Egress ports and VLANs (<i>Number</i> must be the VLAN ID of the VLAN you want to match).
dot1q-user-priority <i>number</i>	<p>802.1Q priority field in the Ethernet frame (used for class-of-service priorities). Values can be 0–7.</p> <p>In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed):</p> <ul style="list-style-type: none"> • best-effort (0)—Best effort • background (1)—Background • standard (2)—Standard or spare • excellent-load (3)—Excellent load • controlled-load (4)—Controlled load • video (5)—Video • voice (6)—Voice • network-control (7)—Network control reserved traffic 	Ingress ports and VLANs. Egress ports and VLANs.

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
dscp value	<p>Differentiated Services code point (DSCP). The DiffServ protocol uses the type-of-service (ToS) byte in the IP header. The most-significant 6 bits of this byte form the DSCP.</p> <p>You can specify DSCP in hexadecimal, binary, or decimal form.</p> <p>In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed):</p> <ul style="list-style-type: none"> • be—best effort (default) • ef (46)—as defined in RFC 3246, <i>An Expedited Forwarding PHB</i>. • af11 (10), af12 (12), af13 (14); af21 (18), af22 (20), af23 (22); af31 (26), af32 (28), af33 (30); af41 (34), af42 (36), af43 (38) These four classes, with three drop precedences in each class, for a total of 12 code points, are defined in RFC 2597, <i>Assured Forwarding PHB</i>. • cs0, cs1, cs2, cs3, cs4, cs5, cs6, cs7, cs5 	<p>Ingress ports, VLANs, and IPv4 (inet) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
ether-type value	<p>Ethernet type field of a packet. The EtherType value specifies what protocol is being transported in the Ethernet frame. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed):</p> <ul style="list-style-type: none"> • aarp (0x80F3)—EtherType value AARP • appletalk (0x809B)—EtherType value AppleTalk • arp (0x0806)—EtherType value ARP • fcoe (0x8906)—EtherType value FCoE • fip (0x8914)—EtherType value FIP • ipv4 (0x0800)—EtherType value IPv4 • ipv6 (0x08DD)—EtherType value IPv6 • mpls-multicast (0x8848)—EtherType value MPLS multicast • mpls-unicast (0x8847)—EtherType value MPLS unicast • oam (0x88A8)—EtherType value OAM • ppp (0x880B)—EtherType value PPP • pppoe-discovery (0x8863)—EtherType value PPPoE Discovery Stage • pppoe-session (0x8864)—EtherType value PPPoE Session Stage • sna (0x80D5)—EtherType value SNA 	<p>Ingress ports and VLANs.</p> <p>Egress ports and VLANs.</p>
exp	Match on MPLS EXP bits.	<p>Ingress MPLS interfaces.</p> <p>Egress MPLS interfaces.</p>
fragment-flags value	<p>IP fragmentation flags. In place of the numeric value, you can specify one of the following text synonyms (the hexadecimal values are also listed):</p> <ul style="list-style-type: none"> • is-fragment • dont-fragment (0x4000) • more-fragments (0x2000) • reserved (0x8000) 	Ingress ports and VLANs.

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
icmp-code value	<p>ICMP code field. Because the meaning of the value depends upon the associated icmp-type, you must specify a value for icmp-type along with a value for icmp-code. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed). The keywords are grouped by the ICMP type with which they are associated:</p> <ul style="list-style-type: none"> <i>IPv4</i>: parameter-problem—ip-header-bad (0), required-option-missing (1) <i>IPv6</i>: parameter-problem—ip6-header-bad (0), unrecognized-next-header (1), unrecognized-option (2) redirect—redirect-for-network (0), redirect-for-host (1), redirect-for-tos-and-net (2), redirect-for-tos-and-host (3) time-exceeded—ttl-eq-zero-during-reassembly (1), ttl-eq-zero-during-transit (0) <i>IPv4</i>: unreachable—network-unreachable (0), host-unreachable (1), protocol-unreachable (2), port-unreachable (3), fragmentation-needed (4), source-route-failed (5), destination-network-unknown (6), destination-host-unknown (7), source-host-isolated (8), destination-network-prohibited (9), destination-host-prohibited (10), network-unreachable-for-TOS (11), host-unreachable-for-TOS (12), communication-prohibited-by-filtering (13), host-precedence-violation (14), precedence-cutoff-in-effect (15) <i>IPv6</i>: unreachable—address-unreachable (3), administratively-prohibited (1), no-route-to-destination (0), port-unreachable (4) 	<p>Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>
hop-limitvalue NOTE: This match condition is not supported on the QFX5110 switch.	Match the the specified hop limit or set of hop limits. Specify a single value or a range of values from 0 through 255.	Ingress and egress IPv6 (inet6) interfaces.

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
icmp-type <i>value</i>	<p>ICMP message type field. Typically, you specify this match in conjunction with the protocol match statement to determine which protocol is being used on the port. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed):</p> <p><i>IPv4:</i> echo-reply (0), destination unreachable (3), source-quench (4), redirect (5), echo-request (8), IPv4 (inet)-advertisement (9), IPv4 (inet)-solicit (10), time-exceeded (11), parameter-problem (12), timestamp (13), timestamp-reply (14), info-request (15), info-reply (16), mask-request (17), mask-reply (18)</p> <p><i>IPv6:</i> destination-unreachable (1), packet-too-big (2), time-exceeded (3), parameter-problem (4), echo-request (128), echo-reply (129), membership-query (130), membership-report (131), membership-termination (132), router-solicit (133), router-advertisement (134), neighbor-solicit (135), neighbor-advertisement (136), redirect (137), router-renumbering (138), node-information-request (139), node-information-reply (140)</p> <p>See also icmp-code <i>variable</i>.</p>	<p>Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>
interface <i>interface-name</i>	<p>Interface on which the packet is received, including the logical unit. You can include the wildcard character (*) as part of an interface name or logical unit.</p> <p>NOTE: An interface from which a packet is sent cannot be used as a match condition.</p>	<p>Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces.</p> <p>Egress IPv4 (inet) interfaces and IPv6 (inet6) interfaces.</p>
ip-destination-address <i>address</i>	IPv4 address that is the final destination node address for the packet.	Ingress ports and VLANs.
ip6-destination-address <i>address</i>	IPv6 address that is the final destination node address for the packet.	Ingress ports and VLANs. (You cannot simultaneously apply a filter with this match criterion to a Layer 2 port and VLAN that includes that port.)
ip-options	Specify any to create a match if anything is specified in the options field in the IP header.	<p>Ingress ports, VLANs, and IPv4 (inet) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
ip-precedence <i>ip-precedence-field</i>	IP precedence field. In place of the numeric field value, you can specify one of the following text synonyms (the field values are also listed): critical-ecp (0xa0), flash (0x60), flash-override (0x80), immediate (0x40), internet-control (0xc0), net-control (0xe0), priority (0x20), or routine (0x00).	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
ip-protocol <i>number</i>	IP protocol field.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
ip-source-address <i>address</i>	IPv4 address of the source node sending the packet.	Ingress ports and VLANs.
ip6-source-address <i>address</i>	IPv6 address of the source node sending the packet.	Ingress ports and VLANs. (You cannot simultaneously apply a filter with this match criterion to a Layer 2 port and VLAN that includes that port.)
ip-version <i>address</i>	IP version of the packet. Use this condition to match IPv4 or IPv6 header fields in traffic that arrives on a Layer 2 port or VLAN interface.	Ingress ports and VLANs.
is-fragment	Using this condition causes a match if the More Fragments flag is enabled in the IP header or if the fragment offset is not zero.	Ingress ports, VLANs, and IPv4 (inet) interfaces. Egress IPv4 (inet) interfaces.
l2-encap-type <i>llc-non-snap</i>	Match on logical link control (LLC) layer packets for non-Subnet Access Protocol (SNAP) Ethernet Encapsulation type.	Ingress ports and VLANs. Egress ports and VLANs.
label	Match on MPLS label bits.	Ingress MPLS interfaces. Egress MPLS interfaces.
learn-vlan-id <i>number</i>	Matches the ID of a normal VLAN or the ID of the outer (service) VLAN (for Q-in-Q VLANs). The acceptable values are 1-4095.	Ingress ports and VLANs. Egress ports and VLANs.

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
next-header	<p>IPv4 or IPv6 protocol value. In place of the numeric value, you can specify one of the following text synonyms (the numeric values are also listed):</p> <p>hop-by-hop (0), icmp (1), icmp6 (58), igmp (2), ipip (4), tcp (6), egp (8), udp (17), ipv6 (41), routing (43), fragment (44), rsvp (46), gre (47), esp (50), ah (51), icmp6 (58), no-next-header (59), dstopts (60), ospf (89), pim (103), vrrp (112), sctp (132)</p>	<p>Ingress ports, VLANs, and IPv6 (inet6) interfaces.</p> <p>Egress IPv6 (inet6) interfaces.</p>
packet-length	<p>Packet length in bytes. You must enter a value between 0 and 65535.</p>	<p>Ingress ports, VLANs, IPv4 (inet), and IPv6 (inet6) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>
payload-protocol	<p>IPv4 or IPv6 protocol value. In place of the numeric value, you can specify one of the following text synonyms (the numeric values are also listed):</p> <p>hop-by-hop (0), icmp (1), icmp6 (58), igmp (2), ipip (4), tcp (6), egp (8), udp (17), ipv6 (41), routing (43), fragment (44), rsvp (46), gre (47), esp (50), ah (51), icmp6 (58), no-next-header (59), dstopts (60), ospf (89), pim (103), vrrp (112), sctp (132)</p>	<p>Ingress ports, VLANs, and IPv6 (inet6) interfaces.</p> <p>Egress IPv6 (inet6) interfaces.</p>
precedence value	<p>IP precedence bits in the type-of-service (ToS) byte in the IP header. (This byte can also be used for the DiffServ DSCP.) In place of the numeric value, you can specify one of the following text synonyms (the numeric values are also listed):</p> <ul style="list-style-type: none"> • routine (0) • priority (1) • immediate (2) • flash (3) • flash-override (4) • critical-ecp (5) • internet-control (6) • net-control (7) 	<p>Ingress ports, VLANs, and IPv4 (inet) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
protocol type	<p>IPv4 or IPv6 protocol value. In place of the numeric value, you can specify one of the following text synonyms (the numeric values are also listed):</p> <p>hop-by-hop (0), icmp (1), icmp6, igmp (2), ipip (4), tcp (6), egp (8), udp (17), ipv6 (41), routing (43), fragment (44), rsvp (46), gre (47), esp (50), ah (51), icmp6 (58), no-next-header (59), dstopts (60), ospf (89), pim (103), vrrp (112), sctp (132)</p>	<p>Ingress ports, VLANs and IPv4 (inet) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>
rat-type tech-type-value	<p>Match the radio-access technology (RAT) type specified in the 8-bit Tech-Type field of Proxy Mobile IPv4 (PMIPv4) access technology type extension. The technology type specifies the access technology through which the mobile device is connected to the access network. Specify a single value, a range of values, or a set of values. You can specify a technology type as a numeric value from 0 through 255 or as a system keyword.</p> <ul style="list-style-type: none"> Numeric value 1 matches IEEE 802.3. Numeric value 2 matches IEEE 802.11a/b/g. Numeric value 3 matches IEEE 802.16e Numeric value 4 matches IEEE 802.16m. Text string eutran matches 4G. Text string geran matches 2G. Text string utran matches 3G. 	Egress and ingress IPv4 (inet) interfaces.
sample	Sample the packet traffic. Apply this option only if you have enabled traffic sampling.	Egress and ingress IPv4 (inet) interfaces.
source-address ip-address	IP source address field, which is the address of the node that sent the packet.	<p>Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>
source-mac-address <i>mac-address</i>	Source media access control (MAC) address of the packet.	<p>Ingress ports and VLANs.</p> <p>Egress ports and VLANs.</p>

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
source-port <i>value</i>	TCP or UDP source port. Typically, you specify this match in conjunction with the protocol match statement. In place of the numeric field, you can specify one of the text synonyms listed under destination-port .	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
source-port range-optimize <i>range</i>	Match a range of TCP or UDP port ranges while using the available memory more efficiently. Using this condition allows you to configure more firewall filters than if you configure individual source ports. (Not supported with filter-based forwarding.)	Egress and ingress IPv4 (inet) interfaces.
source-prefix-list <i>prefix-list</i>	IP source prefix list. You can define a list of IP address prefixes under a prefix-list alias for frequent use. Define this list at the [edit policy-options] hierarchy level.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
tcp-established	Match packets of an established TCP connection. This condition matches packets other than those used to set up a TCP connection—that is, three-way handshake packets are not matched. When you specify tcp-established , a switch does not implicitly verify that the protocol is TCP. You must also specify the protocol tcp match condition.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
tcp-flags <i>value</i>	One or more TCP flags: <ul style="list-style-type: none"> • ack (0x10) • fin (0x01) • push (0x08) • rst (0x04) • syn (0x02) • urgent (0x20) 	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.
tcp-initial	Match the first TCP packet of a connection. A match occurs when the TCP flag SYN is set and the TCP flag ACK is not set. When you specify tcp-initial , a switch does not implicitly verify that the protocol is TCP. You must also specify the protocol tcp match condition.	Ingress ports, VLANs, IPv4 (inet) interfaces, and IPv6 (inet6) interfaces. Egress IPv4 (inet) interfaces.

Table 5: Supported Match Conditions for Firewall Filters (*continued*)

Match Condition	Description	Direction and Interface
traffic-class	<p>8-bit field that specifies the class-of-service (CoS) priority of the packet. The traffic-class field is used to specify a DiffServ code point (DSCP) value. This field was previously used as the type-of-service (ToS) field in IPv4, and, the semantics of this field (for example, DSCP) are identical to those of IPv4.</p> <p>You can specify one of the following text synonyms (the field values are also listed):</p> <p>af11 (10), af12 (12), af13 (14), af21 (18), af22 (20), af23 (22), af31 (26), af32 (28), af33 (30), af41 (34), af42 (36), af43 (38), cs0 (0), cs1 (8), cs2 (16), cs3 (24), cs4 (32), cs5 (40), cs6 (48), cs7 (56), ef (46)</p>	<p>Ingress ports, VLANs, and IPv6 (inet6) interfaces.</p> <p>Egress IPv6 (inet6) interfaces.</p>
ttl value	IP Time-to-live (TTL) field in decimal. The value can be 1-255.	<p>Ingress IPv4 (inet) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>
user-vlan-1p-priority value	Matches the specified 802.1p VLAN priority in the range 0-7.	<p>Ingress ports, VLANs, and IPv4 (inet) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>
user-vlan-id number	Matches the ID of the inner (customer) VLAN for a Q-in-Q VLAN. The acceptable values are 1-4095.	<p>Ingress ports, VLANs, and IPv4 (inet) interfaces.</p> <p>Egress IPv4 (inet) interfaces.</p>

Use **then** statements to define actions that should occur if a packet matches all conditions in a **from** statement. [Table 6 on page 24](#) shows the actions that you can specify in a term. (If you do not include a **then** statement, the system accepts packets that match the filter.)

Table 6: Actions for Firewall Filters

Action	Description
accept	Accept a packet. This is the default action for packets that match a term.
discard	Discard a packet silently without sending an Internet Control Message Protocol (ICMP) message.

Table 6: Actions for Firewall Filters (*continued*)

Action	Description
reject <i>message-type</i>	<p>Discard a packet and send a “destination unreachable” ICMPv4 message (type 3). To log rejected packets, configure the syslog action modifier.</p> <p>You can specify one of the following message types: administratively-prohibited (default), bad-host-tos, bad-network-tos, host-prohibited, host-unknown, host-unreachable, network-prohibited, network-unknown, network-unreachable, port-unreachable, precedence-cutoff, precedence-violation, protocol-unreachable, source-host-isolated, source-route-failed, or tcp-reset.</p> <p>If you specify tcp-reset, the system sends a TCP reset if the packet is a TCP packet; otherwise nothing is sent.</p> <p>If you do not specify a message type, the ICMP notification “destination unreachable” is sent with the default message “communication administratively filtered.”</p> <p>NOTE: The reject action is supported on ingress interfaces only.</p>
routing-instance <i>instance-name</i>	Forward matched packets to a virtual routing instance.
vlan <i>VLAN-name</i>	<p>Forward matched packets to a specific VLAN.</p> <p>NOTE: The vlan action is supported on ingress interfaces only.</p> <p>NOTE: This action is not supported on OCX series switches.</p>

You can also specify the action modifiers listed in [Table 7 on page 25](#) to count, mirror, rate-limit, and classify packets.

Table 7: Action Modifiers for Firewall Filters

Action Modifier	Description
analyzer <i>analyzer-name</i>	<p>(Non-ELS platforms) Mirror traffic (copy packets) to an analyzer configured at the [edit ethernet-switching-options analyzer] hierarchy level.</p> <p>You can specify port mirroring for ingress port, VLAN, and IPv4 (inet) firewall filters only.</p>
count <i>counter-name</i>	Count the number of packets that match the term.
decapsulate [<i>gre</i> <i>routing-instance</i>]	De-encapsulate GRE packets or forward de-encapsulated GRE packets to the specified routing instance

Table 7: Action Modifiers for Firewall Filters (*continued*)

Action Modifier	Description
dscp value NOTE: This action modifier is not supported on the QFX5110 switch.	<p>Differentiated Services code point (DSCP). The DiffServ protocol uses the type-of-service (ToS) byte in the IP header. The most-significant 6 bits of this byte form the DSCP.</p> <p>You can specify DSCP in hexadecimal, binary, or decimal form.</p> <p>In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed):</p> <ul style="list-style-type: none"> • be—best effort (default) • ef (46)—as defined in RFC 3246, <i>An Expedited Forwarding PHB</i>. • af11 (10), af12 (12), af13 (14); af21 (18), af22 (20), af23 (22); af31 (26), af32 (28), af33 (30); af41 (34), af42 (36), af43 (38) <p>These four classes, with three drop precedences in each class, for a total of 12 code points, are defined in RFC 2597, <i>Assured Forwarding PHB</i>.</p> <ul style="list-style-type: none"> • cs0, cs1, cs2, cs3, cs4, cs5, cs6, cs7, cs5
forwarding-class class	<p>Classify the packet in one of the following default forwarding classes, or in a user-defined forwarding class:</p> <ul style="list-style-type: none"> • best-effort • fcoe • mcast • network-control • no-loss <p>NOTE: To configure a forwarding class, you must also configure loss priority.</p>
interface	Switch the traffic to the specified interface without performing a lookup on it. This action is valid only when the filter is applied on ingress.
log	<p>Log the packet's header information in the Routing Engine. To view this information, enter the show firewall log operational mode command.</p> <p>NOTE: The log action modifier is supported on ingress interfaces only.</p>
loss-priority (low medium-low medium-high high)	<p>Set the packet loss priority (PLP).</p> <p>NOTE: The loss-priority action modifier is supported on ingress interfaces only.</p> <p>NOTE: The loss-priority action modifier is not supported in combination with the policer action.</p>

Table 7: Action Modifiers for Firewall Filters (*continued*)

Action Modifier	Description
policer <i>policer-name</i>	<p>Send packets to a policer (for the purpose of applying rate limiting).</p> <p>You can specify a policer for ingress port, VLAN, IPv4 (inet), IPv6 (inet6), and MPLS filters.</p> <p>NOTE: The policer action modifier is not supported in combination with the loss-priority action.</p>
port-mirror	<p>(ELS platforms) Mirror traffic (copy packets) to an output interface configured in a port-mirroring instance at the [edit forwarding-options port-mirroring] hierarchy level.</p> <p>You can specify port mirroring for ingress port, VLAN, and IPv4 (inet) firewall filters only.</p>
port-mirror-instance <i>port-mirror-instance-name</i>	<p>(ELS platforms) Mirror traffic to a port-mirroring instance configured at the [edit forwarding-options port-mirroring] hierarchy level.</p> <p>You can specify port mirroring for ingress port, VLAN, and IPv4 (inet) firewall filters only.</p> <p>NOTE: This action modifier is not supported on OCX series switches.</p>
syslog	<p>Log an alert for this packet.</p> <p>NOTE: The syslog action modifier is supported on ingress interfaces only.</p>
three-color-policer <i>three-color-policer-name</i>	<p>Send packets to a three-color policer (for the purpose of applying rate limiting).</p> <p>You can specify a three-color policer for ingress and egress port, VLAN, IPv4 (inet), IPv6 (inet6), and MPLS filters.</p> <p>NOTE: The policer action modifier is not supported in combination with the loss-priority action.</p>

- Related Documentation**
- [Understanding How Firewall Filters Are Evaluated on page 6](#)
 - [Understanding How a Firewall Filter Tests a Protocol on page 28](#)
 - [Overview of Policers on page 55](#)
 - [Understanding Port Mirroring](#)
 - [Configuring Firewall Filters on page 35](#)

Understanding How a Firewall Filter Tests a Protocol

When examining match conditions in a firewall filter, a switch tests only the fields that you specify. It does not implicitly test any fields that you do not explicitly configure. For example, if you specify a match condition of **source-port ssh**, there is no implied test to determine if the protocol is TCP. In this case, the switch considers any packet that has a value of **22** (decimal) in the 2-byte field that follows a *presumed* IP header to be a match. To ensure that the term matches on TCP packets, you also specify an **ip-protocol tcp** match condition.

For the following match conditions, you should explicitly specify the protocol match condition in the same term:

- **destination-port**—Specify protocol **tcp** or protocol **udp**.
- **icmp-code**—Specify protocol **icmp** and **icmp-type**.
- **icmp-type**—Specify protocol **icmp** or protocol **icmp6**.
- **source-port**—Specify protocol **tcp** or protocol **udp**.
- **tcp-flags**—Specify protocol **tcp**.

Related Documentation

- [Understanding Firewall Filter Match Conditions on page 9](#)
- [Configuring Firewall Filters on page 35](#)

Understanding Firewall Filter Planning

Before you create a firewall filter and apply it, determine what you want the filter to accomplish and how to use its match conditions and actions to achieve your goals. It is important that you understand how packets are matched, the default and configured actions of the firewall filter, and where to apply the firewall filter.

You can apply no more than one firewall filter per port, VLAN, or router interface per direction (input and output). For example, for a given port you can apply at most one filter in the input direction and one filter in the output direction. You should try to be conservative in the number of terms (rules) that you include in each firewall filter, because a large number of terms requires longer processing time during a commit operation and can make testing and troubleshooting more difficult.

Before you configure and apply firewall filters, answer the following questions for each of them:

1. What is the purpose of the filter?

For example, the system can drop packets based on header information, rate-limit traffic, classify packets into forwarding classes, log and count packets, or prevent denial-of-service attacks.

2. What are the appropriate match conditions? Determine the packet header fields that the packet must contain for a match. Possible fields include:

- Layer 2 header fields—Source and destination MAC addresses, 802.1Q tag, Ethernet type, or VLAN.
 - Layer 3 header fields—Source and destination IP addresses, protocols, and IP options (IP precedence, IP fragmentation flags, or TTL type).
 - TCP header fields—Source and destination ports and flags.
 - ICMP header fields—Packet type and code.
3. What are the appropriate actions to take if a match occurs?
- The system can accept, discard, or reject packets.
4. What additional action modifiers might be required?
- For example, you can configure the system to mirror (copy) packets to a specified port, count matching packets, apply traffic management, or police packets.
5. On what port, router interface, or VLAN should the firewall filter be applied?

Start with the following basic guidelines:

- If packets entering or leaving a Layer 2 interface (port) need to be filtered, apply the filter at the **[edit family ethernet switching filter]** hierarchy level. This is a port filter.
- If packets entering or leaving any port in a specific VLAN need to be filtered, use a VLAN filter.
- If packets entering or leaving a Layer 3 (routed) interface or routed VLAN interface (RVI) need to be filtered, use a router firewall filter. Apply the filter to the interface at the **[edit family inet]** hierarchy level. You can also apply a router firewall filter on a loopback interface.

Before you choose the interface or VLAN on which to apply a firewall filter, understand how that placement can affect traffic flow to other interfaces. In general, apply a filter close to the source device if the filter matches on source or destination IP addresses, IP protocols, or protocol information—such as ICMP message types, and TCP or UDP port numbers. However, you should apply a filter close to the destination device if the filter matches *only* on a source IP address. When you apply a filter too close to the source device, the filter could prevent that source device from accessing other services that are available on the network.



NOTE: Egress firewall filters do not affect the flow of locally generated control packets from the Routing Engine.

6. In which direction should the firewall filter be applied?

You typically configure different actions for traffic entering an interface than you configure for traffic exiting an interface.

7. How many filters should I create?

See [“Planning the Number of Firewall Filters to Create” on page 30](#) for information about how many firewall filters you can apply.

- Related Documentation**
- [Overview of Policers on page 55](#)
 - [Understanding How Firewall Filters Are Evaluated on page 6](#)
 - [Configuring Firewall Filters on page 35](#)

Planning the Number of Firewall Filters to Create

- [Understanding How Many Firewall Filters Are Supported on page 30](#)
- [Egress Filters on page 31](#)
- [Avoid Configuring too Many Filters on page 31](#)
- [Configuring TCAM Error Messages on page 32](#)
- [Policies can Limit Egress Filters on page 32](#)
- [Planning for Filter-Specific Policies on page 33](#)
- [Planning for Filter-Based Forwarding on page 33](#)

Understanding How Many Firewall Filters Are Supported

QFX3500, QFX3600, QFX5100, QFX5110, and EX4600 switches, QFabric Node devices, and VCF members support the maximum numbers of firewall filter terms per type of attachment point shown in [Table 8 on page 30](#).

Table 8: Supported Firewall Filter Numbers

Filter Type	QFX3500, QFX3600	QFX5100, EX4600	QFX5110	QFX5200	QFX10000
Ingress	768	1536	6144	768	8192
Egress	1024	1024	1024	1024	8192

On QFX5100, QFX5110, and QFX5200 switches, you can see how many filters have been programmed of each type by entering **show pfe filter hw summary**.

The totals are applied in aggregate. For example, on the QFX3500 and QFX3600 you can apply a total of 768 terms in all your port filters, Layer 3 filters, and VLAN filters that are applied in the input direction and 1024 terms in port filters, Layer 3 filters, and VLAN filters that are applied in the output direction.



NOTE: If you want to create more than 512 egress VLAN filters, your first VLAN ID should be 6 and the subsequent VLAN IDs should increase by 1. For example, to create 1024 egress VLAN filters, the first VLAN ID would be 6, the second ID would be 7, and the sequence would continue through VLAN ID 1029. Similarly, if you want to create fewer than 512 egress VLAN filters but want the total number of terms in those filters to exceed 512, you should number your VLAN IDs in the same manner. If you do not use this approach to create your VLAN IDs, the total number of allowed terms or filters will be less than 1024 and might be 512.

The ternary content addressable memory (TCAM) for firewall filters is divided into slices that accommodate 256 terms, and all the terms in a memory slice must be in filters of the same type and applied in the same direction. A memory slice is reserved as soon as you commit a filter. For example, if you create a port filter and apply it in the input direction, a memory slice is reserved that will only store ingress port filters. If you create and apply only one ingress port filter and that filter has only one term, the rest of this slice is unused and is unavailable for other filter types.

Continuing with the above example for QFX3500 and QFX3600 switches, assume that you create and apply 256 ingress port filters with one term each so that one memory slice is filled. This leaves two more memory slices available for ingress filters. (Remember that the maximum number of ingress terms is 768.) If you then create and apply an ingress Layer 3 filter with one term, another memory slice is reserved for ingress Layer 3 filters. As before, the rest of the slice is unused and is unavailable for different filter types. At this point there is one memory slice available for any ingress filter type.

Now assume that you create and apply a VLAN ingress filter. The final memory slice is reserved for VLAN ingress filters. Memory allocation for ingress filters (once again assuming one term per filter) is as follows:

- Slice 1: Filled with 256 ingress port filters. You cannot commit any more ingress port filters.
- Slice 2: Contains one ingress Layer 3 filter with one term. You can commit 255 more terms in ingress Layer 3 filters.
- Slice 3: Contains one ingress VLAN filter with one term. You can commit 255 more terms in ingress VLAN filters.

Here is another example for QFX3500 and QFX3600 switches. Assume that you create 257 ingress port filters with one term per filter—that is, you create one more term than a single memory slice can accommodate. When you apply the filters and commit the configuration, the filter memory allocation is:

- Slice 1: Filled with 256 ingress port filters. You cannot apply any more ingress port filters.
- Slice 2: Contains one ingress port filter. You can apply 255 more terms in ingress port filters.
- Slice 3: This slice is unassigned. You can create and apply 256 terms in ingress filters of any type (port, Layer 3, or VLAN), but all the filters must be of the same type.

Egress Filters

All of the preceding principles also apply to egress filters, but four memory slices are used because IPv4 Layer 3 filters and IPv6 Layer 3 filters are stored in separate slices. The memory slices for egress filters are the same size as those for ingress filters, so the maximum number of egress filter terms is therefore 1024.

Avoid Configuring too Many Filters

If you violate any of these restrictions and commit a configuration that is not in compliance, Junos OS rejects the excessive filters. For example, if you configure 300 ingress port filters

and 300 ingress Layer 3 filters and try to commit the configuration, Junos OS does the following (again assuming one term per filter):

- Accepts the 300 ingress port filters (storing them in two memory slices).
- Accepts the first 256 ingress Layer 3 filters it processes (storing them in the third memory slice).
- Rejects the remaining 44 ingress Layer 3 filters.



NOTE: In this situation, be sure to delete excessive filters (for example, the remaining 44 ingress Layer 3 filters) from the configuration before you reboot the device. If you reboot a device that has a noncompliant configuration, you cannot predict which filters are installed after the reboot. Using the example above, the 44 ingress Layer 3 filters that were originally rejected might be installed, and 44 of the port filters that were originally accepted might be rejected.

Configuring TCAM Error Messages

You can configure your switch to display error messages if a filter cannot be installed because there isn't enough TCAM space available. To have TCAM error messages sent to a syslog file, enter

```
set system syslog file filename pfe emergency
```

To have TCAM error messages sent to the console, enter

```
set system syslog console pfe emergency
```

To have TCAM error messages sent to an SSH terminal session, enter

```
set system syslog user user-login pfe emergency
```

Policers can Limit Egress Filters

On some switches, the number of egress policers that you configure can affect the total number of allowed egress firewall filters. (This issue does not affect QFX10000 switches.) On the affected switches, every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.
- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
 - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
 - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

You can prevent this problem from occurring by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

Planning for Filter-Specific Policers

You can configure policers to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps. However, the behavior of a filter-specific policer is affected by how the firewall filter terms that reference the policer are stored in ternary content addressable memory (TCAM). If you create a filter-specific policer and reference it in multiple firewall filter terms, the policer allows more traffic than expected if the terms are stored in different TCAM slices. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms that are stored in three separate memory slices, the total bandwidth allowed by the filter is 3 Gbps, not 1 Gbps.

To prevent this unexpected behavior from occurring, use the information about TCAM slices presented above to organize your configuration file so that all the firewall filter terms that reference a given filter-specific policer are stored in the same TCAM slice.

Planning for Filter-Based Forwarding

You can use firewall filters in conjunction with virtual routing instances to specify different routes for packets to travel in their networks. To set up this feature—called filter-based

forwarding—you specify a filter and match criteria and then specify the virtual routing instance to send packets to. Filters used in this way also consume memory in an additional TCAM. See *Understanding FIP Snooping, FBF, and MVR Filter Scalability* for more information. The section *FBF Filter VFP TCAM Consumption* in this topic specifically addresses the number of supported filters when using filter-based forwarding.



WARNING: Filter-based forwarding does not work with IPv6 interfaces on some Juniper switches.

**Related
Documentation**

- [Understanding How Firewall Filters Are Evaluated on page 6](#)
- [Understanding Firewall Filter Planning on page 28](#)
- [Configuring Firewall Filters on page 35](#)
- [Understanding Filter-Based Forwarding](#)

Understanding Firewall Filter Processing Points for Bridged and Routed Packets

You apply firewall filters at multiple processing points in the forwarding path. At each processing point, the action to be taken on a packet is determined by the configuration of the filter and the results of the lookup in the forwarding or routing table.

For both bridged (Layer 2) unicast packets and routed (Layer 3) unicast packets, firewall filters are applied in the prescribed order shown below (assuming that each filter is present and a packet is accepted by each one).

Bridged packets:

1. Ingress port filter
2. Ingress VLAN filter
3. Egress VLAN filter
4. Egress port filter

Routed packets:

1. Ingress port firewall filter
2. Ingress VLAN firewall filter (Layer 2 CoS)
3. Ingress router firewall filter (Layer 3 CoS)
4. Egress router firewall filter
5. Egress VLAN firewall filter
6. Egress port filter



NOTE: MAC learning occurs before filters are applied, so switches learn the MAC addresses of packets that are dropped by ingress filters.

Related Documentation

- [Overview of Firewall Filters on page 3](#)
- [Understanding How Firewall Filters Control Packet Flows on page 8](#)
- [Configuring Firewall Filters on page 35](#)

Configuring Firewall Filters

You can configure firewall filters in a switch to control traffic that enters switch ports or enters and exits VLANs and Layer 3 (routed) interfaces. To use a firewall filter, you must configure the filter and then apply it to a port, VLAN, or Layer 3 interface.

- [Configuring a Firewall Filter on page 35](#)
- [Applying a Firewall Filter to a Port on page 37](#)
- [Applying a Firewall Filter to a VLAN on page 37](#)
- [Applying a Firewall Filter to a Layer 3 \(Routed\) Interface on page 38](#)

Configuring a Firewall Filter

To configure a firewall filter:

1. Configure the family address type, filter name, term name, and at least one match condition—for example, match on packets that contain a specific source address:

```
[edit]
user@switch# set firewall family ethernet-switching filter ingress-port-filter term term-one
from source-address 192.0.2.14
```

For a firewall filter that is applied to a port or VLAN, specify the family address type **ethernet-switching**. For a firewall filter that is applied to a Layer 3 (routed) interface, specify the family address type **inet**.

The filter and term names can contain letters, numbers, and hyphens (-) and can be up to 64 characters long. Each filter name must be unique. A filter can contain one or more terms, and each term name must be unique within a filter.

2. Configure additional match conditions. For example, match on packets that contain a specific source port:

```
[edit firewall family ethernet-switching filter ingress-port-filter term
term-one from]
user@switch# set source-port 80
```

You can specify one or more match conditions in a single **from** statement. For a match to occur, the packet must match all the conditions in the term. The **from** statement is optional, but if included in a term, it cannot be empty. If you omit the **from** statement, all packets are considered to match.

3. If you want to apply a firewall filter to multiple interfaces and be able to see counters specific to each interface, configure the **interface-specific** option:

```
[edit firewall family ethernet-switching filter ingress-port-filter]
user@switch# set interface-specific
```

4. In each firewall filter term, specify the actions to take if the packet matches all the conditions in that term. You can specify an action and action modifiers:

- To specify a filter action, for example, to discard packets that match the conditions of the filter term:

```
[edit firewall family ethernet-switching filter ingress-port-filter term
term-one then]
user@switch# set discard
```

You can specify no more than one action (**accept**, **discard**, **reject**, **routing-instance**, or **vlan**) per term.

- To specify action modifiers, for example, to count and classify packets to a forwarding class:

```
[edit firewall family ethernet-switching filter ingress-port-filter term
term-one then]
user@switch# set count counter-one
user@switch# set forwarding-class expedited-forwarding
user@switch# set loss-priority high
```

You can specify any of the following action modifiers in a **then** statement:

- **analyzer *analyzer-name***—Mirror port traffic to a specified analyzer, which you must configure at the **[ethernet-switching-options]** level.
- **count *counter-name***—Count the number of packets that pass this filter term.



NOTE: We recommend that you configure a counter for each term in a firewall filter, so that you can monitor the number of packets that match the conditions specified in each filter term.



NOTE: On QFX3500 and QFX3600 switches, filters automatically count packets that have been dropped on ingress because of cyclic redundancy check (CRC) errors.

- **forwarding-class *class***—Assign packets to a forwarding class.
- **log**—Log the packet header information in the Routing Engine.
- **loss-priority *priority***—Set the priority of dropping a packet.
- **policer *policer-name***—Apply rate-limiting to the traffic.
- **syslog**—Log an alert for this packet.

If you omit the **then** statement or do not specify an action, packets that match all the conditions in the **from** statement are accepted. However, you should always explicitly configure an action in the **then** statement. You can include no more than one action statement, but you can use any combination of action modifiers. For an action or action modifier to take effect, all conditions in the **from** statement must match.



NOTE: Implicit discard is also applicable to a firewall filter applied to the loopback interface, lo0.

Applying a Firewall Filter to a Port

To apply a firewall filter to an ingress port:

1. Provide a meaningful description of the firewall filter in the configuration of the port to which the filter will be applied:

[edit]

```
user@switch# set interfaces ge-0/0/6 description "filter to limit tcp traffic at trunk port for employee-vlan"
```

2. Apply the filter to the interface, specifying the unit number, family address type, the direction of the filter (for packets entering the port), and the filter name:

[edit]

```
user@switch# set ge-0/0/6 unit 0 family ethernet-switching filter input ingress-port-filter
```

For firewall filters that are applied to ports, the family address type must be **ethernet-switching**.



NOTE: You can apply only one filter to a port for a given direction (ingress or egress).

Applying a Firewall Filter to a VLAN

To apply a firewall filter to a VLAN:

1. Provide a meaningful description of the firewall filter in the configuration of the VLAN to which the filter will be applied:

[edit]

```
user@switch# set vlans employee-vlan vlan-id 20 description "filter to block rogue devices on employee-vlan"
```

2. Apply firewall filters to filter packets that are entering or exiting the VLAN:

- To apply a filter to match packets that are entering the VLAN:

[edit]

```
user@switch# set vlans employee-vlan vlan-id 20 filter input ingress-vlan-rogue-block
```

- To apply a firewall filter to match packets that are exiting the VLAN:

[edit]

```
user@switch# set vlans employee-vlan vlan-id 20 filter output egress-vlan-filter
```



NOTE: You can apply only one filter to a VLAN for a given direction (ingress or egress).

Applying a Firewall Filter to a Layer 3 (Routed) Interface

To apply a firewall filter to a Layer 3 routed interface:

1. Provide a meaningful description of the firewall filter in the configuration of the interface to which the filter will be applied:

```
[edit]
user@switch# set interfaces ge-0/1/6 description "filter to count and monitor traffic on layer
3 interface"
```

2. You can apply firewall filters to filter packets that enter or exit a Layer 3 routed interface:

- To apply a firewall filter to filter packets that enter a Layer 3 interface:

```
[edit]
user@switch# set interfaces ge-0/1/6 unit 0 family inet filter input ingress-router-filter
```

- To apply a firewall filter to filter packets that exit a Layer 3 interface:

```
[edit]
user@switch# set interfaces ge-0/1/6 unit 0 family inet filter output egress-router-filter
```

For firewall filters applied to Layer 3 routed interfaces, the family address type must be **inet**.



NOTE: You can apply only one filter to an interface for a given direction (ingress or egress).

Related Documentation

- [Overview of Firewall Filters on page 3](#)
- [Firewall Filter Match Conditions and Actions on page 12](#)
- [Verifying That Firewall Filters Are Operational on page 42](#)
- [Monitoring Firewall Filter Traffic on page 41](#)
- [Configuring Port Mirroring](#)

Applying Firewall Filters to Interfaces

For a firewall filter to work, you must apply it to at least one interface. To do this, include the **filter** statement when configuring a logical interface at the **[edit interfaces]** hierarchy level:

```
[edit interfaces]
user@switch# set interface-name unit logical-unit-number family family-name filter (input |
output) filter-name
```

In the **input** statement, specify a firewall filter to be evaluated when packets are received on the interface. Input filters applied to a loopback interface affect only traffic destined for the Routing Engine.

In the **output** statement, specify a filter to be evaluated when packets exit the interface.



NOTE: When you create a loopback interface, it is important to apply an ingress filter to it so the Routing Engine is protected. We recommend that when you apply a filter to the loopback interface `lo0`, you include the `apply-groups` statement. Doing so ensures that the filter is automatically inherited on every loopback interface, including `lo0` and other loopback interfaces.

Related Documentation

- [Configuring Firewall Filters on page 35](#)

Configuring MPLS Firewall Filters and Policers

You can configure an MPLS firewall filter to count packets based on the EXP bits for the top-level MPLS label in a packet. You can also configure policers for MPLS LSPs.

The following sections discuss MPLS firewall filters and policers:

- [Configuring MPLS Firewall Filters on page 39](#)
- [Examples: Configuring MPLS Firewall Filters on page 40](#)
- [Configuring Policers for LSPs on page 40](#)

Configuring MPLS Firewall Filters

You can configure an MPLS firewall filter to count packets based on the EXP bits for the top-level MPLS label in a packet. You can then apply this filter to a specific interface on input or output. You can also configure a policer for the MPLS filter to police (that is, rate-limit) the traffic on the interface to which the filter is attached. You cannot apply MPLS firewall filters to loopback interfaces.

You can configure the following match conditions for MPLS filters at the `[edit firewall family mpls filter filter-name term term-name from]` hierarchy level:

- `exp`
- `label`

These `exp` match condition can accept EXP bits in the range 0 through 7. You can configure the following choices:

- A single EXP bit—for example, `exp 3`;
- Several EXP bits—for example, `exp 0, 4`;
- A range of EXP bits—for example, `exp [0-5]`;

The `label` match condition can accept a range of values from 0 to 1048575.

If you do not specify a match criterion (that is, you do not configure the `from` statement and use only the `then` statement with the `count` action keyword), all the MPLS packets passing through the interface on which the filter is applied will be counted.

You also can configure any of the following action keywords at the **[edit firewall family mpls filter *filter-name* term *term-name* then]** hierarchy level:

- **accept**
- **count**
- **discard**
- **policer**
- **three-color-policer**

Examples: Configuring MPLS Firewall Filters

The following examples illustrate how you might configure an MPLS firewall filter and then apply the filter to an interface. This filter is configured to count MPLS packets with EXP bits set to either 0 or 4.

The following shows a configuration for an MPLS firewall filter:

```
[edit firewall]
family mpls {
  filter expf {
    term expt0 {
      from {
        exp 0,4;
      }
      then {
        count counter0;
        accept;
      }
    }
  }
}
```

Configuring Policers for LSPs

MPLS LSP policing allows you to control the amount of traffic forwarded through a particular LSP. Policing helps to ensure that the amount of traffic forwarded through an LSP never exceeds the requested bandwidth allocation. LSP policing is supported on regular LSPs, LSPs configured with DiffServ-aware traffic engineering, and multiclass LSPs. You can configure multiple policers for each multiclass LSP. For regular LSPs, each LSP policer is applied to all of the traffic traversing the LSP. The policer's bandwidth limitations become effective as soon as the total sum of traffic traversing the LSP exceeds the configured limit.

You configure the multiclass LSP and DiffServ-aware traffic engineering LSP policers in a filter. The filter can be configured to distinguish between the different class types and apply the relevant policer to each class type. The policers distinguish between class types based on the EXP bits.

You configure LSP policers under the **family any** filter. The **family any** filter is used because the policer is applied to traffic entering the LSP. This traffic might be from different

families: IPv6, MPLS, and so on. You do not need to know what sort of traffic is entering the LSP, as long as the match conditions apply to all types of traffic.

LSP Policer Limitations

When configuring MPLS LSP policers, be aware of the following limitations:

- LSP policers are supported for packet LSPs only.
- LSP policers are supported for unicast next hops only. Multicast next hops are not supported.
- LSP policers are not supported on aggregated interfaces.
- The LSP policer runs before any output filters.
- Traffic sourced from the Routing Engine (for example, ping traffic) does not take the same forwarding path as transit traffic. This type of traffic cannot be policed.

Related Documentation

- [Overview of Policers on page 55](#)

Monitoring Firewall Filter Traffic

You can use operational mode commands to monitor firewall filter traffic.

- [Monitoring Traffic for All Firewall Filters and Policers That Are Configured on page 41](#)
- [Monitoring Traffic for a Specific Firewall Filter on page 42](#)
- [Monitoring Traffic for a Specific Policer on page 42](#)

Monitoring Traffic for All Firewall Filters and Policers That Are Configured

Purpose Monitor the number of packets and bytes that matched the firewall filters and monitor the number of packets that exceeded policer rate limits:

Action Use the **show firewall** operational mode command:

```
user@switch> show firewall
Filter: egress-vlan-watch-employee
Counters:
Name                                     Bytes      Packets
counter-employee-web                    3348        27
Filter: ingress-port-limit-tcp-icmp
Counters:
Name                                     Bytes      Packets
icmp-counter                           560         10
Policers:
Name                                     Packets
icmp-connection-policer                 10
tcp-connection-policer                   0
Filter: ingress-vlan-rogue-block
Filter: ingress-vlan-limit-guest
```

Meaning The **show firewall** command displays the names of all firewall filters, counters, and policers that are configured. For each counter that is specified in a filter configuration,

the output field shows the byte count and packet count for the term in which the counter is specified. For each policer that is specified in a filter configuration, the output field shows the packet count for packets that exceed the specified rate limits.

Monitoring Traffic for a Specific Firewall Filter

Purpose Monitor the number of packets and bytes that matched a firewall filter and monitor the number of packets that exceeded policer rate limits.

Action Use the **show firewall filter *filter-name*** operational mode command:

```
user@switch> show firewall filter ingress-port-limit-tcp-icmp
Filter: ingress-port-limit-tcp-icmp
Counters:
Name                                     Bytes      Packets
icmp-counter                             560         10
```

Meaning The **show firewall filter *filter-name*** command limits the display information to the counters and policers that are defined for the specified filter.

Monitoring Traffic for a Specific Policer

Purpose Monitor the number of packets that exceeded the rate limits of a policer:

Action Use the **show firewall policer *policer-name*** operational mode command:

```
user@switch> show firewall policer icmp-connection-policer
Filter: ingress-port-limit-tcp-icmp
Policers:
Name                                     Packets
icmp-connection-policer                  10
```

Meaning The **show firewall policer *policer-name*** command displays the number of packets that exceeded the rate limits for the specified policer.

Related Documentation

- [Configuring Firewall Filters on page 35](#)
- [Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73](#)
- [Verifying That Firewall Filters Are Operational on page 42](#)

Verifying That Firewall Filters Are Operational

Purpose Verify that firewall filters are working properly.

Action Use the **show firewall** operational mode command to verify that the firewall filters are working properly:

```
user@switch> show firewall
Filter: egress-vlan-watch-employee
Counters:
Name                                     Bytes      Packets
counter-employee-web                     0           0
```

```

Filter: ingress-port-limit-tcp-icmp
Counters:
Name                               Bytes          Packets
icmp-counter                        560            10
Policers:
Name                               Packets
icmp-connection-policer            10
tcp-connection-policer              0
Filter: ingress-vlan-rogue-block
Filter: ingress-vlan-limit-guest

```

Meaning The **show firewall** command displays the names of all firewall filters, counters, and policers that are configured. For each counter that is specified in a filter configuration, the output field shows the byte count and packet count for the term in which the counter is specified. In the above example, the **icmp-counter** in the filter **ingress-port-limit-tcp-icmp** shows that the filter matched 10 packets. For each policer that is specified in a filter configuration, the output field shows the packet count for packets that exceed the specified rate limits. The policer **icmp-connection-policer** shows that 10 ICMP packets were policed.

- Related Documentation**
- [Configuring Firewall Filters on page 35](#)
 - [Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73](#)
 - [Monitoring Firewall Filter Traffic on page 41](#)

Troubleshooting Firewall Filters

Use the following information to troubleshoot your firewall filter configuration.

- [Troubleshooting QFX10000 Switches on page 43](#)
- [Troubleshooting Other Switches on page 44](#)

Troubleshooting QFX10000 Switches

This section describes issues specific to QFX10000 switches:

- [Do Not Combine Match Conditions for Different Layers on page 43](#)
- [Layer 2 Packets Cannot be Discarded with Firewall Filters on page 44](#)
- [Protect-RE \(loopback\) Firewall Filter Does Not Filter Packets Applied to EM0 Interfaces on page 44](#)

Do Not Combine Match Conditions for Different Layers

On QFX10000 switches, do not combine match conditions for Layer 2 and any other layer in a **family ethernet-switching** filter. (For example, do not include conditions that match MAC addresses and IP addresses in the same filter.) If you do so, the filter will commit successfully but will not work. You will also see the following log message: **L2 filter *filter-name* doesn't support mixed L2 and L3/L4 match conditions. Please re-config.**

Layer 2 Packets Cannot be Discarded with Firewall Filters

Problem **Description:** Layer 2 (L2) control packets such as Link Layer Discovery Protocol (LLDP) and bridge protocol data unit (BPDU) cannot be discarded with firewall filters.

Solution Configure distributed denial-of-service (DDoS) protection on the L2 control packet and set the aggregate policer bandwidth and burst values to the minimum value of 1. For example,

```
[edit system ddos-protection protocols protocol name]  
user@host# set aggregate bandwidth 1
```

```
[edit system ddos-protection protocols protocol name]  
user@host# set aggregate burst 1
```

Protect-RE (loopback) Firewall Filter Does Not Filter Packets Applied to EMO Interfaces

Problem **Description:** On QFX10000 switches, the Protect-RE (loopback) firewall filter does not filter packets applied to EMO interfaces including SNMP, Telnet, and other services.

Solution This is expected behavior.

Troubleshooting Other Switches

This section describes issues specific to QFX switches other than QFX10000 switches. This information also applies to OCX1100 switches and EX4600 switches.

- [Firewall Filter Configuration Returns a No Space Available in TCAM Message on page 45](#)
- [Filter Counts Previously Dropped Packet on page 46](#)
- [Matching Packets Not Counted on page 47](#)
- [Counter Reset When Editing Filter on page 47](#)
- [Cannot Include loss-priority and policer Actions in Same Term on page 47](#)
- [Cannot Egress Filter Certain Traffic Originating on QFX Switch on page 48](#)
- [Firewall Filter Match Condition Not Working with Q-in-Q Tunneling on page 48](#)
- [Egress Firewall Filters with Private VLANs on page 48](#)
- [Egress Filtering of L2PT Traffic Not Supported on page 49](#)
- [Cannot Drop BGP Packets in Certain Circumstances on page 49](#)
- [Invalid Statistics for Policer on page 50](#)
- [Policers can Limit Egress Filters on page 50](#)

Firewall Filter Configuration Returns a No Space Available in TCAM Message

Problem **Description:** When a firewall filter configuration exceeds the amount of available Ternary Content Addressable Memory (TCAM) space, the system returns the following **syslogd** message:

```
No space available in tcam.
Rules for filter filter-name will not be installed.
```

A switch returns this message during the commit operation if the firewall filter that has been applied to a port, VLAN, or Layer 3 interface exceeds the amount of space available in the TCAM table. The filter is not applied, but the commit operation for the firewall filter configuration is completed in the CLI module.

Solution When a firewall filter configuration exceeds the amount of available TCAM table space, you must configure a new firewall filter with fewer filter terms so that the space requirements for the filter do not exceed the available space in the TCAM table.

You can perform either of the following procedures to correct the problem:

To delete the filter and its binding and apply the new smaller firewall filter to the same binding:

1. Delete the filter and its binding to ports, VLANs, or Layer 3 interfaces. For example:

```
[edit]
user@switch# delete firewall family ethernet-switching filter ingress-vlan-rogue-block
user@switch# delete vlans employee-vlan description "filter to block rogue devices on
employee-vlan"
user@switch# delete vlans employee-vlan filter input ingress-vlan-rogue-block
```

2. Commit the changes:

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

3. Configure a smaller filter with fewer terms that does not exceed the amount of available TCAM space. For example:

```
[edit]
user@switch# set firewall family ethernet-switching filter new-ingress-vlan-rogue-block ...
```

4. Apply (bind) the new firewall filter to a port, VLAN, or Layer 3 interface. For example:

```
[edit]
user@switch# set vlans employee-vlan description "filter to block rogue devices on
employee-vlan"
user@switch# set vlans employee-vlan filter input new-ingress-vlan-rogue-block
```

5. Commit the changes:

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

To apply a new firewall filter and overwrite the existing binding but not delete the original filter:

1. Configure a firewall filter with fewer terms than the original filter:

```
[edit]
user@switch# set firewall family ethernet-switching filter new-ingress-vlan-rogue-block...
```

2. Apply the firewall filter to the port, VLAN, or Layer 3 interfaces to overwrite the binding of the original filter—for example:

```
[edit]
user@switch# set vlans employee-vlan description "smaller filter to block rogue devices on employee-vlan"
```

```
user@switch# set vlans employee-vlan filter input new-ingress-vlan-rogue-block
```

Because you can apply no more than one firewall filter per VLAN per direction, the binding of the original firewall filter to the VLAN is overwritten with the new firewall filter **new-ingress-vlan-rogue-block**.

3. Commit the changes:

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



NOTE: The original filter is not deleted and is still available in the configuration.

Filter Counts Previously Dropped Packet

- Problem Description:** If you configure two or more filters in the same direction for a physical interface and one of the filters includes a counter, the counter will be incorrect if the following circumstances apply:
- You configure the filter that is applied to packets first to discard certain packets. For example, imagine that you have a VLAN filter that accepts packets sent to 10.10.1.0/24 addresses and implicitly discards packets sent to any other addresses. You apply the filter to the **admin** VLAN in the output direction, and interface xe-0/0/1 is a member of that VLAN.
 - You configure a subsequent filter to accept and count packets that are dropped by the first filter. In this example, you have a port filter that accepts and counts packets sent to 192.168.1.0/24 addresses that is also applied to xe-0/0/1 in the output direction.

The egress VLAN filter is applied first and correctly discards packets sent to 192.168.1.0/24 addresses. The egress port filter is applied next and counts the discarded packets as matched packets. The packets are not forwarded, but the counter displayed by the egress port filter is incorrect.

Remember that the order in which filters are applied depends on the direction in which they are applied, as indicated here:

Ingress filters:

1. Port (Layer 2) filter
2. VLAN filter
3. Router (Layer 3) filter

Egress filters:

1. Router (Layer 3) filter
2. VLAN filter
3. Port (Layer 2) filter

Solution This is expected behavior.

Matching Packets Not Counted

Problem **Description:** If you configure two egress filters with counters for a physical interface and a packet matches both of the filters, only one of the counters includes that packet. For example:

- You configure an egress port filter with a counter for interface xe-0/0/1.
- You configure an egress VLAN filter with a counter for the **adminVLAN**, and interface xe-0/0/1 is a member of that VLAN.
- A packet matches both filters.

In this case, the packet is counted by only one of the counters even though it matched both filters.

Solution This is expected behavior.

Counter Reset When Editing Filter

Problem **Description:** If you edit a firewall filter term, the value of any counter associated with any term in the same filter is set to 0, including the implicit counter for any policer referenced by the filter. Consider the following examples:

- Assume that your filter has **term1**, **term2**, and **term3**, and each term has a counter that has already counted matching packets. If you edit any of the terms in any way, the counters for all the terms are reset to 0.
- Assume that your filter has **term1** and **term2**. Also assume that **term2** has a **policer** action modifier and the implicit counter of the policer has already counted 1000 matching packets. If you edit **term1** or **term2** in any way, the counter for the policer referenced by **term2** is reset to 0.

Solution This is expected behavior.

Cannot Include loss-priority and policer Actions in Same Term

Problem **Description:** You cannot include both of the following actions in the same firewall filter term in a QFX Series switch:

- **loss-priority**
- **policer**

If you do so, you see the following error message when you attempt to commit the configuration: "cannot support policer action if loss-priority is configured."

Solution This is expected behavior.

Cannot Egress Filter Certain Traffic Originating on QFX Switch

Problem **Description:** On a QFX Series switch, you cannot filter certain traffic with a firewall filter applied in the output direction if the traffic originates on the QFX switch. This limitation applies to control traffic for protocols such as ICMP (ping), STP, LACP, and so on.

Solution This is expected behavior.

Firewall Filter Match Condition Not Working with Q-in-Q Tunneling

Problem **Description:** If you create a firewall filter that includes a match condition of **dot1q-tag** or **dot1q-user-priority** and apply the filter on input to a trunk port that participates in a service VLAN, the match condition does not work if the Q-in-Q EtherType is not 0x8100. (When Q-in-Q tunneling is enabled, trunk interfaces are assumed to be part of the service provider or data center network and therefore participate in service VLANs.)

Solution This is expected behavior. To set the Q-in-Q EtherType to 0x8100, enter the **set dot1q-tunneling ethertype 0x8100** statement at the **[edit ethernet-switching-options]** hierarchy level. You must also configure the other end of the link to use the same Ethertype.

Egress Firewall Filters with Private VLANs

Problem **Description:** If you apply a firewall filter in the output direction to a primary VLAN, the filter also applies to the secondary VLANs that are members of the primary VLAN when the traffic egresses with the primary VLAN tag or isolated VLAN tag, as listed below:

- Traffic forwarded from a secondary VLAN trunk port to a promiscuous port (trunk or access)
- Traffic forwarded from a secondary VLAN trunk port that carries an isolated VLAN to a PVLAN trunk port.
- Traffic forwarded from a promiscuous port (trunk or access) to a secondary VLAN trunk port
- Traffic forwarded from a PVLAN trunk port. to a secondary VLAN trunk port
- Traffic forwarded from a community port to a promiscuous port (trunk or access)

If you apply a firewall filter in the output direction to a primary VLAN, the filter does *not* apply to traffic that egresses with a community VLAN tag, as listed below:

- Traffic forwarded from a community trunk port to a PVLAN trunk port
- Traffic forwarded from a secondary VLAN trunk port that carries a community VLAN to a PVLAN trunk port
- Traffic forwarded from a promiscuous port (trunk or access) to a community trunk port
- Traffic forwarded from a PVLAN trunk port to a community trunk port

If you apply a firewall filter in the output direction to a community VLAN, the following behaviors apply:

- The filter is applied to traffic forwarded from a promiscuous port (trunk or access) to a community trunk port (because the traffic egresses with the community VLAN tag).
- The filter is applied to traffic forwarded from a community port to a PVLAN trunk port (because the traffic egresses with the community VLAN tag).
- The filter is *not* applied to traffic forwarded from a community port to a promiscuous port (because the traffic egresses with the primary VLAN tag or untagged).

Solution These are expected behaviors. They occur only if you apply a firewall filter to a private VLAN in the output direction and do not occur if you apply a firewall filter to a private VLAN in the input direction.

Egress Filtering of L2PT Traffic Not Supported

Problem **Description:** Egress filtering of L2PT traffic is not supported on the QFX3500 switch. That is, if you configure L2PT to tunnel a protocol on an interface, you cannot also use a firewall filter to filter traffic for that protocol on that interface in the output direction. If you commit a configuration for this purpose, the firewall filter is not applied to the L2PT-tunneled traffic.

Solution This is expected behavior.

Cannot Drop BGP Packets in Certain Circumstances

Problem **Description:** BGP packets with a time-to-live (TTL) value greater than 1 cannot be discarded using a firewall filter applied to a loopback interface or applied on input to a Layer 3 interface. BGP packets with TTL value of 1 or 0 can be discarded using a firewall filter applied to a loopback interface or applied on input to a Layer 3 interface.

Solution This is expected behavior.

Invalid Statistics for Policer

Problem **Description:** If you apply a single-rate two-color policer in more than 128 terms in a firewall filter, the output of the **show firewall** command displays incorrect data for the policer.

Solution This is expected behavior.

Policers can Limit Egress Filters

Problem **Description:** On some switches, the number of egress policers that you configure can affect the total number of allowed egress firewall filters. (This issue does not affect QFX10000 switches.) On the affected switches, every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.
- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
 - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
 - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

Solution You can prevent this problem by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.

- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

PART 2

Policers

- [Configuring Policers on page 55](#)

CHAPTER 2

Configuring Policers

- [Overview of Policers on page 55](#)
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- [Understanding Color-Blind Mode for Single-Rate Tricolor Marking on page 61](#)
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- [Configuring Color-Blind Egress Policers for Medium-Low PLP on page 72](#)
- [Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73](#)
- [Verifying That Two-Color Policers Are Operational on page 75](#)
- [Verifying That Three-Color Policers Are Operational on page 76](#)
- [Troubleshooting Policer Configuration on page 76](#)

Overview of Policers

A switch polices traffic by limiting the input or output transmission rate of a class of traffic according to user-defined criteria. Policing (or rate-limiting) traffic allows you to control the maximum rate of traffic sent or received on an interface and to provide multiple priority levels or classes of service.

- [Policer Overview on page 56](#)
- [Policer Types on page 56](#)
- [Policer Actions on page 57](#)
- [Policer Colors on page 58](#)
- [Filter-Specific Policers on page 58](#)
- [Suggested Naming Convention for Policers on page 59](#)
- [Policer Counters on page 59](#)
- [Policer Algorithms on page 59](#)

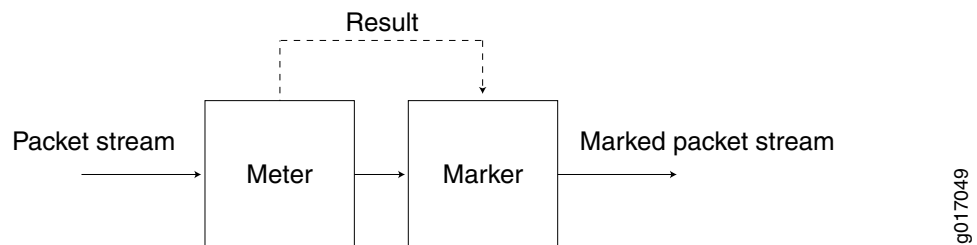
- [How Many Policers Are Supported? on page 60](#)
- [Policies Can Limit Egress Firewall Filters on page 60](#)

Policer Overview

You use policers to apply limits to traffic flow and set consequences for packets that exceed these limits—usually applying a higher loss priority—so that if packets encounter downstream congestion, they can be discarded first. Policers apply only to unicast packets.

Policers provide two functions: metering and marking. A policer meters (measures) each packet against traffic rates and burst sizes that you configure. It then passes the packet and the metering result to the marker, which assigns a packet loss priority that corresponds to the metering result. [Figure 3 on page 56](#) illustrates this process.

Figure 3: Flow of Tricolor Marking Policer Operation



After you name and configure a policer, you can use it by specifying it as an action in one or more firewall filters.

Policer Types

A switch supports three types of policers:

- **Single-rate two-color marker**—A two-color policer (or “policer” when used without qualification) meters the traffic stream and classifies packets into two categories of packet loss priority (PLP) according to a configured bandwidth and burst-size limit. You can mark packets that exceed the bandwidth and burst-size limit with a specified PLP or simply discard them.

You can specify this type of policer in an ingress or egress firewall.



NOTE: A two-color policer is most useful for metering traffic at the port (physical interface) level.

- **Single-rate three-color marker**—This type of policer is defined in RFC 2697, *A Single Rate Three Color Marker*, as part of an assured forwarding (AF) per-hop-behavior (PHB) classification system for a Differentiated Services (DiffServ) environment. This type of policer meters traffic based on one rate—the configured committed information rate (CIR) as well as the committed burst size (CBS) and the excess burst size (EBS). The CIR specifies the average rate at which bits are admitted to the switch. The CBS specifies the usual burst size in bytes and the EBS specifies the maximum burst size in bytes. The EBS must be greater than or equal to the CBS, and neither can be 0.

You can specify this type of policer in an ingress or egress firewall.



NOTE: A single-rate three-color marker (TCM) is most useful when a service is structured according to packet length and not peak arrival rate.

- Two-rate three-color marker—This type of policer is defined in RFC 2698, *A Two Rate Three Color Marker*, as part of an assured forwarding per-hop-behavior classification system for a Differentiated Services environment. This type of policer meters traffic based on two rates—the CIR and peak information rate (PIR) along with their associated burst sizes, the CBS and peak burst size (PBS). The PIR specifies the maximum rate at which bits are admitted to the network and must be greater than or equal to the CIR.

You can specify this type of policer in an ingress or egress firewall.



NOTE: A two-rate three-color policer is most useful when a service is structured according to arrival rates and not necessarily packet length.

See [Table 9 on page 57](#) for information about how metering results are applied for each of these policer types.

Policer Actions

Policer actions are implicit or explicit and vary by policer type. *Implicit* means that Junos OS assigns the loss priority automatically. [Table 9 on page 57](#) describes the policer actions.

Table 9: Policer Actions

Policer	Marking	Implicit Action	Configurable Action
Single-rate two-color	Green (conforming)	Assign low loss priority	None
	Red (nonconforming)	None	Discard
Single-rate three-color	Green (conforming)	Assign low loss priority	None
	Yellow (above the CIR and CBS)	Assign medium-high loss priority	None
	Red (above the EBS)	Assign high loss priority	Discard

Table 9: Policer Actions (*continued*)

Policer	Marking	Implicit Action	Configurable Action
Two-rate three-color	Green (conforming)	Assign low loss priority	None
	Yellow (above the CIR and CBS)	Assign medium-high loss priority	None
	Red (above the PIR and PBS)	Assign high loss priority	Discard



NOTE: If you specify a policer in an egress firewall filter, the only supported action is **discard**.

Policer Colors

Single-rate and two-rate three-color policers can operate in two modes:

- **Color-blind**—In color-blind mode, the three-color policer assumes that all packets examined have not been previously marked or metered. In other words, the three-color policer is “blind” to any previous coloring a packet might have had.
- **Color-aware**—In color-aware mode, the three-color policer assumes that all packets examined have been previously marked or metered. In other words, the three-color policer is “aware” of the previous coloring a packet might have had. In color-aware mode, the three-color policer can increase the PLP of a packet but cannot decrease it. For example, if a color-aware three-color policer meters a packet with a medium PLP marking, it can raise the PLP level to high but cannot reduce the PLP level to low.

Filter-Specific Policers

You can configure policers to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this on some QFX switches, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps. However, the behavior of a filter-specific policer is affected by how the firewall filter terms that reference the policer are stored in TCAM. If you create a filter-specific policer and reference it in multiple firewall filter terms, the policer allows more traffic than expected if the terms are stored in different TCAM slices. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms that are stored in three separate memory slices, the total bandwidth allowed by the filter is 3 Gbps, not 1 Gbps. (This behavior does not occur in QFX10000 switches.)

To prevent this unexpected behavior from occurring, use the information about TCAM slices presented in [“Planning the Number of Firewall Filters to Create” on page 30](#) to

organize your configuration file so that all the firewall filter terms that reference a given filter-specific policer are stored in the same TCAM slice.

Suggested Naming Convention for Policers

We recommend that you use the naming convention ***policertypeTCM#-color type*** when configuring three-color policers and ***policer#*** when configuring two-color policers. TCM stands for three-color marker. Because policers can be numerous and must be applied correctly to work, a simple naming convention makes it easier to apply the policers properly. For example, the first single-rate, color-aware three-color policer configured would be named ***srTCM1-ca***. The second two-rate, color-blind three-color configured would be named ***trTCM2-cb***. The elements of this naming convention are explained below:

- sr (single-rate)
- tr (two-rate)
- TCM (tricolor marking)
- 1 or 2 (number of marker)
- ca (color-aware)
- cb (color-blind)

Policer Counters

On some QFX switches, each policer that you configure includes an implicit counter that counts the number of packets that exceed the rate limits that are specified for the policer. If you use the same policer in multiple terms—either within the same filter or in different filters—the implicit counter counts all the packets that are policed in all of these terms and provides the total amount. (This does not apply to QFX10000 switches.) If you want to obtain separate packet counts for each term on an affected switch, use these options:

- Configure a unique policer for each term.
- Configure only one policer, but use a unique, explicit counter in each term.

Policer Algorithms

Policing uses the *token-bucket algorithm*, which enforces a limit on average bandwidth while allowing bursts up to a specified maximum value. It offers more flexibility than the *leaky bucket algorithm* in allowing a certain amount of bursty traffic before it starts discarding packets.



NOTE: In an environment of light bursty traffic, QFX5200 might not replicate all multicast packets to two or more downstream interfaces. This occurs only at a line rate burst—if traffic is consistent, the issue does not occur. In addition, the issue occurs only when packet size increases beyond 6k in a one gigabit traffic flow.

How Many Policers Are Supported?

QFX10000 switches support 8K policers (all policer types). QFX5100 and QFX5200 switches support 1535 ingress policers and 1024 egress policers (assuming one policer per firewall filter term). QFX5110 switches support 6144 ingress policers and 1024 egress policers (assuming one policer per firewall filter term).

QFX3500 and QFX3600 standalone switches and QFabric Node devices support the following numbers of policers (assuming one policer per firewall filter term):

- Two-color policers used in ingress firewall filters: 767
- Three-color policers used in ingress firewall filters: 767
- Two-color policers used in egress firewall filters: 1022
- Three-color policers used in egress firewall filters: 512

Policers Can Limit Egress Firewall Filters

On some switches, the number of egress policers that you configure can affect the total number of allowed egress firewall filters. (This issue does not affect QFX10000 switches.) On the affected switches, every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.
- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
 - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
 - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

You can prevent this problem by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In

this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

**Related
Documentation**

- [Understanding Color-Blind Mode for Single-Rate Tricolor Marking on page 61](#)
- [Understanding Color-Blind Mode for Two-Rate Tricolor Marking on page 64](#)
- [Understanding Color-Aware Mode for Single-Rate Tricolor Marking on page 62](#)
- [Understanding Color-Aware Mode for Two-Rate Tricolor Marking on page 64](#)
- [Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73](#)

Understanding Policers with Link Aggregation Groups

If you apply a policer to a link aggregation group (LAG) on a standalone switch or QFabric node, the policer applies to all the interfaces in the LAG in aggregate. For example, if you configure a policer to rate-limit at 1 Gbps and apply the policer (by using a firewall filter) to a LAG that has two member interfaces on a single switch or node, the total allowed throughput for both members is 1 Gbps.

If you apply a policer to a LAG that has members on different nodes in a QFabric network Node group or redundant server Node group, the configured rate applies to the interface on each node. For example, if you configure a policer to rate-limit at 1 Gbps and apply the policer to a LAG that has one member on server node A and one member on server node B, the allowed throughput for each member is 1 Gbps, for a total allowed throughput of 2 Gbps.

**Related
Documentation**

- [Overview of Policers on page 55](#)
- [Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73](#)

Understanding Color-Blind Mode for Single-Rate Tricolor Marking

With the color-blind mode of single-rate tricolor marking, all packets are evaluated against the CBS. If a packet exceeds the CBS, it is evaluated against the EBS. In color-blind mode, the policer supports three loss priorities only: low, medium-high, and high.

Packets that exceed the CBS but are below the EBS are marked yellow (medium-high). Packets that exceed the EBS are marked red (high), as shown in [Table 10 on page 62](#).

Table 10: Color-Blind Mode TCM Color-to-PLP Mapping

Color	PLP	Meaning
Green	low	Conforming.
Yellow	medium-high	Packet exceeds the CIR and CBS but does not exceed the EBS.
Red	high	Packet exceeds the EBS.

Related Documentation

- [Overview of Policers on page 55](#)
- [Configuring Color-Blind Egress Policers for Medium-Low PLP on page 72](#)

Understanding Color-Aware Mode for Single-Rate Tricolor Marking

In color-aware mode, the treatment the packet receives depends on its classification. Marking can increase a preassigned PLP but cannot decrease it.

Summary of PLP Changes

Table 11 on page 62 shows how a packet's incoming priority can be modified with single-rate marking.

Table 11: Color-Aware Mode Single-Rate PLP Mapping

Incoming PLP	Packet Metered Against	Possible Cases	Outgoing PLP
low	CIR, CBS, and EBS	Conforming	low
		Packet exceeds the CIR and CBS but does not exceed the EBS.	medium-high
		Packet exceeds the EBS.	high
medium-low	EBS only	Packet does not exceed the EBS.	medium-low
		Packet exceeds the EBS.	high
medium-high	EBS only	Packet does not exceed the EBS.	medium-high
		Packet exceeds the EBS.	high
high	Not metered by the policer.	All cases.	high

The following sections describe single-rate color-aware PLP mapping in more detail.

Effect on Green Packets (Low PLP)

Packets belonging to the green class have already been marked by a classifier with low PLP. The marking policer can leave the PLP unchanged or increase it to medium-high or high, so these packets are therefore metered against both the CBS and the EBS. For example, if a behavior aggregate or multifield classifier marks a packet with low PLP and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CIR, packets remain marked as low PLP.
- If bursts exceed the CBS but not the EBS, some of the packets are marked as medium-high PLP, and some of the packets remain marked as low PLP.
- If bursts exceed the EBS, some of the packets are marked as high PLP, and some of the packets remain marked as low PLP.

Effect on Yellow Packets (Medium PLP)

Packets belonging to the yellow class have already been marked by a classifier with medium-low or medium-high PLP. The marking policer can leave the PLP unchanged or increase it to high, so these packets are therefore metered against the EBS only. For example, if a behavior aggregate or multifield classifier marks a packet with medium-low PLP and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CBS, the packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the CBS but less than the EBS, the packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the EBS, some of the packets are marked as high PLP and some remain marked as medium-low PLP.

If a BA or multifield classifier marks a packet with medium-high PLP and the two-rate TCM policer is in color-aware mode, the policer assigns output loss priority as follows:

- If the rate of traffic flow is less than the CBS, the packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the CBS but less than the EBS, the packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the EBS, some of the packets are marked as high PLP and some remain marked as medium-high PLP.

Effect on Red Packets (High PLP)

Packets belonging to the red class have already been marked by a classifier with high PLP. Because the policer cannot decrease the PLP, it does not change it, and these packets are not metered against the CBS or the EBS.

- Related Documentation**
- [Overview of Policers on page 55](#)
 - [Configuring Color-Blind Egress Policers for Medium-Low PLP on page 72](#)

Understanding Color-Blind Mode for Two-Rate Tricolor Marking

With the color-blind mode of two-rate tricolor marking, all packets are evaluated against the committed information rate (CIR). If a packet exceeds the CIR, it is evaluated against the peak information rate (PIR). Packets that exceed the CIR but are below the PIR are marked yellow (medium-high). Packets that exceed the PIR are marked red (high).

Table 12: Color-Blind Mode TCM Color-to-PLP Mapping

Color	PLP	Meaning
Green	low	Packet does not exceed the CIR.
Yellow	medium-high	Packet exceeds the CIR but does not exceed the PIR.
Red	high	Packet exceeds the PIR.

- Related Documentation**
- [Overview of Policers on page 55](#)
 - [Configuring Color-Blind Egress Policers for Medium-Low PLP on page 72](#)

Understanding Color-Aware Mode for Two-Rate Tricolor Marking

In color-aware mode, the treatment the packet receives depends on its classification. Marking can increase the preassigned PLP but cannot decrease it.

Summary of PLP Changes

[Table 13 on page 64](#) shows how a packet's incoming priority can be modified with two-rate marking.

Table 13: Color-Aware Mode Two-Rate PLP Mapping

Incoming PLP	Packet Metered Against	Possible Cases	Outgoing PLP
low	CIR and PIR	Packet does not exceed the CIR.	low
		Packet exceeds the CIR but not the PIR.	medium-high
		Packet exceeds the PIR.	high
medium-low	PIR only	Packet does not exceed the PIR.	medium-low
		Packet exceeds the PIR.	high

Table 13: Color-Aware Mode Two-Rate PLP Mapping (*continued*)

Incoming PLP	Packet Metered Against	Possible Cases	Outgoing PLP
medium-high	PIR only	Packet does not exceed the PIR.	medium-high
		Packet exceeds the PIR.	high
high	Not metered by the policer.	All cases.	high

The following sections describe color-aware two-rate PLP mapping in more detail.

Effect on Green Packets (Low PLP)

Packets belonging to the green class have already been marked by a classifier with low PLP. The marking policer can leave the packet's PLP unchanged or increase the PLP to medium-high or high. These packets are therefore metered against both the CIR and the PIR. For example, if a behavior aggregate or multifield classifier marks a packet with low PLP and the two-rate TCM policer is in color-aware mode, the output loss priority is as follows:

- If the rate of traffic flow is less than the CIR, the packets remain marked as low PLP.
- If the rate of traffic flow is greater than the CIR but less than the PIR, some of the packets are marked as medium-high PLP and some of the packets remain marked as low PLP.
- If the rate of traffic flow is greater than the PIR, some of the packets are marked as high PLP and some of the packets remain marked as low PLP.

Effect on Yellow Packets (Medium PLP)

Packets belonging to the yellow class have already been marked by a classifier with medium-low or medium-high PLP. The marking policer can leave the PLP unchanged or increase it to high. These packets are therefore metered against the PIR only. For example, if a behavior aggregate (BA) or multifield classifier marks a packet with medium-low PLP and the two-rate TCM policer is in color-aware mode, the policer assigns output loss priority as follows:

- If the rate of traffic flow is less than the CIR, the packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the CIR but less than the PIR, the packets remain marked as medium-low PLP.
- If the rate of traffic flow is greater than the PIR, some of the packets are marked as high PLP and some of the packets remain marked as medium-low PLP.

If a BA or multifield classifier marks a packet with medium-high PLP and the two-rate TCM policer is in color-aware mode, the policer assigns output loss priority as follows:

- If the rate of traffic flow is less than the CIR, the packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the CIR but less than the PIR, the packets remain marked as medium-high PLP.
- If the rate of traffic flow is greater than the PIR, some of the packets are marked as high PLP and some of the packets remain marked as medium-high PLP.

Effect on Red Packets (High PLP)

Packets belonging to the red class have already been marked by a classifier with high PLP. Because the policer cannot decrease the PLP, it does not change it, and these packets are not metered against the CIR or the PIR.

Related Documentation

- [Overview of Policers on page 55](#)
- [Configuring Color-Blind Egress Policers for Medium-Low PLP on page 72](#)

Example: Using Two-Color Policers and Prefix Lists

If you provide specific amounts of bandwidth to internal or external customers, you can use policing to make sure that customers do not consume more bandwidth than they should receive. For example, you might connect many customers to one 10-Gbps interface and want to ensure that none of them congest the interface by using more bandwidth than they have been allotted.

You could accomplish this by creating a two-color policer similar to the following for each customer:

```
firewall {
  policer Limit-Customer-1 {
    if-exceeding {
      bandwidth-limit 100m;
      burst-size-limit 150m;
    }
    then discard;
  }
}
```

Creating a policer for each customer is clearly not a scalable solution, however. As an alternative, you can create prefix lists that group classes of customers and then create policers for each prefix list. For example, you could create prefix lists such as **Class-A-Customer-Prefixes**, **Class-B-Customer-Prefixes**, and **Class-C-Customer-Prefixes** (at the **[edit policy-options]** hierarchy level) and create the following corresponding policers:

```
firewall {
  policer Class-A {
    if-exceeding {
      bandwidth-limit 100m;
      burst-size-limit 150m;
    }
    then discard;
  }
}
```

```

}
policer Class-B {
  if-exceeding {
    bandwidth-limit 75m;
    burst-size-limit 100m;
  }
  then discard;
}
policer Class-C {
  if-exceeding {
    bandwidth-limit 50m;
    burst-size-limit 75m;
  }
  then discard;
}
}

```

You must create filter terms that specify the prefix lists in their **from** statements and the corresponding policers in their **then** statements similar to the following:

```

firewall
family inet {
  filter Class-A-Customers {
    term term-1 {
      from {
        destination-prefix-list {
          Class-A-Customer-Prefixes;
        }
      }
      then policer Class-A;
    }
  }
  filter Class-B-Customers {
    term term-1 {
      from {
        destination-prefix-list {
          Class-B-Customer-Prefixes;
        }
      }
      then policer Class-B;
    }
  }
  filter Class-C-Customers {
    term term-1 {
      from {
        destination-prefix-list {
          Class-C-Customer-Prefixes;
        }
      }
      then policer Class-C;
    }
  }
}
}

```

Here are the steps to create this firewall configuration:

1. Create the first policer:

```
[edit firewall]
user@switch# set policer Class-A if-exceeding bandwidth-limit 100m burst-size-limit 150m
user@switch# set policer Class-A then discard
```

2. Create the second policer:

```
[edit firewall]
user@switch# set policer Class-B if-exceeding bandwidth-limit 75m burst-size-limit 100m
user@switch# set policer Class-B then discard
```

3. Create the third policer:

```
[edit firewall]
user@switch# set policer Class-C if-exceeding bandwidth-limit 50m burst-size-limit 75m
user@switch# set policer Class-C then discard
```

4. Create a filter for class A customers:

```
[edit firewall]
user@switch# edit family inet filter Class-A-Customers
```

5. Configure the filter to send packets matching the **Class-A-Customer-Prefixes** prefix list to the **Class-A** policer:

```
[edit firewall family inet filter Class-A-Customers]
user@switch# set term term-1 from source-prefix-list Class-A-Customers
user@switch# set term term-1 then policer Class-A
```

6. Create a filter for class B customers:

```
[edit firewall]
user@switch# edit family inet filter Class-B-Customers
```

7. Configure the filter to send packets matching the **Class-B-Customer-Prefixes** prefix list to the **Class-B** policer:

```
[edit firewall family inet filter Class-B-Customers]
user@switch# set term term-1 from source-prefix-list Class-B-Customers
user@switch# set term term-1 then policer Class-B
```

8. Create a filter for class C customers:

```
[edit firewall]
user@switch# edit family inet filter Class-C-Customers
```

9. Configure the filter to send packets matching the **Class-C-Customer-Prefixes** prefix list to the **Class-C** policer:

```
[edit firewall family inet filter Class-C-Customers]
user@switch# set term term-1 from source-prefix-list Class-C-Customers
user@switch# set term term-1 then policer Class-C
```

10. Apply the filters you created to the appropriate interfaces in the output direction.



NOTE: Note that the implicit deny statement in this filter will block traffic from any source that does not match one of the prefix lists. If you want the filter to allow this traffic, you must include an explicit term for this purpose.

- Related Documentation**
- [Overview of Policers on page 55](#)
 - [prefix-list](#)

Example: Using Policers to Manage Oversubscription

You might want to use a policer when an interface is oversubscribed and you want to control what will happen if congestion occurs. For example, you might have servers connected to a switch as listed in [Table 14 on page 69](#).

Table 14: Servers Connected to Switch

Server Type	Connection	IP Address
Network application server	1-gigabit interface	10.0.0.1
Authentication server	1-gigabit interface	10.0.0.2
Database server	10-gigabit interface	10.0.0.3

In this example, users access services provided by the network application server, which requests information from the database server as appropriate. When it receives a request from a user, the network application server first contacts the authentication server to verify the user's credentials. When a user is authenticated and the network application server provides the requested service, all the packets sent from the database server to the application server must transit the 1-Gigabit Ethernet interface connected to the application server twice—once on ingress to the application server and again on egress to the user.

The sequence of events for a user session is as follows:

1. A user connects to the application server and requests a service.
2. The application server requests the user's credentials and relays them to the authentication server.
3. If the authentication server verifies the credentials, the application server initiates the requested service.
4. The application server requests the files necessary to meet the user's request from the database server.
5. The database server sends the requested files to the application server.
6. The application server includes the requested files in its response to the user.

Traffic from the database server to the application server might congest the 1-gigabit interface to which that the application server is connected. This congestion might prevent the server from responding to requests from users and creating new sessions for them. You can use policing to make sure that this does not occur.

To create this firewall configuration, perform the following steps on the database server:

1. Create a policer to drop traffic from the database server to the application server if it exceeds certain limits:

```
[edit firewall]
user@switch# set policer Database-Egress-Policer if-exceeding bandwidth-limit 400
burst-size-limit 500m
user@switch# set policer Database-Egress-Policer then discard
```

2. Create a filter to examine traffic from the database server to the application server:

```
[edit firewall]
user@switch# edit family inet filter Database-Egress-Filter
```

3. Configure the filter to apply the policer to traffic egressing the database server and destined for the application server:

```
[edit firewall family inet filter Database-Egress-Filter]
user@switch# set term term-1 from destination-address 10.0.0.1
user@switch# set term term-1 then policer Database-Egress-Policer
```

4. If required, configure a term to allow traffic from the database server to other destinations (otherwise the traffic will be dropped by the implicit deny statement):

```
[edit firewall family inet filter Database-Egress-Filter]
user@switch# set term term-2 then accept
```

Note that omitting a **from** statement causes the term to match all packets, which is the desired behavior.

5. Install the egress filter as an output filter on the database server interface that is connected the application server:

```
[edit interfaces]
user@switch# set xe-0/0/3 unit 0 family inet filter output Database-Egress-Filter
```

Here is how the final configuration would appear:

```
firewall {
  policer Database-Egress-Policer {
    if-exceeding {
      bandwidth-limit 400;
      burst-size-limit 500m;
    }
    then discard;
  }
  family inet {
    filter Database-Egress-Filter {
      term term-1 {
        from {
          destination-address {
            10.0.0.1/24;
          }
        }
        then policer Database-Egress-Policer;
      }
      term term-2 { # If required, include this term so that traffic from the database server
                    # to other destinations is allowed.
        then accept;
      }
    }
  }
}
```



```
}
]
```

Related Documentation

- [Overview of Policers on page 55](#)

Assigning Forwarding Classes and Loss Priority

You can configure firewall filters to assign packet loss priority (PLP) and forwarding classes so that if congestion occurs, the marked packets can be dropped according to the priority you set. The valid match conditions are one or more of the six packet header fields: destination address, source address, IP protocol, source port, destination port, and DSCP. In other words, you can set the forwarding class and the PLP for each packet entering or an interface with a specific destination address, source address, IP protocol, source port, destination port, or DSCP.



NOTE: Junos OS assigns forwarding classes and PLP on ingress only. Do not use a filter that assigns forwarding classes or PLP as an egress filter.

When tricolor marking is enabled, a switch supports four PLP designations: **low**, **medium-low**, **medium-high**, and **high**. You can also specify any of the forwarding classes listed in [Table 15 on page 71](#)

Table 15: Unicast Forwarding Classes

Unicast Forwarding Class	For CoS Traffic Type
be	Best-effort traffic
no-loss	Guaranteed delivery for TCP traffic
fcoe	Guaranteed delivery for Fibre Channel over Ethernet (FCoE) traffic
nc	Network-control traffic

To assign forwarding classes in firewall filters:

1. Configure the family address type and filter name:

```
[edit]
```

```
user@switch# edit firewall family ethernet-switching filter ingress-filter
```

2. Configure the terms of the filter as appropriate, including the **forwarding-class** and **loss-priority** action modifiers. For example, each of the following terms in the filter examines various packet header fields and assigns the appropriate forwarding class and packet loss priority:

- The term **corp-traffic** matches all IPv4 packets with a **10.1.1.0/24** source address and assigns the packets to forwarding class **no-loss** with a loss priority of **low**:

```
[edit firewall family ethernet-switching filter ingress-filter]
user@switch# set term corp-traffic from source-address 10.1.1.0/24;
```

```
user@switch# set term corp-traffic then forwarding-class no-loss
user@switch# set term corp-traffic then loss-priority low
```

- The term **data-traffic** matches all IPv4 packets with a 10.1.2.0/24 source address and assigns the packets to forwarding class **be** (best effort) with a loss priority of **medium-high**:

```
[edit firewall family ethernet-switching filter ingress-filter]
user@switch# set term data-traffic from source-address 10.1.2.0/24;
user@switch# set term data-traffic then forwarding-class be
user@switch# set term data-traffic then loss-priority medium-high
```

- Because the loss of network-generated packets can jeopardize proper network operation, the delay of these packets is preferable to discarding these packets. The term **network-traffic** assigns the packets with an IP precedence of **net-control** to forwarding class **nc** (network control) with a loss priority of **low**:

```
[edit firewall family ethernet-switching filter ingress-filter]
user@switch# set term network-traffic from precedence net-control
user@switch# set term network-traffic then forwarding-class nc
user@switch# set term network-traffic then loss-priority low
```

- The last term **accept-traffic** matches any packets that did not match on any of the preceding terms and assigns the packets to forwarding class **be** with a loss priority of **high**:

```
[edit firewall family ethernet-switching filter ingress-filter]
user@switch# set term accept-traffic then forwarding-class be
user@switch# set term accept-traffic then loss-priority high
```

3. Apply the filter **ingress-filter** to a port, VLAN, or Layer 3 interface. For information about applying the filter, see [“Configuring Firewall Filters” on page 35](#). (Assigning forwarding classes and PLP is supported only on ingress filters.)

Related Documentation

- [Configuring Firewall Filters on page 35](#)
- [Verifying That Firewall Filters Are Operational on page 42](#)
- [Monitoring Firewall Filter Traffic on page 41](#)
- [Overview of Policers on page 55](#)
- [Understanding CoS Classifiers](#)
- [Understanding CoS Forwarding Classes](#)

Configuring Color-Blind Egress Policers for Medium-Low PLP

If you use color-blind mode and want to configure an egress policer that marks packets to have medium-low PLP, you must configure a single-rate two-color policer at the **[edit firewall policer *policer-name*]** hierarchy level, because color-blind mode does not support medium-low priority. For example:

1. Specify the name of the policer, the bandwidth limit in bits per second (bps) to control the traffic rate on an interface, and the maximum allowed burst size to control the amount of traffic bursting:

```
[edit]
```

```
user@switch# set firewall policer policer-name if-exceeding bandwidth-limit bytes
burst-size-limit bytes
```

2. Specify medium-low loss priority for matching packets:

```
[edit]
```

```
user@switch# set firewall policer policer-name then loss-priority medium-low;
```

3. Apply the filter to a port, VLAN, or Layer 3 interface.

Related Documentation

- [Overview of Policers on page 55](#)
- [Understanding Color-Blind Mode for Single-Rate Tricolor Marking on page 61](#)
- [Understanding Color-Blind Mode for Two-Rate Tricolor Marking on page 64](#)
- [Configuring Firewall Filters on page 35](#)
- [Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73](#)

Configuring Two-Color and Three-Color Policers to Control Traffic Rates

You can rate-limit traffic by configuring a policer and specifying it as an action modifier for a term in a firewall filter. By default, if you specify the same policer in multiple terms, Junos OS creates a separate policer instance for each term and applies rate limiting separately for each instance. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, each policer instance enforces a 1-Gbps limit. In this case, the total bandwidth allowed by the filter is 3 Gbps.

You can also configure a policer to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps.



NOTE: You can include two-color policer actions on ingress firewall filters only. You can include three-color policer actions on ingress and egress filters.

1. [Configuring Two-Color Policers on page 73](#)
2. [Configuring Three-Color Policers on page 74](#)
3. [Specifying Policers in a Firewall Filter Configuration on page 74](#)
4. [Applying a Firewall Filter That Includes a Policer on page 75](#)

Configuring Two-Color Policers

To configure a two-color policer:

1. Specify the name of the policer, the bandwidth limit to control the traffic rate on an interface, and the maximum allowed burst size to control the amount of traffic bursting:

```
[edit firewall]
```

```
user@switch# set policer policer-name <filter-specific> if-exceeding bandwidth-limit bps
burst-size-limit bytes
```

The policer name can contain letters, numbers, and hyphens (-) and can have as many as 64 characters.

The range for the bandwidth limit is 32000 (32k) through 102,300,000,000 (102300m) bps.

To determine the value for the burst-size limit, multiply the bandwidth of the interface on which the filter is applied by the amount of time to allow a burst of traffic at that bandwidth to occur and divide the result by 8:

maximum burst size = (interface bandwidth) X (allowable time for burst) / (8 bits/byte)

The range for the burst-size limit is 1 through 2,147,450,880 bytes.

2. Specify the policer action to discard or assign a loss priority to packets that exceed the rate limits:

```
[edit firewall policer policer-name]
user@switch# set then (discard | loss-priority low | loss-priority high)
```

Configuring Three-Color Policers

To configure a three-color policer:

1. Specify the name of the policer and (optionally) whether to automatically discard packets with high loss priority (PLP):

```
[edit firewall]
user@switch# set three-color-policer policer-name
user@switch# set three-color-policer policer-name action loss-priority high then discard
```

2. Specify whether the three-color policer should be single-rate or two-rate and whether it should be color-aware or color-blind:

```
[edit firewall three-color-policer policer-name]
user@switch# set (single-rate | two-rate) (color-aware | color-blind)
```

3. For single-rate three-color policers, configure the CIR, CBS, and EBS:

```
[edit firewall three-color-policer policer-name single-rate]
user@switch# set committed-information-rate bps
user@switch# set committed-burst-size bytes
user@switch# set excess-burst-size bytes
```

4. For two-rate three-color policers, configure the CIR, CBS, PIR, and PBS:

```
[edit firewall three-color-policer policer-name single-rate]
user@switch# set committed-information-rate bps
user@switch# set committed-burst-size bytes
user@switch# set peak-information-rate bps
user@switch# set peak-burst-size bytes
```

Specifying Policers in a Firewall Filter Configuration

To use a two-color policer, configure a filter term that includes the action **policer**:

```
[edit firewall family family-name]
user@switch# set filter filter-name term name then name
```

For example, the following commands apply a two-color policer to all packets sent from 192.0.2.0/24.

```
[edit firewall family family-name]
user@switch# set filter limit—hosts term term1 from source-address 192.0.2.0/24
```

```
user@switch# set filter limit—hosts term term1 then policer policer1
```

To use a three-color policer, configure a filter term that includes the action **three-color-policer**:

```
[edit firewall family name]
```

```
user@switch# set filter name term name from match-condition
```

```
user@switch# set filter name term name then three-color-policer (single-rate | two-rate) name
```

For example, the following commands apply a single-rate three-color policer to all packets received or sent by interface **ge-0/0/6** (depending on whether the filter is an ingress or egress filter).

```
[edit firewall family name]
```

```
user@switch# set filter srTCM term term-one from interface ge-0/0/6
```

```
user@switch# set filter srTCM term term-one then three-color-policer single-rate srTCM1-ca
```

You must specify whether the three-color policer is single-rate or two-rate, and this must match the policer itself. Otherwise, the configuration listing includes an error message indicating that the three-color policer you referenced in the filter does not exist.

Applying a Firewall Filter That Includes a Policer

A firewall filter that includes one or more policer action modifiers must be applied to a port, VLAN, or Layer 3 interface like any other filter. For information about applying firewall filters, see “Configuring Firewall Filters” on page 35.



NOTE: You can include two-color policer actions on ingress firewall filters only. You can include three-color policer actions on ingress and egress filters.

Related Documentation

- [Configuring Firewall Filters on page 35](#)
- [Overview of Policers on page 55](#)
- [Verifying That Two-Color Policers Are Operational on page 75](#)
- [Verifying That Three-Color Policers Are Operational on page 76](#)
- [Configuring Color-Blind Egress Policers for Medium-Low PLP on page 72](#)

Verifying That Two-Color Policers Are Operational

Purpose Verify that two-color policers in firewall filter configurations are working properly.

Action Use the **show firewall policer** operational mode command to verify that the policers are working properly:

```
user@switch> show firewall policer
Filter: egress-vlan-watch-employee
Filter: ingress-port-filter
Filter: ingress-port-limit-tcp-icmp
Policers:
Name
icmp-connection-policer
tcp-connection-policer
Filter: ingress-vlan-rogue-block
Filter: ingress-vlan-limit-guest
```

```
Packets
10
539
```

Meaning	The show firewall policer command displays the names of all firewall filters and policers that are configured. For each policer that is specified in a filter configuration, the output field shows the current packet count for all packets that exceed the specified rate limits.
Related Documentation	<ul style="list-style-type: none">• Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73• Configuring Firewall Filters on page 35• Monitoring Firewall Filter Traffic on page 41

Verifying That Three-Color Policers Are Operational

Purpose	Verify that three-color policers in firewall filter configurations are working properly.
Action	<p>Use the following operational mode commands to verify that a three-color policer is working properly:</p> <ul style="list-style-type: none">• show class-of-service forwarding-table classifiers• show interfaces <i>interface-name</i> extensive• show interfaces queue <i>interface-name</i>
Related Documentation	<ul style="list-style-type: none">• Overview of Policers on page 55• Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73

Troubleshooting Policer Configuration

- [Incomplete Count of Packet Drops on page 76](#)
- [Counter Reset When Editing Filter on page 77](#)
- [Invalid Statistics for Policer on page 77](#)
- [Egress Policers on QFX3500 Devices Might Allow More Throughput Than Is Configured on page 77](#)
- [Filter-Specific Egress Policers on QFX3500 Devices Might Allow More Throughput Than Is Configured on page 78](#)
- [Policies Can Limit Egress Filters on page 79](#)

Incomplete Count of Packet Drops

Problem	<p>Description: Under certain circumstances, Junos OS might display a misleading number of packets dropped by an ingress policer.</p> <p>If packets are dropped because of ingress admission control, policer statistics might not show the number of packet drops you would expect by calculating the difference between ingress and egress packet counts. This might happen if you apply an ingress policer to multiple interfaces, and the aggregate ingress rate of those interfaces exceeds the line rate of a common egress interface. In this case, packets might be dropped from the</p>
----------------	---

ingress buffer. These drops are not included in the count of packets dropped by the policer, which causes policer statistics to underreport the total number of drops.

Solution This is expected behavior.

Counter Reset When Editing Filter

Problem Description: If you edit a firewall filter term, the value of any counter associated with any term in the same filter is set to 0, including the implicit counter for any policer referenced by the filter. Consider the following examples:

- Assume that your filter has **term1**, **term2**, and **term3**, and each term has a counter that has already counted matching packets. If you edit any of the terms in any way, the counters for all the terms are reset to 0.
- Assume that your filter has **term1** and **term2**. Also assume that **term2** has a **policer** action modifier and the implicit counter of the policer has already counted 1000 matching packets. If you edit **term1** or **term2** in any way, the counter for the policer referenced by **term2** is reset to 0.

Solution This is expected behavior.

Invalid Statistics for Policer

Problem Description: If you apply a single-rate two-color policer in more than 128 terms in a firewall filter, the output of the **show firewall** command displays incorrect data for the policer.

Solution This is expected behavior.

Egress Policers on QFX3500 Devices Might Allow More Throughput Than Is Configured

Problem Description: If you configure a policer to rate-limit throughput and apply it on egress to multiple interfaces on a QFX3500 switch or Node, the measured aggregate policed rate might be twice the configured rate, depending on which interfaces you apply the policer to. The doubling of the policed rate occurs if you apply a policer to multiple interfaces and *both* of the following are true:

- There is at least one policed interface in the range xe-0/0/0 to xe-0/0/23 or the range xe-0/1/1 to xe-0/1/7.
- There is at least one policed interface in the range xe-0/0/24 to xe-0/0/47 or the range xe-0/1/8 to xe-0/1/15.

For example, if you configure a policer to rate-limit traffic at 1 Gbps and apply the policer (by using a firewall filter) to xe-0/0/0 and xe-0/0/24 in the output direction, each interface is rate-limited at 1 Gbps, for a total allowed throughput of 2 Gbps. The same behavior occurs if you apply the policer to xe-0/1/1 and xe-0/0/24—each interface is rate-limited at 1 Gbps.

If you apply the same policer on egress to multiple interfaces in these groups, each *group* is rate-limited at 1 Gbps. For example, if you apply the policer to xe-0/0/0 through xe-0/0/4 (five interfaces) and xe-0/0/24 through xe-0/0/33 (ten interfaces), each group is rate-limited at 1 Gbps, for a total allowed throughput of 2 Gbps.

Here is another example: If you apply the policer to xe-0/0/0 through xe-0/0/4 and xe-0/1/1 through xe-0/1/5 (a total of ten interfaces), that group is rate-limited at 1 Gbps in aggregate. If you also apply the policer to xe-0/0/24, that one interface is rate-limited at 1 Gbps while the other ten are still rate-limited at 1 Gbps in aggregate.

Interfaces xe-0/1/1 through xe-0/1/15 are physically located on the QSFP+ uplink ports, according to the following scheme:

- xe-0/1/1 through xe-0/1/3 are on Q0.
- xe-0/1/4 through xe-0/1/7 are on Q1.
- xe-0/1/8 through xe-0/1/11 are on Q2.
- xe-0/1/12 through xe-0/1/15 are on Q3.

The doubling of the policed rate occurs only if the policer is applied in the output direction. If you configure a policer as described above but apply it in the input direction, the total allowed throughput for all interfaces is 1 Gbps.

Solution This is expected behavior.

Filter-Specific Egress Policers on QFX3500 Devices Might Allow More Throughput Than Is Configured

Problem **Description:** You can configure policers to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. When you do this, rate limiting is applied in aggregate, so if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms, the total bandwidth allowed by the filter is 1 Gbps. However, the behavior of a filter-specific policer is affected by how the firewall filter terms that reference the policer are stored in ternary content addressable memory (TCAM). If you create a filter-specific policer and reference it in multiple firewall filter terms, the policer allows more traffic than expected if the terms are stored in different TCAM slices. For example, if you configure a policer to discard traffic that exceeds 1 Gbps and reference that policer in three different terms that are stored in three separate memory slices, the total bandwidth allowed by the filter is 3 Gbps, not 1 Gbps.

Solution To prevent this unexpected behavior, use the information about TCAM slices presented in [“Planning the Number of Firewall Filters to Create” on page 30](#) to organize your configuration file so that all the firewall filter terms that reference a given filter-specific policer are stored in the same TCAM slice.

Policers Can Limit Egress Filters

Problem **Description:** On some switches, the number of egress policers that you configure can affect the total number of allowed egress firewall filters. (This issue does not affect QFX10000 switches.) On the affected switches, every policer has two implicit counters that consume two entries in a 1024-entry TCAM that is used for counters, including counters that are configured as action modifiers in firewall filter terms. (Policers consume two entries because one is used for green packets and one is used for nongreen packets regardless of policer type.) If the TCAM becomes full, you cannot commit any more egress firewall filters that have terms with counters. For example, if you configure and commit 512 egress policers (two-color, three-color, or a combination of both policer types), all of the memory entries for counters are used up. If later in your configuration file you insert additional egress firewall filters with terms that also include counters, *none* of the terms in those filters are committed because there is no available memory space for the counters.

Here are some additional examples:

- Assume that you configure egress filters that include a total of 512 policers and no counters. Later in your configuration file you include another egress filter with 10 terms, 1 of which has a counter action modifier. None of the terms in this filter are committed because there is not enough TCAM space for the counter.
- Assume that you configure egress filters that include a total of 500 policers, so 1000 TCAM entries are occupied. Later in your configuration file you include the following two egress filters:
 - Filter A with 20 terms and 20 counters. All the terms in this filter are committed because there is enough TCAM space for all the counters.
 - Filter B comes after Filter A and has five terms and five counters. *None* of the terms in this filter are committed because there is not enough memory space for *all* the counters. (Five TCAM entries are required but only four are available.)

Solution You can prevent this problem by ensuring that egress firewall filter terms with counter actions are placed earlier in your configuration file than terms that include policers. In this circumstance, Junos OS commits policers even if there is not enough TCAM space for the implicit counters. For example, assume the following:

- You have 1024 egress firewall filter terms with counter actions.
- Later in your configuration file you have an egress filter with 10 terms. None of the terms have counters but one has a policer action modifier.

You can successfully commit the filter with 10 terms even though there is not enough TCAM space for the implicit counters of the policer. The policer is committed without the counters.

PART 3

Configuring Port Security

- [Port Security on page 83](#)

CHAPTER 3

Port Security

- Overview of Access Port Protection on page 83
- Understanding Port Security Features to Protect the Access Ports on Your Device Against the Loss of Information and Productivity on page 86
- Understanding DHCP Snooping for Monitoring DHCP Messages Received from Untrusted Devices on page 88
- Verifying That DHCP Snooping Is Working Correctly on page 95
- Understanding Dynamic ARP Inspection for Protecting Switching Devices Against ARP Spoofing on page 96
- Verifying That DAI Is Working Correctly on page 99
- Understanding MAC Limiting and MAC Move Limiting for Port Security on page 99
- Verifying That MAC Limiting Is Working Correctly on page 101
- Verifying That MAC Move Limiting Is Working Correctly on page 104
- Verifying That the Port Error Disable Setting Is Working Correctly on page 105
- Understanding Trusted and Untrusted Ports on page 106
- Understanding Trusted DHCP Servers for Port Security on page 106
- Verifying That a Trusted DHCP Server Is Working Correctly on page 106
- Understanding DHCP Option 82 for Port Security on page 108
- Understanding Static ARP Entries on page 110

Overview of Access Port Protection

Port security features can protect a switch against various types of attacks. Protection methods against some common attacks are:

- Mitigation of Ethernet Switching Table Overflow Attacks on page 84
- Mitigation of Rogue DHCP Server Attacks on page 84
- Protection Against ARP Spoofing Attacks on page 85
- Protection Against DHCP Snooping Database Alteration Attacks on page 85
- Protection Against DHCP Starvation Attacks on page 85

Mitigation of Ethernet Switching Table Overflow Attacks

In an overflow attack on an Ethernet switching table, an intruder sends so many requests from new MAC addresses that the table cannot learn all the addresses. The attack forces the switch to send broadcast messages when it needs to send traffic to addresses for which it lacks MAC addresses. In addition to generating unnecessary traffic, the attacker might be able to sniff the broadcast packets.

To mitigate such attacks, you can configure a limit for learned MAC addresses or allow only specific MAC addresses. Use the MAC limit feature to control the total number of MAC addresses that can be added to the Ethernet switching table for the specified interface or interfaces. By setting the MAC addresses that are explicitly allowed, you ensure that the addresses of network devices whose network access is critical are guaranteed to be included in the Ethernet switching table.

Mitigation of Rogue DHCP Server Attacks

By default, all access ports are untrusted, and all trunk ports are trusted with regard to DHCP. Trusted ports allow DHCP servers to provide IP addresses and other information to requesting devices. If someone connects an unauthorized DHCP server to a trusted port, the unauthorized server can start issuing IP addresses and configuration information to the network's DHCP clients. The information provided to the clients by this server can disrupt their network access. The unauthorized server might also assign itself as the default gateway device for the network. An attacker can then sniff the network traffic and perpetrate a man-in-the-middle attack—that is, it misdirects traffic intended for a legitimate network device to a device of its choice.

To mitigate this problem, set the interface to which the unauthorized server is connected as untrusted. That action blocks all ingress DHCP server messages from that interface.



NOTE: The switch logs all DHCP server packets that are received on untrusted ports. For example:

```
5 untrusted DHCPOFFER received, interface xe-0/0/2.0[65], vlan v1[10] server  
ip/mac 12.12.12.1/00:00:00:00:01:12 offer ip/client mac  
12.12.12.253/00:AA:BB:CC:DD:01
```

You can use these messages to detect unauthorized DHCP servers on the network.



NOTE: If you attach a DHCP server to an access port, you must configure the port as trusted.

Protection Against ARP Spoofing Attacks

In ARP spoofing, an attacker sends faked ARP messages on the network. The attacker associates its own MAC address with the IP address of a network device connected to the switch. Any traffic sent to that IP address is instead sent to the attacker. Now the attacker can create various types of problems, including sniffing the packets that were meant for another host and perpetrating man-in-the middle attacks. (In a man-in-the-middle attack, the attacker intercepts messages between two hosts, reads them, and perhaps alters them, all without the original hosts knowing that their communications have been compromised.)

To protect against ARP spoofing on your switch, enable both DHCP snooping and dynamic ARP inspection (DAI). DHCP snooping builds and maintains the DHCP snooping table. That table contains the MAC addresses, IP addresses, lease times, binding types, VLAN information, and interface information for the untrusted interfaces on the switch. DAI uses the information in the DHCP snooping table to validate ARP packets. Invalid ARP packets are blocked, and when they are blocked, a system log message is recorded that includes the type of ARP packet and the sender's IP address and MAC address.

See Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks.

Protection Against DHCP Snooping Database Alteration Attacks

In an attack designed to alter the DHCP snooping database, an intruder introduces a DHCP client on one of the switch's untrusted access interfaces that has a MAC address identical to that of a client on another untrusted port. The intruder acquires the DHCP lease, which results in changes to the entries in the DHCP snooping table. Subsequently, what would have been valid ARP requests from the legitimate client are blocked.

To protect against this type of alteration of the DHCP snooping database, configure MAC addresses that are explicitly allowed on the interface. *See Example: Configuring Allowed MAC Addresses to Protect the Switch from DHCP Snooping Database Alteration Attacks.*

Protection Against DHCP Starvation Attacks

In a DHCP starvation attack, an attacker floods an Ethernet LAN with DHCP requests from spoofed (counterfeit) MAC addresses so that trusted DHCP servers cannot keep up with requests from legitimate DHCP clients. The address space of those servers is completely used up, so they can no longer assign IP addresses and lease times to clients. DHCP requests from those clients are either dropped—that is, the result is a denial of service (DoS)—or directed to a rogue DHCP server set up by the attacker to imitate a legitimate DHCP server.

To protect the switch from DHCP starvation attacks, use the MAC limiting feature. Specify the maximum number of MAC addresses that the switch can learn on the access interfaces to which DHCP clients connect. The DHCP server or servers can then supply only the specified number of IP addresses over each of those interfaces. If a DHCP starvation attack occurs after the maximum number of IP addresses has been assigned, the attack fails.

Related Documentation

- [Understanding MAC Limiting and MAC Move Limiting for Port Security on page 99](#)
- [Configuring MAC Limiting](#)
- [Verifying That MAC Limiting Is Working Correctly on page 101](#)
- [Understanding DHCP Option 82 for Port Security on page 108](#)
- [Example: Configuring MAC Limiting to Protect the Switch from DHCP Starvation Attacks](#)
- [Understanding Dynamic ARP Inspection for Protecting Switching Devices Against ARP Spoofing on page 96](#)

Understanding Port Security Features to Protect the Access Ports on Your Device Against the Loss of Information and Productivity

Ethernet LANs are vulnerable to attacks such as address spoofing (forging) and Layer 2 denial of service (DoS) on network devices. Port security features help protect the access ports on your device against the loss of information and productivity that such attacks can cause.

The Juniper Networks Junos operating system (Junos OS) provides features to help secure ports on a device. Ports can be categorized as either trusted or untrusted. You apply policies appropriate to each category to protect ports against various types of attacks.

Basic port security features are enabled in the device's default configuration. You can configure additional features with minimal configuration steps.

Depending on the particular feature, you can configure the feature either on VLANs or bridge domain interfaces.

Port security features supported on switching devices are:

- DHCP snooping—Filters and blocks ingress Dynamic Host Configuration Protocol (DHCP) server messages on untrusted ports, and builds and maintains a database of DHCP lease information, which is called the DHCP snooping database.



NOTE: DHCP snooping is not enabled in the default configuration of the switching device. DHCP snooping is enabled on a VLAN or bridge domain. The details of enabling DHCP snooping depend on the particular device.

- DHCPv6 snooping—DHCP snooping for IPv6.
- DHCP option 82—Also known as the DHCP Relay Agent Information option. This DHCPv4 feature helps protect the switching device against attacks such as spoofing of IP addresses and MAC addresses and DHCP IP address starvation. Option 82 provides information about the network location of a DHCP client, and the DHCP server uses this information to implement IP addresses or other parameters for the client.
- DHCPv6 option 37—Option 37 is the remote ID option for DHCPv6 and is used to insert information about the network location of the remote host into DHCPv6 packets. You enable option 37 on a VLAN.



NOTE: DHCPv6 snooping with option 37 is not supported on the MX Series.

- DHCPv6 option 18—Option 18 is the circuit ID option for DHCPv6 and is used to insert information about the client port into DHCPv6 packets. This option includes other details that can be optionally configured, such as the prefix and the interface description.
- DHCPv6 option 16—Option 16 is the vendor ID option for DHCPv6 and is used to insert information about the vendor of the client hardware into DHCPv6 packets.
- Dynamic ARP inspection (DAI)—Prevents Address Resolution Protocol (ARP) spoofing attacks. ARP requests and replies are compared against entries in the DHCP snooping database, and filtering decisions are made on the basis of the results of those comparisons. You enable DAI on a VLAN.
- IPv6 neighbor discovery inspection—Prevents IPv6 address spoofing attacks. Neighbor discovery requests and replies are compared against entries in the DHCPv6 snooping database, and filtering decisions are made on the basis of the results of those comparisons. You enable neighbor discovery inspection on a VLAN.
- IP source guard—Mitigates the effects of IP address spoofing attacks on the Ethernet LAN. With IP source guard enabled, the source IP address in the packet sent from an untrusted access interface is validated against the DHCP snooping database. If the packet cannot be validated, it is discarded. You enable IP source guard on a VLAN or bridge domain.



NOTE: IP source guard is not supported on the QFX Series.

- IPv6 source guard—IP source guard for IPv6.



NOTE: IPv6 source guard is not supported on the QFX Series.

- MAC limiting—Protects against flooding of the Ethernet switching table (also known as the MAC forwarding table or Layer 2 forwarding table). You can enable MAC limiting on an interface.
- MAC move limiting—Tracks MAC movement and detects MAC spoofing on access ports. You enable this feature on a VLAN or bridge domain.
- Persistent MAC learning—Also known as sticky MAC. Persistent MAC learning enables interfaces to retain dynamically learned MAC addresses across switch reboots. You enable this feature on an interface.
- Trusted DHCP server—Configuring the DHCP server on a trusted port protects against rogue DHCP servers sending leases. You enable this feature on an interface (port). By default, access ports are untrusted, and trunk ports are trusted. (Access ports are the switch ports that connect to Ethernet endpoints such as user PCs and laptops, servers, and printers. Trunk ports are the switch ports that connect an Ethernet switch to other switches or to routers.)

- Related Documentation**
- [Security Features for EX Series Switches Overview](#)
 - [Understanding DHCP Snooping for Monitoring DHCP Messages Received from Untrusted Devices on page 88](#)
 - [Understanding DHCP Snooping for Port Security](#)
 - [Understanding IPv6 Neighbor Discovery Inspection](#)
 - [Understanding Dynamic ARP Inspection for Protecting Switching Devices Against ARP Spoofing on page 96](#)
 - [Understanding IP Source Guard for Port Security on EX Series Switches](#)
 - [Understanding MAC Limiting and MAC Move Limiting for Port Security on EX Series Switches](#)
 - [Understanding DHCP Option 82 for Protecting Switching Devices Against Attacks](#)

Understanding DHCP Snooping for Monitoring DHCP Messages Received from Untrusted Devices

DHCP snooping enables the switching device, which can be either a switch or a router, to monitor DHCP messages received from untrusted devices connected to the switching device. When DHCP snooping is enabled on a VLAN, the system examines DHCP messages sent from untrusted hosts associated with the VLAN and extracts their IP addresses and lease information. This information is used to build and maintain the DHCP snooping database. Only hosts that can be verified using this database are allowed access to the network.

- [DHCP Snooping Basics on page 88](#)
- [DHCP Snooping Process on page 89](#)
- [DHCPv6 Snooping on page 90](#)
- [Rapid Commit for DHCPv6 on page 91](#)
- [DHCP Server Access on page 91](#)
- [Static IP Address Additions to the DHCP Snooping Database on page 94](#)
- [Snooping DHCP Packets That Have Invalid IP Addresses on page 94](#)
- [Prioritizing Snooped Packets on page 95](#)

DHCP Snooping Basics

The Dynamic Host Configuration Protocol (DHCP) allocates IP addresses dynamically, *leasing* addresses to devices so that the addresses can be reused when no longer needed. Hosts and end devices that require IP addresses obtained through DHCP must communicate with a DHCP server across the LAN.

DHCP snooping acts as a guardian of network security by keeping track of valid IP addresses assigned to downstream network devices by a trusted DHCP server (the server is connected to a trusted network port).

By default, all trunk ports on the switch are trusted and all access ports are untrusted for DHCP snooping.

When DHCP snooping is enabled, the lease information from the switching device is used to create the DHCP snooping table, also known as the binding table. The table shows the IP-MAC binding, as well as the lease time for the IP address, type of binding, VLAN name, and interface for each host.



NOTE: DHCP snooping is disabled in the default configuration of the switching device. You must explicitly enable DHCP snooping by setting `examine-dhcp` at the `[edit ethernet-switching-options secure-access-port]` hierarchy level.

Entries in the DHCP snooping database are updated in these events:

- When a DHCP client releases an IP address (sends a DHCPRELEASE message). In this event, the associated mapping entry is deleted from the database.
- If you move a network device from one VLAN to another. In this event, typically the device needs to acquire a new IP address. Therefore, its entry in the database, including its VLAN ID, is updated.
- When the lease time (timeout value) assigned by the DHCP server expires. In this event, the associated entry is deleted from the database.



TIP: By default, the IP-MAC bindings are lost when the switching device is rebooted and DHCP clients (the network devices, or hosts) must reacquire bindings. However, you can configure the bindings to persist by setting the `dhcp-snooping-file` statement to store the database file either locally or remotely.

You can configure the switching device to snoop DHCP server responses from particular VLANs only. This prevents spoofing of DHCP server messages.

You configure DHCP snooping per VLAN, not per interface (port). DHCP snooping is disabled by default on switching devices.

DHCP Snooping Process

The basic process of DHCP snooping consists of the following steps:



NOTE: When DHCP snooping is enabled for a VLAN, all DHCP packets sent from the network devices in that VLAN are subjected to DHCP snooping. The final IP-MAC binding occurs when the DHCP server sends DHCPACK to the DHCP client.

1. The network device sends a DHCPDISCOVER packet to request an IP address.
2. The switching device forwards the packet to the DHCP server.

3. The server sends a DHCPOFFER packet to offer an address. If the DHCPOFFER packet is from a trusted interface, the switching device forwards the packet to the DHCP client.
4. The network device sends a DHCPREQUEST packet to accept the IP address. The switching device adds an IP-MAC placeholder binding to the database. The entry is considered a placeholder until a DHCPACK packet is received from the server. Until then, the IP address could still be assigned to some other host.
5. The server sends a DHCPACK packet to assign the IP address or a DHCPNAK packet to deny the address request.
6. The switching device updates the DHCP snooping database according to the type of packet received:
 - If the switching device receives a DHCPACK packet, it updates lease information for the IP-MAC bindings in its database.
 - If the switching device receives a DHCPNAK packet, it deletes the placeholder.



NOTE: The DHCP snooping database is updated only after the DHCPREQUEST packet has been sent.

For general information about the messages that the DHCP client and DHCP server exchange during the assignment of an IP address for the client, see the *Junos OS Administration Library for Routing Devices*.

DHCPv6 Snooping

DHCPv6 snooping is the equivalent of DHCP snooping for IPv6. The process for DHCPv6 snooping is similar to that for DHCP snooping, but uses different names for the messages exchanged between the client and server to assign IPv6 addresses. [Table 16 on page 90](#) shows DHCPv6 messages and their DHCP equivalents.

Table 16: DHCPv6 Messages and Equivalent DHCPv4 Messages

Sent by	DHCPv6 Messages	Equivalent DHCP Messages
Client	SOLICIT	DHCPDISCOVER
Server	ADVERTISE	DHCPOFFER
Client	REQUEST, RENEW, REBIND	DHCPREQUEST
Server	REPLY	DHCPACK/DHCPNAK
Client	RELEASE	DHCPRELEASE
Client	INFORMATION-REQUEST	DHCPINFORM
Client	DECLINE	DHCPDECLINE

Table 16: DHCPv6 Messages and Equivalent DHCPv4 Messages (*continued*)

Sent by	DHCPv6 Messages	Equivalent DHCP Messages
Client	CONFIRM	none
Server	RECONFIGURE	DHCPFORCERENEW
Client	RELAY-FORW, RELAY-REPLY	none

Rapid Commit for DHCPv6

DHCPv6 provides for a Rapid Commit option (DHCPv6 option 14), which, when supported by the server and set by the client, shortens the exchange from a four-way relay to a two-message handshake. For more information about enabling the Rapid Commit option, see *Enabling DHCPv6 Rapid Commit Support*.

In the rapid commit process:

1. The DHCPv6 client sends out a SOLICIT message that contains a request that rapid assignment of address, prefix, and other configuration parameters be preferred.
2. If the DHCPv6 server supports rapid assignment, it responds with a REPLY message, which contains the assigned IPv6 address and prefix and other configuration parameters.

DHCP Server Access

You can configure a switching device's access to the DHCP server in three ways:

- [Switching Device, DHCP Clients, and DHCP Server Are All on the Same VLAN on page 91](#)
- [Switching Device Acts as DHCP Server on page 92](#)
- [Switching Device Acts as Relay Agent on page 93](#)

Switching Device, DHCP Clients, and DHCP Server Are All on the Same VLAN

When the switching device, DHCP clients, and DHCP server are *all members of the same VLAN*, the DHCP server can be connected to the switching device in one of two ways:

- The server is directly connected to the same switching device as the one connected to the DHCP clients (the hosts, or network devices, that are requesting IP addresses from the server). The VLAN is enabled for DHCP snooping to protect the untrusted access ports. The trunk port is configured by default as a trusted port. See [Figure 4 on page 92](#).
- The server is connected to an intermediary switching device (Switching Device 2). The DHCP clients are connected to Switching Device 1, which is connected through a trunk port to Switching Device 2. Switching Device 2 is being used as a transit device. The VLAN is enabled for DHCP snooping to protect the untrusted access ports. The trunk port is configured by default as a trusted port. As shown in [Figure 5 on page 92](#), ge-0/0/11 is a trusted trunk port.

Figure 4: DHCP Server Connected Directly to a Switching Device

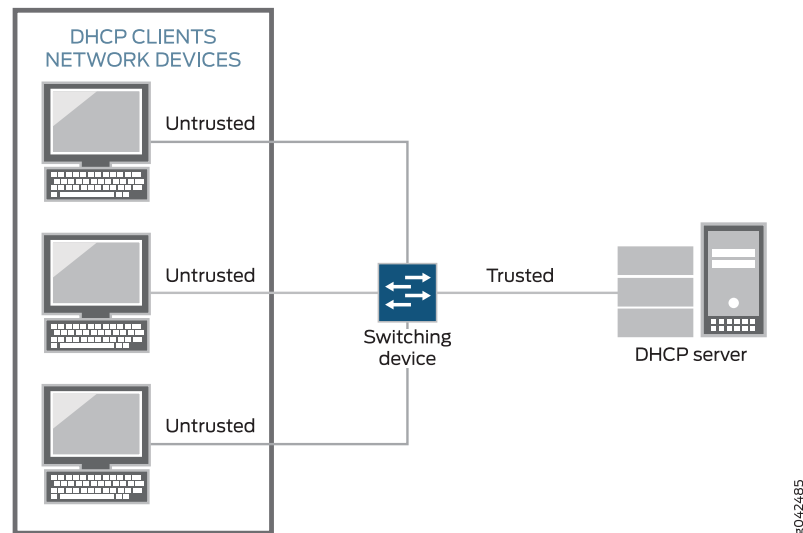
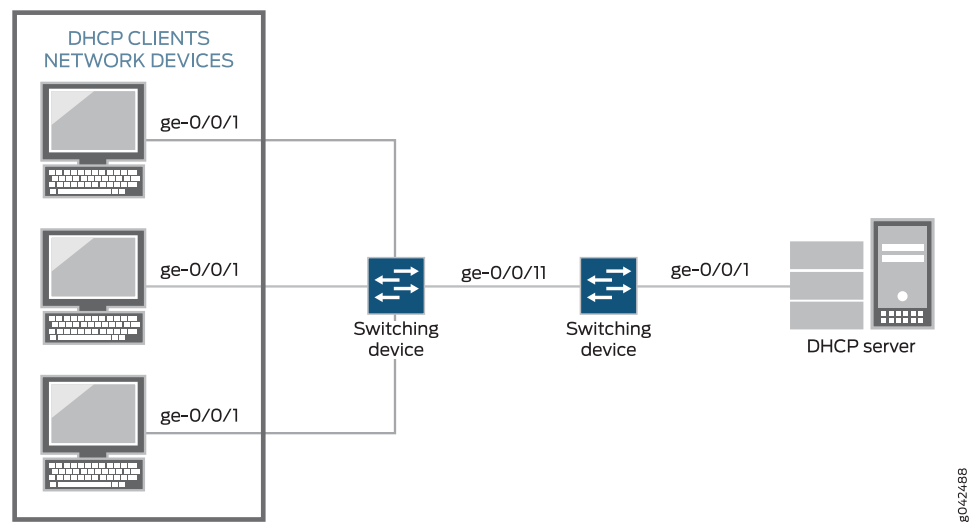


Figure 5: DHCP Server Connected Directly to Switching Device 2, with Switching Device 2 Connected to Switching Device 1 Through a Trusted Trunk Port



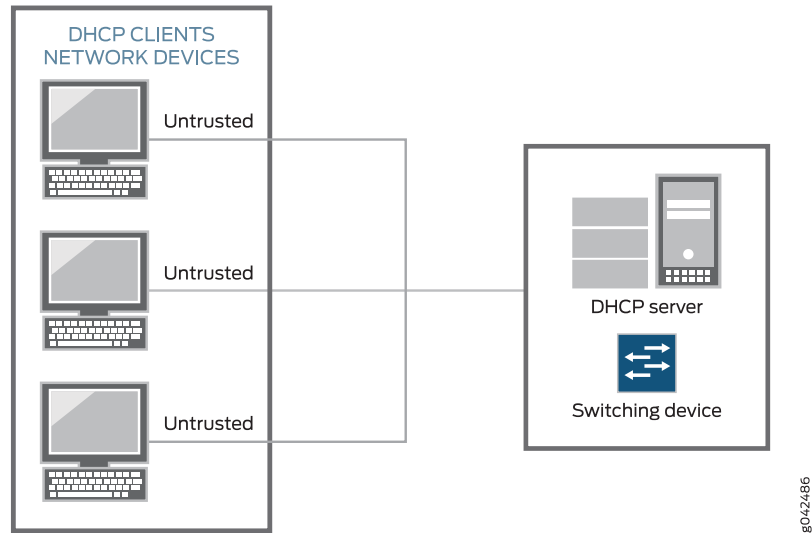
Switching Device Acts as DHCP Server



NOTE: The switching device acting as a DHCP server is not supported on the QFX Series.

The switching device itself is configured as a DHCP server; this is known as a *local configuration*. See [Figure 6 on page 93](#).

Figure 6: Switching Device Is the DHCP Server



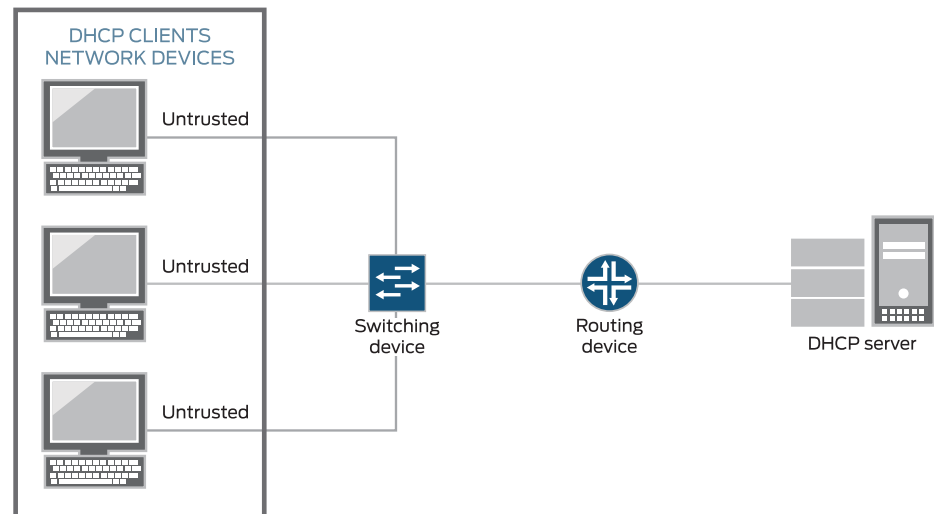
Switching Device Acts as Relay Agent

The switching device functions as a relay agent when the DHCP clients or the DHCP server is connected to the device through a Layer 3 interface. The Layer 3 interfaces on the switching device are configured as routed VLAN interfaces (RVIs), which are also known as integrated routing and bridging (IRB) interfaces. The trunk interfaces are trusted by default.

These two scenarios illustrate the switching device acting as a relay agent:

- The DHCP server and clients are in different VLANs.
- The switching device is connected to a router that is in turn connected to the DHCP server. See [Figure 7 on page 94](#).

Figure 7: Switching Device Acting as Relay Agent Through Router to DHCP Server



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Static IP Address Additions to the DHCP Snooping Database

You can add specific static IP addresses to the database as well as have the addresses dynamically assigned through DHCP snooping. To add static IP addresses, you supply the IP address, the MAC address of the device, the interface on which the device is connected, and the VLAN with which the interface is associated. No lease time is assigned to the entry. The statically configured entry never expires.

Snooping DHCP Packets That Have Invalid IP Addresses

If you enable DHCP snooping on a VLAN and then devices on that VLAN send DHCP packets that request invalid IP addresses, these invalid IP addresses are stored in the DHCP snooping database until they are deleted when their default timeout is reached. To eliminate this unnecessary consumption of space in the DHCP snooping database, the switching device drops the DHCP packets that request invalid IP addresses, preventing the snooping of these packets. The invalid IP addresses are:

- 0.0.0.0
- 128.0.x.x
- 191.255.x.x
- 192.0.0.x
- 223.255.255.x
- 224.x.x.x
- 240.x.x.x to 255.255.255.255

Prioritizing Snooped Packets



NOTE: Prioritizing snooped packets is not supported on the QFX Series and the EX4600 switch.

You can use class-of-service (CoS) forwarding classes and queues to prioritize DHCP snooped packets for a specified VLAN. This type of configuration places the DHCP snooped packets for that VLAN in a specified egress queue, so that the security procedure does not interfere with the transmission of high-priority traffic. For additional information, see *Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic*.

Related Documentation

- [Understanding Port Security Features to Protect the Access Ports on Your Device Against the Loss of Information and Productivity on page 86](#)
- [Understanding Trusted DHCP Servers for Port Security on page 106](#)
- [Configuring a DHCP Server on a Trusted Interface to Protect it Against Rogue DHCP Servers Sending Leases \(CLI Procedure\)](#)
- [Configuring Static IP Addresses for DHCP Bindings on Access Ports for MX Series Routers \(CLI Procedure\)](#)

Verifying That DHCP Snooping Is Working Correctly

Purpose Verify that DHCP snooping is working on the switch and that the DHCP snooping database is correctly populated with both dynamic and static bindings.

Action Send some DHCP requests from network devices (here they are DHCP clients) connected to the switch.

Display the DHCP snooping information when the interface on which the DHCP server connects to the switch is trusted. The following output results when requests are sent from the MAC addresses and the server has provided the IP addresses and leases:

```
user@switch> show dhcp snooping binding
```

DHCP Snooping Information:

MAC address	IP address	Lease (seconds)	Type	VLAN	Interface
00:05:85:3A:82:77	192.0.2.17	600	dynamic	employee	ge-0/0/1.0
00:05:85:3A:82:79	192.0.2.18	653	dynamic	employee	ge-0/0/1.0
00:05:85:3A:82:80	192.0.2.19	720	dynamic	employee	ge-0/0/2.0
00:05:85:3A:82:81	192.0.2.20	932	dynamic	employee	ge-0/0/2.0
00:05:85:3A:82:83	192.0.2.21	1230	dynamic	employee	ge-0/0/2.0
00:05:85:27:32:88	192.0.2.22	—	static	data	ge-0/0/4.0

Meaning When the interface on which the DHCP server connects to the switch has been set to trusted, the output (see preceding sample) shows, for each MAC address, the assigned IP address and lease time—that is, the time, in seconds, remaining before the lease

expires. Static IP addresses have no assigned lease time. The statically configured entry never expires.

If the DHCP server had been configured as untrusted, no entries would be added to the DHCP snooping database and nothing would be shown in the output of the **show dhcp snooping binding** command.

**Related
Documentation**

- *Enabling DHCP Snooping (CLI Procedure)*
- *Enabling DHCP Snooping (J-Web Procedure)*
- *Configuring Static IP Addresses in the DHCP Snooping Database for Access Ports (CLI Procedure)*
- *Example: Configuring Basic Port Security Features*
- *Example: Configuring DHCP Snooping, DAI, and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch*
- *Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks*
- *Monitoring Port Security*
- *Troubleshooting Port Security*

Understanding Dynamic ARP Inspection for Protecting Switching Devices Against ARP Spoofing

Dynamic ARP inspection (DAI) protects switching devices against ARP spoofing.

DAI inspects Address Resolution Protocol (ARP) packets on the LAN and uses the information in the DHCP snooping database on the switch to validate ARP packets and to protect against ARP spoofing (also known as ARP poisoning or ARP cache poisoning). ARP requests and replies are compared against entries in the DHCP snooping database, and filtering decisions are made based on the results of those comparisons. When an attacker tries to use a forged ARP packet to spoof an address, the switch compares the address with entries in the database. If the media access control (MAC) address or IP address in the ARP packet does not match a valid entry in the DHCP snooping database, the packet is dropped.

ARP packets are sent to the Routing Engine and are rate-limited to protect the switching device from CPU overload.

- [Address Resolution Protocol on page 97](#)
- [ARP Spoofing on page 97](#)
- [Dynamic ARP Inspection on page 97](#)
- [Prioritizing Inspected Packets on page 98](#)

Address Resolution Protocol

Sending IP packets on a multi-access network requires mapping an IP address to an Ethernet MAC address.

Ethernet LANs use ARP to map MAC addresses to IP addresses.

The switching device maintains this mapping in a cache that it consults when forwarding packets to network devices. If the ARP cache does not contain an entry for the destination device, the host (the DHCP client) broadcasts an ARP request for that device's address and stores the response in the cache.

ARP Spoofing

ARP spoofing is one way to initiate man-in-the-middle attacks. The attacker sends an ARP packet that spoofs the MAC address of another device on the LAN. Instead of the switching device sending traffic to the proper network device, it sends the traffic to the device with the spoofed address that is impersonating the proper device. If the impersonating device is the attacker's machine, the attacker receives all the traffic from the switch that must have gone to another device. The result is that traffic from the switching device is misdirected and cannot reach its proper destination.

One type of ARP spoofing is gratuitous ARP, which is when a network device sends an ARP request to resolve its own IP address. In normal LAN operation, gratuitous ARP messages indicate that two devices have the same MAC address. They are also broadcast when a network interface card (NIC) in a device is changed and the device is rebooted, so that other devices on the LAN update their ARP caches. In malicious situations, an attacker can poison the ARP cache of a network device by sending an ARP response to the device that directs all packets destined for a certain IP address to go to a different MAC address instead.

To prevent MAC spoofing through gratuitous ARP and through other types of spoofing, the switches examine ARP responses through DAI.

Dynamic ARP Inspection

DAI examines ARP requests and responses on the LAN and validates ARP packets. The switch intercepts ARP packets from an access port and validates them against the DHCP snooping database. If no IP-MAC entry in the database corresponds to the information in the ARP packet, DAI drops the ARP packet and the local ARP cache is not updated with the information in that packet. DAI also drops ARP packets when the IP address in the packet is invalid. ARP probe packets are not subjected to dynamic ARP inspection. The switch always forwards such packets.

Junos OS for EX Series switches and the QFX Series uses DAI for ARP packets received on access ports because these ports are untrusted by default. Trunk ports are trusted by default, and therefore ARP packets bypass DAI on them.

You configure DAI for each VLAN, not for each interface (port). By default, DAI is disabled for all VLANs.

If you set an interface to be a DHCP trusted port, it is also trusted for ARP packets.

**NOTE:**

- If your switching device is an EX Series switch and uses Junos OS with support for the Enhanced Layer 2 Software (ELS) configuration style, see *Enabling a Trusted DHCP Server (CLI Procedure)* for information about configuring an access interface to be a DHCP trusted port.
- If your switching device is an EX Series switch and is *not* using Junos OS with support for the Enhanced Layer 2 Software (ELS) configuration style, see *Enabling a Trusted DHCP Server (CLI Procedure)* for information about configuring an access interface to be a DHCP trusted port.

For packets directed to the switching device to which a network device is connected, ARP queries are broadcast on the VLAN. The ARP responses to those queries are subjected to the DAI check.

For DAI, all ARP packets are trapped to the Packet Forwarding Engine. To prevent CPU overloading, ARP packets destined for the Routing Engine are rate-limited.

If the DHCP server goes down and the lease time for an IP-MAC entry for a previously valid ARP packet runs out, that packet is blocked.

Prioritizing Inspected Packets



NOTE: Prioritizing inspected packets is not supported on the QFX Series and the EX4600 switch.

You can use class-of-service (CoS) forwarding classes and queues to prioritize DAI packets for a specified VLAN. This type of configuration places inspected packets for that VLAN in the egress queue, that you specify, ensuring that the security procedure does not interfere with the transmission of high-priority traffic.

Related Documentation

- [Understanding Port Security Features to Protect the Access Ports on Your Device Against the Loss of Information and Productivity on page 86](#)
- [Understanding DHCP Snooping for Monitoring DHCP Messages Received from Untrusted Devices on page 88](#)
- [Example: Configuring Basic Port Security Features](#)
- [Example: Configuring DHCP Snooping, DAI, and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch](#)
- [Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks](#)
- [Example: Configuring IP Source Guard and Dynamic ARP Inspection to Protect the Switch from IP Spoofing and ARP Spoofing](#)
- [Example: Using CoS Forwarding Classes to Prioritize Snooped Packets in Heavy Network Traffic](#)

- *Enabling Dynamic ARP Inspection (CLI Procedure)*
- *Enabling Dynamic ARP Inspection (CLI Procedure)*
- *Enabling Dynamic ARP Inspection (J-Web Procedure)*

Verifying That DAI Is Working Correctly

Purpose Verify that dynamic ARP inspection (DAI) is working on the switch.

Action Send some ARP requests from network devices connected to the switch.

Display the DAI information:

```
user@switch> show arp inspection statistics
ARP inspection statistics:
Interface          Packets received  ARP inspection pass  ARP inspection failed
-----
ge-0/0/1.0          7                  5                    2
ge-0/0/2.0          10                 10                   0
ge-0/0/3.0          12                 12                   0
```

Meaning The sample output shows the number of ARP packets received and inspected per interface, with a listing of how many packets passed and how many failed the inspection on each interface. The switch compares the ARP requests and replies against the entries in the DHCP snooping database. If a MAC address or IP address in the ARP packet does not match a valid entry in the database, the packet is dropped.

- Related Documentation**
- *Enabling Dynamic ARP Inspection (CLI Procedure)*
 - *Enabling Dynamic ARP Inspection (J-Web Procedure)*
 - *Example: Configuring Basic Port Security Features*
 - *Example: Configuring DHCP Snooping, DAI, and MAC Limiting on a Switch with Access to a DHCP Server Through a Second Switch*
 - *Example: Configuring DHCP Snooping and DAI to Protect the Switch from ARP Spoofing Attacks*
 - *Monitoring Port Security*

Understanding MAC Limiting and MAC Move Limiting for Port Security

MAC limiting protects against flooding of the Ethernet switching table (also known as the MAC forwarding table or Layer 2 forwarding table). You enable this feature on Layer 2 interfaces (ports). MAC move limiting detects MAC movement and MAC spoofing on access interfaces. You enable this feature on VLANs.

- [MAC Limiting on page 100](#)
- [MAC Move Limiting on page 100](#)

- [Actions for MAC Limiting on page 101](#)
- [MAC Addresses That Exceed the MAC Limit or MAC Move Limit on page 101](#)

MAC Limiting

MAC limiting sets a limit on the number of MAC addresses that can be learned on a single Layer 2 access interface or on all the Layer 2 access interfaces on the switch. Junos OS provides two MAC limiting methods:

- Maximum number of MAC addresses—You configure the maximum number of dynamic MAC addresses allowed per interface. When the limit is exceeded, incoming packets with new MAC addresses can be ignored, dropped, or logged. You can also specify that the interface be shut down or temporarily disabled.
- Allowed MAC addresses—You configure specific “allowed” MAC addresses for the access interface. Any MAC address that is not in the list of configured addresses is not learned, and the switch logs an appropriate message. Allowed MAC binds MAC addresses to a VLAN so that the address does not get registered outside the VLAN. If an allowed MAC setting conflicts with a dynamic MAC setting, the allowed MAC setting takes precedence.



NOTE: If you do not want the system to log messages about invalid MAC addresses received by an interface that has been configured for allowed MAC addresses, disable the logging by configuring the [no-allowed-mac-log](#) statement.

You configure MAC limiting per interface, not per VLAN. You can specify the maximum number of dynamic MAC addresses that can be learned on a single Layer 2 access interface (including tagged-access interfaces) or on all Layer 2 access interfaces.

MAC Move Limiting

MAC move limiting causes the switch to track the number of times a MAC address can move to a new interface (port). It can help to prevent MAC spoofing, and it can also detect and prevent loops.

If a MAC address moves more than the configured number of times within 1 second, the switch performs the configured action. You can configure MAC move limiting to apply to all VLANs or to a specific VLAN.



CAUTION: Mac move limiting does not work properly on a QFX5100 switch used as a Node device in a QFabric system. Do not use this feature on a QFX5100 switch in a QFabric system.

Actions for MAC Limiting

You can choose to have one of the following actions performed when the limit of MAC addresses or the limit of MAC moves is exceeded:

- **drop**—Drop the packet and generate a system log entry. This is the default.
- **log**—Do not drop the packet but generate a system log entry.
- **none**—Take no action.
- **shutdown**—Disable the interface and generate an alarm. If you configure the switch with the **port-error-disable** statement, the disabled interface recovers automatically upon expiration of the specified timeout. If this is not configured, you can bring up the disabled interfaces by running the **clear ethernet-switching port-error** command.

See descriptions of results of these various action settings in “[Verifying That MAC Limiting Is Working Correctly](#)” on page 101.

If you set a MAC limit to apply to all interfaces on the switch, you can override that setting for a particular interface by specifying action **none**. See *mac-limit* for more information.

MAC Addresses That Exceed the MAC Limit or MAC Move Limit

If you have configured the **port-error-disable** statement, you can view which interfaces are temporarily disabled because the MAC limit or MAC move limit was exceeded. Use the **show ethernet-switching interfaces** command.

The log messages that indicate the MAC limit or MAC move limit has been exceeded include the offending MAC addresses.

Related Documentation

- [Understanding Port Security Features to Protect the Access Ports on Your Device Against the Loss of Information and Productivity on page 86](#)
- [Configuring MAC Limiting](#)
- [Configuring MAC Move Limiting \(CLI Procedure\)](#)
- [Verifying That MAC Limiting Is Working Correctly on page 101](#)
- [Verifying That MAC Move Limiting Is Working Correctly on page 104](#)
- [Example: Configuring Basic Port Security Features](#)
- [no-allowed-mac-log on page 184](#)

Verifying That MAC Limiting Is Working Correctly

MAC limiting protects against flooding of the Ethernet switching table by setting a limit on the number of MAC addresses that can be learned on a single Layer 2 access interface (port).

Junos OS provides two MAC limiting methods:

- **Maximum number of MAC addresses**—You configure the maximum number of dynamic MAC addresses allowed per interface. When the limit is exceeded, incoming packets with new MAC addresses can be ignored, dropped, or logged. You can also specify that the interface be shut down or temporarily disabled.
- **Allowed MAC addresses**—You configure specific “allowed” MAC addresses for the access interface. Any MAC address that is not in the list of configured addresses is not learned, and the switch logs an appropriate message. The allowed MAC method binds MAC addresses to a VLAN so that the address is not registered outside the VLAN. If an allowed MAC setting conflicts with a dynamic MAC setting, the allowed MAC setting takes precedence.

This topic includes the following tasks:

1. [Verifying That MAC Limiting for Dynamic MAC Addresses Is Working Correctly on page 102](#)
2. [Verifying That Allowed MAC Addresses Are Working Correctly on page 102](#)
3. [Verifying That Interfaces Are Shut Down on page 103](#)
4. [Customizing the Ethernet Switching Table Display to View Information for a Specific Interface on page 104](#)

Verifying That MAC Limiting for Dynamic MAC Addresses Is Working Correctly

Purpose Verify that MAC limiting for dynamic MAC addresses is working.

Action Display the MAC addresses that have been learned. The following sample output shows the results of sending two packets from hosts connected to **xe-1:0/0/1** and five packets from hosts connected to **xe-1:0/0/2**, with both interfaces configured with a MAC limit of **4** and the action **drop**:

```
user@switch> show ethernet-switching table
Ethernet-switching table: 7 entries, 6 learned
```

VLAN	MAC address	Type	Age	Interfaces
employee-vlan	*	Flood	–	xe-1:0/0/2.0
employee-vlan	00:05:85:3A:82:77	Learn	0	xe-1:0/0/1.0
employee-vlan	00:05:85:3A:82:79	Learn	0	xe-1:0/0/1.0
employee-vlan	00:05:85:3A:82:80	Learn	0	xe-1:0/0/2.0
employee-vlan	00:05:85:3A:82:81	Learn	0	xe-1:0/0/2.0
employee-vlan	00:05:85:3A:82:83	Learn	0	xe-1:0/0/2.0
employee-vlan	00:05:85:3A:82:85	Learn	0	xe-1:0/0/2.0

Meaning The output shows that the fifth packet received on the **xe-1:0/0/2** interface was dropped because it exceeded the MAC limit for that interface. The address was not learned, and thus an asterisk (*) rather than an address appears in the MAC address column in the first line of the sample output.

Verifying That Allowed MAC Addresses Are Working Correctly

Purpose Verify that allowed MAC addresses are working.

Action Display the MAC cache information after allowed MAC addresses have been configured on an interface. The following sample shows the MAC cache after four allowed MAC addresses had been configured on interface **xe-1:0/0/2** and a fifth MAC address appeared on the interface.

```
user@switch> show ethernet-switching table
Ethernet-switching table: 5 entries, 4 learned
```

VLAN	MAC address	Type	Age	Interfaces
employee-vlan	00:05:85:3A:82:80	Learn	0	xe-1:0/0/2.0
employee-vlan	00:05:85:3A:82:81	Learn	0	xe-1:0/0/2.0
employee-vlan	00:05:85:3A:82:83	Learn	0	xe-1:0/0/2.0
employee-vlan	00:05:85:3A:82:85	Learn	0	xe-1:0/0/2.0
employee-vlan	*	Flood	-	xe-1:0/0/2.0

Meaning Because the fifth address was not allowed it was not learned, and an asterisk (*) rather than an address appears in the MAC address column in the last line of the sample output.

Verifying That Interfaces Are Shut Down

Purpose Verify that an interface is shut down when the MAC limit is exceeded.

Action For more information about interfaces that have been shut down because the MAC limit was exceeded, use the **show ethernet-switching interfaces** command.

```
user@switch> show ethernet-switching interfaces
```

Interface	State	VLAN members	Tag	Tagging	Blocking
bme0.32770	down	mgmt	untagged	unblocked	
xe-0/0/0.0	down	v1	untagged	MAC limit exceeded	
xe- 0/0/1.0	up	v1	untagged	unblocked	
xe-0/0/2.0	up	v1	untagged	unblocked	
me0.0	up	mgmt	untagged	unblocked	



NOTE: You can configure interfaces to recover automatically when the MAC limit has been exceeded by specifying the **port-error-disable** statement with a **disable timeout** value. The switch automatically restores the disabled interface to service when the disable timeout expires. The **port-error-disable** configuration does not apply to preexisting error conditions—it affects only error conditions that are detected after the **port-error-disable** statement has been enabled and the configuration has been committed. To clear a preexisting error condition and restore the interface to service, use the **clear ethernet-switching port-error** command.

Customizing the Ethernet Switching Table Display to View Information for a Specific Interface

Purpose You can use the **show ethernet-switching table** command to view information for a specific interface.

Action For example, to display the MAC addresses that have been learned on the **xe-0/0/2** interface, enter:

```
user@switch> show ethernet-switching table interface xe-0/0/2.0
Ethernet-switching table: 1 unicast entries
```

VLAN	MAC address	Type	Age	Interfaces
v1	*	Flood	-	All-members
v1	00:00:06:00:00:00	Learn	0	xe-0/0/2.0

Meaning The MAC limit value for the **xe-0/0/2** interface had been set to 1, and the output shows that only one MAC address was learned and added to the MAC cache.

- Related Documentation**
- *Configuring MAC Limiting*
 - *Monitoring Port Security*
 - *Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)*
 - *Example: Configuring Allowed MAC Addresses to Protect the Switch from DHCP Snooping Database Alteration Attacks*
 - *Example: Configuring MAC Limiting to Protect the Switch from DHCP Starvation Attacks*

Verifying That MAC Move Limiting Is Working Correctly

Purpose Verify that MAC move limiting is working on the switch.

Action Display the MAC addresses in the Ethernet switching table when MAC move limiting has been configured for a VLAN. The following sample shows the results after two of the hosts on **ge-0/0/2** sent packets after the MAC addresses for those hosts had moved to other interfaces more than five times in 1 second. The VLAN, **employee-vlan**, was set to a MAC move limit of 5 with the action **drop**:

```
user@switch> show ethernet-switching table
```

```
Ethernet-switching table: 7 entries, 4 learned
```

VLAN	MAC address	Type	Age	Interfaces
employee-vlan	00:05:85:3A:82:77	Learn	0	ge-0/0/1.0
employee-vlan	00:05:85:3A:82:79	Learn	0	ge-0/0/1.0
employee-vlan	00:05:85:3A:82:80	Learn	0	ge-0/0/2.0
employee-vlan	00:05:85:3A:82:81	Learn	0	ge-0/0/2.0
employee-vlan	*	Flood	-	ge-0/0/2.0
employee-vlan	*	Flood	-	ge-0/0/2.0

Meaning The last two lines of the sample output show that MAC addresses for two hosts on **ge-0/0/2** were not learned, because the hosts had been moved back and forth from the original interfaces more than five times in 1 second.

- Related Documentation**
- *Configuring MAC Move Limiting (CLI Procedure)*
 - *Configuring MAC Move Limiting (J-Web Procedure)*
 - *Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)*
 - *Example: Configuring Basic Port Security Features*
 - *Monitoring Port Security*

Verifying That the Port Error Disable Setting Is Working Correctly

Purpose Verify that the port error disable setting is working as expected for MAC limited and storm control interfaces.

Action Display information about interfaces:

```
user@switch> show ethernet-switching interfaces
```

Interface	State	VLAN members	Blocking
xe-2:0/0/0.0	up	T1122	unblocked
xe-2:0/0/1.0	down	default	MAC limit exceeded
xe-2:0/0/2.0	down	default	Storm control in effect
xe-2:0/0/3.0	down	default	unblocked
xe-2:0/0/4.0	down	default	unblocked
xe-2:0/0/5.0	down	default	unblocked
xe-2:0/0/6.0	down	default	unblocked

Meaning For interfaces disabled by port security features, the sample output from the **show ethernet-switching interfaces** command specifies the reasons that the interfaces are disabled:

- **MAC limit exceeded**—The interface is temporarily disabled because of 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 because of 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 because of a storm control error. The disabled interface is automatically restored to service when the disable-timeout expires.

- Related Documentation**
- [Understanding MAC Limiting and MAC Move Limiting for Port Security on page 99](#)
 - [port-error-disable on page 186](#)

Understanding Trusted and Untrusted Ports

By default, all access ports are untrusted and all trunk ports are trusted in regard to DHCP. Trusted ports allow DHCP servers to provide IP addresses and other information to requesting devices. Untrusted ports drop traffic from DHCP servers to prevent unauthorized servers from providing any configuration information to clients.

If you attach a DHCP server to an access port, you must configure the port as trusted. Before you do so, ensure that the server is physically secure—that is, that access to the server is monitored and controlled.

- Related Documentation**
- [Understanding DHCP Snooping for Monitoring DHCP Messages Received from Untrusted Devices on page 88](#)
 - *Example: Configuring Basic Port Security Features*

Understanding Trusted DHCP Servers for Port Security

Any interface on the switching device that connects to a DHCP server can be configured as a trusted port. Configuring a DHCP server on a trusted port protects against rogue DHCP servers sending leases.

Ensure that the DHCP server interface is physically secure—that is, that access to the server is monitored and controlled at the site—before you configure the port as trusted.

- Related Documentation**
- *Example: Configuring a DHCP Server Interface as Untrusted to Protect the Switch from Rogue DHCP Server Attacks*
 - *Enabling a Trusted DHCP Server (CLI Procedure)*

Verifying That a Trusted DHCP Server Is Working Correctly

- Purpose** Verify that a DHCP trusted server is working on the switch. See what happens when the DHCP server is trusted and then untrusted.

Action Send some DHCP requests from network devices (here they are DHCP clients) connected to the switch.

Display the DHCP snooping information when the interface on which the DHCP server connects to the switch is trusted. The following output results when requests are sent from the MAC addresses and the server has provided the IP addresses and leases:

```
user@switch> show dhcp snooping binding
```

DHCP Snooping Information:

MAC Address	IP Address	Lease	Type	VLAN	Interface
00:05:85:3A:82:77	192.0.2.17	600	dynamic	employee-vlan	ge-0/0/1.0
00:05:85:3A:82:79	192.0.2.18	653	dynamic	employee-vlan	ge-0/0/1.0
00:05:85:3A:82:80	192.0.2.19	720	dynamic	employee-vlan	ge-0/0/2.0
00:05:85:3A:82:81	192.0.2.20	932	dynamic	employee-vlan	ge-0/0/2.0
00:05:85:3A:82:83	192.0.2.21	1230	dynamic	employee-vlan	ge-0/0/2.0
00:05:85:27:32:88	192.0.2.22	3200	dynamic	employee-vlan	ge-0/0/2.0

Meaning When the interface on which the DHCP server connects to the switch has been set to trusted, the output (see preceding sample) shows, for each MAC address, the assigned IP address and lease time—that is, the time, in seconds, remaining before the lease expires.

If the DHCP server had been configured as untrusted, no entries would be added to the DHCP snooping database and nothing would be shown in the output of the **show dhcp snooping binding** command.

- Related Documentation**
- *Enabling a Trusted DHCP Server (CLI Procedure)*
 - *Enabling a Trusted Port for DHCP*
 - *Example: Configuring Basic Port Security Features*
 - *Example: Configuring a DHCP Server Interface as Untrusted to Protect the Switch from Rogue DHCP Server Attacks*
 - *Monitoring Port Security*
 - *Troubleshooting Port Security*

Understanding DHCP Option 82 for Port Security

You can use DHCP option 82, also known as the DHCP relay agent information option, to help protect the switch against attacks such as spoofing (forging) of IP addresses and MAC addresses, and DHCP IP address starvation. Hosts on untrusted access interfaces on Ethernet LAN switches send requests for IP addresses in order to access the Internet. The switch forwards or relays these requests to DHCP servers, and the servers send offers for IP address leases in response. Attackers can use these messages to perpetrate address spoofing and starvation.

Option 82 provides information about the network location of a DHCP client, and the DHCP server uses this information to implement IP addresses or other parameters for the client. The Juniper Networks Junos operating system (Junos OS) implementation of DHCP option 82 supports RFC 3046, *DHCP Relay Agent Information Option*, at <http://tools.ietf.org/html/rfc3046>.

This topic covers:

- [DHCP Option 82 Processing on page 108](#)
- [Suboption Components of Option 82 on page 109](#)
- [Configurations That Support Option 82 on page 109](#)

DHCP Option 82 Processing

If DHCP option 82 is enabled on the switch, then when a DHCP client that is connected to the switch on an untrusted interface sends a DHCP request, the switch inserts information about the client's network location into the packet header of that request. The switch then sends the request to the DHCP server. The DHCP server reads the option 82 information in the packet header and uses it to implement the IP address or another parameter for the client. See “[Suboption Components of Option 82](#)” on [page 109](#) for details about option 82 information.

You can enable DHCP option 82 on a single VLAN or on all VLANs on the switch. You can also configure it on Layer 3 interfaces (in routed VLAN interfaces, or RVIs) when the switch is functioning as a relay agent.

When option 82 is enabled on the switch, then this sequence of events occurs when a DHCP client sends a DHCP request:

1. The switch receives the request and inserts the option 82 information in the packet header.
2. The switch forwards or relays the request to the DHCP server.
3. The server uses the DHCP option 82 information to formulate its reply and sends a response back to the switch. It does not alter the option 82 information.
4. The switch strips the option 82 information from the response packet.
5. The switch forwards the response packet to the client.



NOTE: To use the DHCP option 82 feature, you must ensure that the DHCP server is configured to accept option 82. If it is not configured to accept option 82, then when it receives requests containing option 82 information, it does not use the information in setting parameters and it does not echo the information in its response message.

Suboption Components of Option 82

When configuring DHCP option 82, you can use the following suboptions:

- **circuit ID**—Identifies the circuit (interface and/or VLAN) on the switch on which the request was received. The circuit ID contains the interface name and/or VLAN name, with the two elements separated by a colon—for example, **xe-0/0/10:vlan1**. If the request packet is received on a Layer 3 interface, the circuit ID is just the interface name—for example, **xe-0/0/10**.

Use the **prefix** option to add an optional prefix to the circuit ID. If you enable the **prefix** option, the hostname for the switch is used as the prefix; for example, **switch1:xe-0/0/10:vlan1**.

You can also specify that the interface description be used rather than the interface name and that the VLAN ID be used rather than the VLAN name.

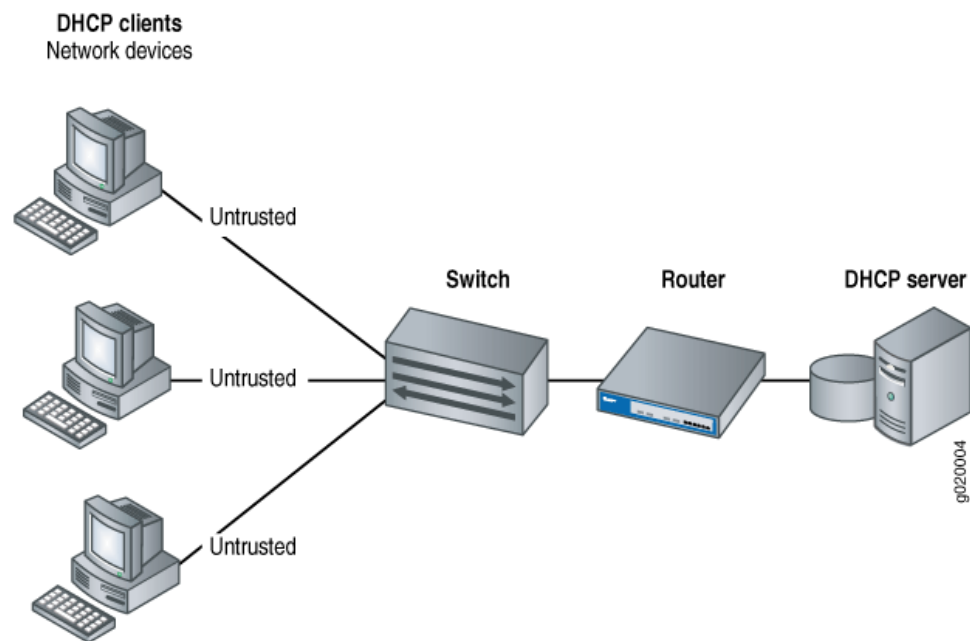
- **remote ID**—Identifies the host. By default, the remote ID is the MAC address of the switch. You can specify that the remote ID be the hostname of the switch, the interface description, or a character string of your choice. You can also add an optional prefix to the remote ID.
- **vendor ID**—Identifies the vendor of the host. If you specify the **vendor-id** option but do not enter a value, the default value **Juniper** is used. To specify a value, you type a character string.

Configurations That Support Option 82

You can use option 82 with the following configurations:

- The DHCP client and the DHCP server are on the same VLAN. In this case the switch forwards the requests from the clients on untrusted access interfaces to the server on a trusted interface. For this configuration, you set DHCP option 82 at the **[edit ethernet-switching-options secure-access-port vlan]** hierarchy level.
- The DHCP client or the DHCP server is connected to the switch through a Layer 3 interface and the switch is configured to relay DHCP requests. [Figure 8 on page 110](#) illustrates a scenario for the switch-as-relay-agent; in this instance, the switch relays requests through a router to the server.

Figure 8: Switch Relays DHCP Requests to Server



For the configuration shown in [Figure 8 on page 110](#), you set DHCP option 82 at the **[edit forwarding-options helpers bootp]** hierarchy level.

Related Documentation

- [Overview of Access Port Protection on page 83](#)
- [DHCP and BOOTP Relay Overview](#)
- [dhcp-option82](#)
- [Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server](#)
- [Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server](#)
- [Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server \(CLI Procedure\)](#)
- [Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server \(CLI Procedure\)](#)

Understanding Static ARP Entries

You can create explicit mappings between IP addresses and MAC addresses, which are called static ARP table entries. Unlike dynamically learned ARP entries, static entries do not age out. You might want to create static ARP entries in a troubleshooting situation or if your device is unable to learn a MAC address dynamically for any reason.

Related Documentation

- [Configuring Static ARP Entries](#)

- *arp*

PART 4

Configuring Device Security

- [Device Security on page 115](#)

CHAPTER 4

Device Security

- [Understanding Storm Control on page 115](#)
- [Example: Configuring Storm Control to Prevent Network Outages on page 116](#)
- [Verifying That the Port Error Disable Setting Is Working Correctly on page 119](#)
- [Understanding Unicast RPF on page 120](#)
- [Configuring Unicast RPF \(CLI Procedure\) on page 124](#)
- [Disabling Unicast RPF \(CLI Procedure\) on page 125](#)
- [Verifying Unicast RPF Status on page 126](#)
- [Understanding Unknown Unicast Forwarding on page 129](#)
- [Configuring Unknown Unicast Forwarding \(CLI Procedure\) on page 129](#)

Understanding Storm Control

A traffic storm occurs when broadcast packets prompt receiving devices to broadcast packets in response. This prompts further responses, creating a snowball effect. The switch is flooded with packets, which creates unnecessary traffic that leads to poor performance or even a complete loss of service by some clients. Storm control causes a device to monitor traffic levels and take a specified action when a specified traffic level—called the *storm control level*—is exceeded, thus preventing packets from proliferating and degrading service. You can configure devices to drop broadcast and unknown unicast packets, shut down interfaces, or temporarily disable interfaces when the storm control level is exceeded.

Storm control is enabled by default on ELS platforms and disabled by default on non-ELS platforms. If storm control is enabled, the default level is 80 percent of the available bandwidth for ingress traffic. You can change the storm control level by configuring it as a specific bandwidth value. (The **level** configuration statement, which allows you to configure the storm control level as a percentage of the combined broadcast and unknown unicast streams, is deprecated and might be removed from future releases. We recommend that you phase out its use and replace it with the **bandwidth** statement.)



NOTE: Storm control is not enabled by default on MX platforms.



NOTE: When you configure storm control bandwidth, the value you configure is rounded off internally to the closest multiple of 64 Kbps, and the rounded-off value represents the bandwidth that is actually enforced. For example, if you configure a bandwidth limit of 150 Kbps, storm control enforces a bandwidth limit of 128 Kbps.



NOTE: On an FCoE-FC gateway, storm control must be disabled on all Ethernet interfaces that belong to an FCoE VLAN to prevent FCoE traffic from being dropped. Configuring storm control on an Ethernet interface that is included in an FCoE-FC gateway may have undesirable effects, including FCoE packet loss. After disabling storm control on all interfaces, enable storm control on any interfaces that are not part of an FCoE-FC gateway on which you want to use storm control. However, on an FCoE transit switch, you can enable storm control on interfaces that carry FCoE traffic.



CAUTION: The Junos OS allows you to configure a storm control value that exceeds the bandwidth of the interface. If you configure an interface this way, storm control does not drop broadcast or unknown unicast packets even if they consume all the available bandwidth.

To recognize a storm, you must be able to identify when traffic has reached an abnormal level. Suspect a storm when operations begin timing out and network response times slow down. Users might be unable to access expected services. Monitor the percentage of broadcast and unknown unicast traffic in the network 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.



NOTE: On a QFX10002 switch, if storm control is configured on a VLAN port associated with an IRB interface, unregistered multicast traffic is classified as registered multicast traffic if IGMP snooping is enabled. If IGMP snooping is disabled, the traffic is classified as unknown unicast traffic.

**Related
Documentation**

- [action-shutdown on page 166](#)
- [port-error-disable on page 186](#)
- [storm-control on page 174](#)

Example: Configuring Storm Control to Prevent Network Outages

Storm control enables you to prevent network outages caused by broadcast storms on the LAN. You can configure storm control on to rate-limit broadcast traffic, multicast

traffic, and unknown unicast traffic at a specified level and to have packets dropped when the specified traffic level is exceeded, thereby preventing packets from proliferating and degrading the LAN.



NOTE: This example uses a Junos OS release that supports the Enhanced Layer 2 Software (ELS) configuration style.

- [Requirements on page 117](#)
- [Overview and Topology on page 117](#)
- [Configuration on page 118](#)

Requirements

This example uses the following hardware and software components:

- One QFX Series switch running Junos OS with ELS
- Junos OS Release 13.2 or later

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, multicast traffic, and unknown unicast traffic to be allowed on an interface. You specify the storm control level as the traffic rate in kilobits per second (Kbps) of the combined applicable traffic streams or as the percentage of available bandwidth used by the combined applicable traffic streams. On ELS systems, storm control is enabled by default on all interfaces at a level of 80 percent of the available bandwidth.

Storm control monitors the level of applicable incoming traffic and compares it with the level that you specify. If the combined level of the applicable traffic exceeds the specified level, the switch drops packets for the controlled traffic types. As an alternative to having the switch drop packets, you can configure storm control to shut down interfaces or temporarily disable interfaces (see the **action-shutdown** statement or the **recovery-timeout** statement) when the storm control level is exceeded.



NOTE: If you configure storm control on an aggregated Ethernet interface, the storm-control level is applied to each member interface individually. For example, if the aggregated interface has two members and you configure a storm-control level of 20 kbps, Junos will not detect a storm if one or both of the member interfaces receives traffic at 15 kbps because in neither of these cases does an individual member receive traffic at a rate greater than the configured storm-control level. In this example, Junos detects a storm only if at least one member interface receives traffic at greater than 20 Kbps.

The topology used in this example consists of one switch connected to various network devices. This example shows how to configure the storm control level on interface xe-0/0/0 by setting the level to a traffic rate of 15,000 Kbps, based on the traffic rate of the combined applicable traffic streams. If the combined traffic exceeds this level, the switch drops packets for the controlled traffic types to prevent a network outage.

Configuration

CLI Quick Configuration

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

```
[edit]
set forwarding-options storm-control-profiles sc-profile all bandwidth-level 15000
set interfaces xe-0/0/0 unit 0 family ethernet-switching storm-control sc-profile
```

Step-by-Step Procedure

To configure storm control:

1. Configure a storm control profile, **sc-profile**, and specify the traffic rate in kilobits per second of the combined traffic streams:

```
[edit]
user@switch> set forwarding-options storm-control-profiles sc-profile all bandwidth-level 15000
```

2. Bind the storm control profile, **sc**, to a logical interface:

```
[edit]
user@switch> set interfaces xe-0/0/0 unit 0 family ethernet-switching storm-control sc-profile
```

Results

Display the results of the configuration:

```
[edit forwarding-options]
user@switch> show storm-control-profiles sc-profile
all {
  bandwidth 15000;
}

[edit]
user@switch> show interfaces xe-0/0/0
unit 0 {
  family ethernet-switching {
    vlan {
      members default;
    }
    storm-control sc-profile;
```



```

    }
}

```

- Related Documentation**
- [Understanding Storm Control on page 115](#)
 - [Configuring Autorecovery for MAC Limited or Storm Control Interfaces \(CLI Procedure\)](#)

Verifying That the Port Error Disable Setting Is Working Correctly

Purpose Verify that the port error disable setting is working as expected for MAC limited and storm control interfaces.

Action Display information about interfaces:

```

user@switch> show ethernet-switching interfaces
Interface      State    VLAN members    Blocking
xe-2:0/0/0.0   up       T1122           unblocked
xe-2:0/0/1.0   down     default         MAC limit exceeded
xe-2:0/0/2.0   down     default         Storm control in effect
xe-2:0/0/3.0   down     default         unblocked
xe-2:0/0/4.0   down     default         unblocked
xe-2:0/0/5.0   down     default         unblocked
xe-2:0/0/6.0   down     default         unblocked

```

Meaning For interfaces disabled by port security features, the sample output from the **show ethernet-switching interfaces** command specifies the reasons that the interfaces are disabled:

- **MAC limit exceeded**—The interface is temporarily disabled because of 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 because of 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 because of a storm control error. The disabled interface is automatically restored to service when the disable-timeout expires.

- Related Documentation**
- [Understanding MAC Limiting and MAC Move Limiting for Port Security on page 99](#)
 - [port-error-disable on page 186](#)

Understanding Unicast RPF

Unicast reverse-path forwarding (RPF) helps protect the switch against denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks by verifying the unicast source address of each packet that arrives on an ingress interface where unicast RPF is enabled. It also helps ensure that traffic arriving on ingress interfaces comes from a network source that the receiving interface can reach.

When you enable unicast RPF, by default the switch forwards a packet only if the receiving interface is the best return path to the packet's unicast source address. This is known as strict mode unicast RPF. You can also enable loose mode, which means that the system checks to see if the packet has a source address with a corresponding prefix in the routing table but does not check whether the receiving interface is the best return path to the packet's unicast source address.



.....

NOTE: On Juniper Networks EX3200, EX4200, and EX4300 Ethernet Switches, the switch applies unicast RPF *globally* to all interfaces when unicast RPF is configured on any interface. For additional information, see [“Limitations of the Unicast RPF Implementation on EX3200, EX4200, and EX4300 Switches” on page 123](#).

.....

This topic covers:

- [Unicast RPF for Switches Overview on page 120](#)
- [Unicast RPF Implementation on page 121](#)
- [When to Enable Unicast RPF on page 121](#)
- [When Not to Enable Unicast RPF on page 122](#)
- [Limitations of the Unicast RPF Implementation on EX3200, EX4200, and EX4300 Switches on page 123](#)

Unicast RPF for Switches Overview

Unicast RPF functions as an ingress filter that reduces the forwarding of IP packets that might be spoofing an address. By default, unicast RPF is disabled on the switch interfaces.

The type of unicast RPF provided on the switches—that is, strict mode unicast RPF is especially useful on untrusted interfaces. An untrusted interface is an interface where untrusted users or processes can place packets on the network segment.

The switch supports only the active paths method of determining the best return path back to a unicast source address. The active paths method looks up the best reverse path entry in the forwarding table. It does not consider alternate routes specified using routing-protocol-specific methods when determining the best return path.

If the forwarding table lists the receiving interface as the interface to use to forward the packet back to its unicast source, it is the best return path interface.

Use strict mode unicast RPF only on symmetrically routed interfaces. (For information about symmetrically routed interfaces, see [“When to Enable Unicast RPF” on page 121.](#))

For more information about strict unicast RPF, see RFC 3704, *Ingress Filtering for Multihomed Networks* at <http://www.ietf.org/rfc/rfc3704.txt>.

Unicast RPF Implementation

This section includes:

- [Unicast RPF Packet Filtering on page 121](#)
- [Bootstrap Protocol \(BOOTP\) and DHCP Requests on page 121](#)
- [Default Route Handling on page 121](#)

Unicast RPF Packet Filtering

When you enable unicast RPF on the switch, the switch handles traffic in the following manner:

- If the switch receives a packet on the interface that is the best return path to the unicast source address of that packet, the switch forwards the packet.
- If the best return path from the switch to the packet's unicast source address is not the receiving interface, the switch discards the packet.
- If the switch receives a packet that has a source IP address that does not have a routing entry in the forwarding table, the switch discards the packet.

Bootstrap Protocol (BOOTP) and DHCP Requests

Bootstrap protocol (BOOTP) and DHCP request packets are sent with a broadcast MAC address and therefore the switch does not perform unicast RPF checks on them. The switch forwards all BOOTP packets and DHCP request packets without performing unicast RPF checks.

Default Route Handling

If the best return path to the source is the default route (0.0.0.0) and the default route points to **reject**, the switch discards the packets. If the default route points to a valid network interface, the switch performs a normal unicast RPF check on the packets.

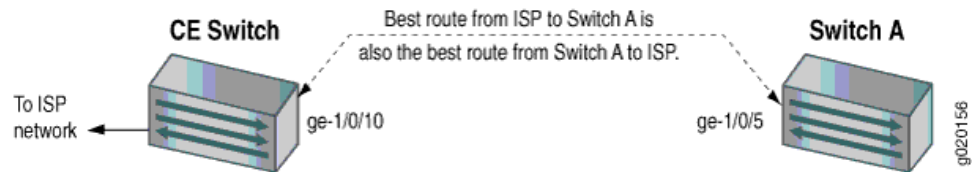
When to Enable Unicast RPF

Enable unicast RPF when you want to ensure that traffic arriving on a network interface comes from a source that resides on a network that that interface can reach. You can enable unicast RPF on untrusted interfaces to filter spoofed packets. For example, a common application for unicast RPF is to help defend an enterprise network from DoS/DDoS attacks coming from the Internet.

Enable unicast RPF only on symmetrically routed interfaces. A symmetrically routed interface uses the same route in both directions between the source and the destination, as shown in [Figure 9 on page 122](#). Symmetrical routing means that if an interface receives a packet, the switch uses the same interface to send a reply to the packet source (the

receiving interface matches the forwarding-table entry for the best return path to the source).

Figure 9: Symmetrically Routed Interfaces



Enabling unicast RPF on asymmetrically routed interfaces (where different interfaces receive a packet and reply to its source) results in packets from legitimate sources being filtered (discarded) because the best return path is not the same interface that received the packet.

The following switch interfaces are most likely to be symmetrically routed and thus are candidates for unicast RPF enabling:

- The service provider edge to a customer
- The customer edge to a service provider
- A single access point out of the network (usually on the network perimeter)
- A terminal network that has only one link



NOTE: Because unicast RPF is enabled globally on EX3200, EX4200, and EX4300 switches, ensure that *all* interfaces are symmetrically routed before you enable unicast RPF on these switches. Enabling unicast RPF on asymmetrically routed interfaces results in packets from legitimate sources being filtered.



TIP: Enabling unicast RPF as close as possible to the traffic source stops spoofed traffic before it can proliferate or reach interfaces that do not have unicast RPF enabled.

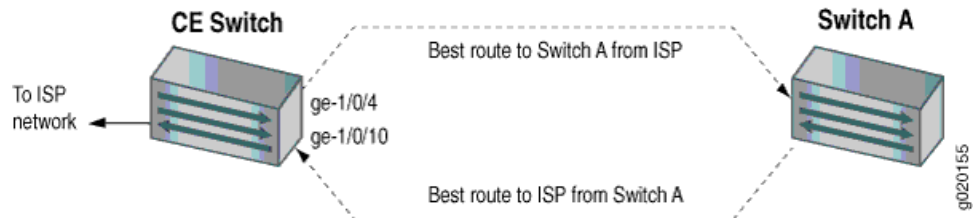
When Not to Enable Unicast RPF

Typically, you will not enable unicast RPF if:

- Switch interfaces are multihomed.
- Switch interfaces are trusted interfaces.
- BGP is carrying prefixes and some of those prefixes are not advertised or are not accepted by the ISP under its policy. (The effect in this case is the same as filtering an interface by using an incomplete access list.)
- Switch interfaces face the network core. Core-facing interfaces are usually asymmetrically routed.

An asymmetrically routed interface uses different paths to send and receive packets between the source and the destination, as shown in [Figure 10 on page 123](#). This means that if an interface receives a packet, that interface does not match the forwarding table entry as the best return path back to the source. If the receiving interface is not the best return path to the source of a packet, unicast RPF causes the switch to discard the packet even though it comes from a valid source.

Figure 10: Asymmetrically Routed Interfaces



NOTE: Do not enable unicast RPF on EX3200, EX4200, and EX4300 switches if any switch interfaces are asymmetrically routed, because unicast RPF is enabled globally on all interfaces of these switches. All switch interfaces must be symmetrically routed for you to enable unicast RPF without the risk of the switch discarding traffic that you want to forward.

Limitations of the Unicast RPF Implementation on EX3200, EX4200, and EX4300 Switches

On EX3200, EX4200, and EX4300 switches, the switch implements unicast RPF on a global basis. You cannot enable unicast RPF on a per-interface basis. Unicast RPF is globally disabled by default.

- When you enable unicast RPF on any interface, it is automatically enabled on all switch interfaces, including link aggregation groups (LAGs), integrated routing and bridging (IRB) interfaces, and routed VLAN interfaces (RVIs).
- When you disable unicast RPF on the interface (or interfaces) on which you enabled unicast RPF, it is automatically disabled on all switch interfaces.



NOTE: You must explicitly disable unicast RPF on every interface on which it was explicitly enabled or unicast RPF remains enabled on all switch interfaces.

QFX switches, OCX switches, and EX3200 and EX4200 switches do not perform unicast RPF filtering on equal-cost multipath (ECMP) traffic. The unicast RPF check examines only one best return path to the packet source, but ECMP traffic employs an address block consisting of multiple paths. Using unicast RPF to filter ECMP traffic on these switches can result in the switch discarding packets that you want to forward because the unicast RPF filter does not examine the entire ECMP address block.

- Related Documentation**
- [Example: Configuring Unicast RPF on an EX Series Switch](#)
 - [Configuring Unicast RPF \(CLI Procedure\) on page 124](#)
 - [Disabling Unicast RPF \(CLI Procedure\) on page 125](#)

Configuring Unicast RPF (CLI Procedure)

Unicast reverse-path forwarding (RPF) can help protect your LAN from denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks on untrusted interfaces. When you enable unicast RPF, by default the switch forwards a packet only if the receiving interface is the best return path to the packet's unicast source address. This is known as strict mode unicast RPF. You can also enable loose mode, which means that the system checks to see if the packet has a source address with a corresponding prefix in the routing table but does not check whether the receiving interface is the best return path to the packet's unicast source address.



NOTE: On EX3200, EX4200, and EX4300 switches, you can enable unicast RPF only globally—that is, on all switch interfaces. You cannot enable unicast RPF on a per-interface basis.

Before you begin:

- On an EX8200, EX6200, QFX Series switch, or OCX Series switch, ensure that the selected switch interface is symmetrically routed before you enable unicast RPF. A symmetrically routed interface is an interface that uses the same route in both directions between the source and the destination. Do not enable unicast RPF on asymmetrically routed interfaces. An asymmetrically routed interface uses different paths to send and receive packets between the source and the destination.
- On an EX3200, EX4200, or EX4300 switch, ensure that *all* switch interfaces are symmetrically routed before you enable unicast RPF on an interface. When you enable unicast RPF on any interface, it is enabled globally on all switch interfaces. Do not enable unicast RPF on asymmetrically routed interfaces. An asymmetrically routed interface uses different paths to send and receive packets between the source and the destination.

To enable unicast RPF, configure it explicitly on a selected customer-edge interface:

[edit interfaces]

user@switch# **set interface-name** unit 0 family inet **rpf-check**

To enable unicast RPF loose mode, enter:

[edit interfaces]

user@switch# **set interface-name** unit 0 family inet **rpf-check mode loose**



BEST PRACTICE: On EX3200, EX4200, and EX4300 switches, unicast RPF is enabled globally on *all* switch interfaces, regardless of whether you configure it explicitly on only one interface or only on some interfaces.

On EX3200, EX4200, and EX4300 switches, we recommend that you enable unicast RPF explicitly on either all interfaces or only one interface. To avoid possible confusion, do not enable it on only some interfaces:

- Enabling unicast RPF explicitly on only one interface makes it easier if you choose to disable it in the future because you must explicitly disable unicast RPF on every interface on which you explicitly enabled it. If you explicitly enable unicast RPF on two interfaces and you disable it on only one interface, unicast RPF is still implicitly enabled globally on the switch. The drawback of this approach is that the switch displays the flag that indicates that unicast RPF is enabled only on interfaces on which unicast RPF is explicitly enabled, so even though unicast RPF is enabled on all interfaces, this status is not displayed.
- Enabling unicast RPF explicitly on all interfaces makes it easier to know whether unicast RPF is enabled on the switch because every interface shows the correct status. (Only interfaces on which you explicitly enable unicast RPF display the flag that indicates that unicast RPF is enabled.) The drawback of this approach is that if you want to disable unicast RPF, you must explicitly disable it on every interface. If unicast RPF is enabled on any interface, it is implicitly enabled on all interfaces.

Related Documentation

- [Example: Configuring Unicast RPF on an EX Series Switch](#)
- [Verifying Unicast RPF Status on page 126](#)
- [Disabling Unicast RPF \(CLI Procedure\) on page 125](#)
- [Troubleshooting Unicast RPF](#)
- [Understanding Unicast RPF on page 120](#)

Disabling Unicast RPF (CLI Procedure)

Unicast reverse-path forwarding (RPF) can help protect your LAN from denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks on untrusted interfaces. Unicast

RPF filters traffic with source addresses that do not use the incoming interface as the best return path back to the source. If the network configuration changes so that an interface that has unicast RPF enabled becomes a trusted interface or becomes asymmetrically routed (the interface that receives a packet is not the best return path to the packet's source), disable unicast RPF.

To disable unicast RPF on an EX3200, EX4200, or EX4300 switch, you must delete it from every interface on which you explicitly configured it. If you do not disable unicast RPF on every interface on which you explicitly enabled it, it remains implicitly enabled on all interfaces. If you attempt to delete unicast RPF from an interface on which it was not explicitly enabled, the **warning: statement not found** message appears. If you do not disable unicast RPF on every interface on which you explicitly enabled it, unicast RPF remains implicitly enabled on all interfaces of the EX3200, EX4200, or EX4300 switch.

On EX8200, EX6200, QFX Series switches, and OCX Series switches, the switch does not apply unicast RPF to an interface unless you explicitly enable that interface for unicast RPF.

To disable unicast RPF, delete its configuration from the interface:

[edit interfaces]

```
user@switch# delete ge-1/0/10 unit 0 family inet rpf-check
```



NOTE: On EX3200, EX4200, and EX4300 switches, if you do not disable unicast RPF on every interface on which you explicitly enabled it, unicast RPF remains implicitly enabled on all interfaces.

Related Documentation

- [Example: Configuring Unicast RPF on an EX Series Switch](#)
- [Verifying Unicast RPF Status on page 126](#)
- [Configuring Unicast RPF \(CLI Procedure\) on page 124](#)
- [Understanding Unicast RPF on page 120](#)

Verifying Unicast RPF Status

Purpose Verify that unicast reverse-path forwarding (RPF) is enabled and is working on the interface.

Action Use one of the **show interfaces *interface-name*** commands with either the **extensive** or **detail** options to verify that unicast RPF is enabled and working on the switch. The following example displays output from the **show interfaces ge- extensive** command.

```
user@switch> show interfaces ge-1/0/10 extensive
Physical interface: ge-1/0/10, Enabled, Physical link is Down
  Interface index: 139, SNMP ifIndex: 58, Generation: 140
  Link-level type: Ethernet, MTU: 1514, Speed: Auto, MAC-REWRITE Error: None,
  Loopback: Disabled, Source filtering: Disabled, Flow control: Enabled,
  Auto-negotiation: Enabled, Remote fault: Online
  Device flags   : Present Running
```



```

Interface flags: Hardware-Down SNMP-Traps Internal: 0x0
Link flags      : None
CoS queues     : 8 supported, 8 maximum usable queues
Hold-times     : Up 0 ms, Down 0 ms
Current address: 00:19:e2:50:95:ab, Hardware address: 00:19:e2:50:95:ab
Last flapped   : Never
Statistics last cleared: Never
Traffic statistics:
  Input bytes   :                0                0 bps
  Output bytes  :                0                0 bps
  Input packets :                0                0 pps
  Output packets:                0                0 pps
IPv6 transit statistics:
  Input bytes   :                0
  Output bytes  :                0
  Input packets :                0
  Output packets:                0
Input errors:
  Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0,
  L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0,
  FIFO errors: 0, Resource errors: 0
Output errors:
  Carrier transitions: 0, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0,

  FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 4 in use
Queue counters:      Queued packets  Transmitted packets      Dropped packets

  0 best-effort                0                0                0
  1 assured-forw                0                0                0
  5 expedited-fo                0                0                0
  7 network-cont                0                0                0

Active alarms  : LINK
Active defects : LINK
MAC statistics:
  Total octets      Receive      Transmit
  Total packets     0            0
  Unicast packets   0            0
  Broadcast packets 0            0
  Multicast packets 0            0
  CRC/Align errors  0            0
  FIFO errors       0            0
  MAC control frames 0            0
  MAC pause frames   0            0
  Oversized frames   0
  Jabber frames      0
  Fragment frames    0
  VLAN tagged frames 0
  Code violations     0
Filter statistics:
  Input packet count      0
  Input packet rejects    0
  Input DA rejects        0
  Input SA rejects        0
  Output packet count      0
  Output packet pad count  0
  Output packet error count 0

```

```

    CAM destination filters: 0, CAM source filters: 0
Autonegotiation information:
  Negotiation status: Incomplete
Packet Forwarding Engine configuration:
  Destination slot: 1

Logical interface ge-1/0/10.0 (Index 69) (SNMP ifIndex 59) (Generation 135)
Flags: Device-Down SNMP-Traps 0x0 Encapsulation: ENET2
Traffic statistics:
  Input bytes :                0
  Output bytes :                0
  Input packets:               0
  Output packets:              0
IPv6 transit statistics:
  Input bytes :                0
  Output bytes :                0
  Input packets:               0
  Output packets:              0
Local statistics:
  Input bytes :                0
  Output bytes :                0
  Input packets:               0
  Output packets:              0
Transit statistics:
  Input bytes :                0                0 bps
  Output bytes :               0                0 bps
  Input packets:               0                0 pps
  Output packets:              0                0 pps
IPv6 transit statistics:
  Input bytes :                0
  Output bytes :                0
  Input packets:               0
  Output packets:              0
  Protocol inet, Generation: 144, Route table: 0
Flags: uRPF
Addresses, Flags: Is-Preferred Is-Primary

```

Meaning The `show interfaces ge-1/0/10 extensive` command (and the `show interfaces ge-1/0/10 detail` command) displays in-depth information about the interface. The **Flags:** output field near the bottom of the display reports the unicast RPF status. If unicast RPF has not been enabled, the **uRPF** flag is not displayed.

On EX3200, EX4200, and EX4300 switches, unicast RPF is implicitly enabled on *all* switch interfaces, including aggregated Ethernet interfaces (also referred to as link aggregation groups or LAGs), integrated routing and bridging (IRB) interfaces, and routed VLAN interfaces (RVIs) when you enable unicast RPF on a single interface. However, the unicast RPF status is shown as enabled only on interfaces for which you have explicitly configured unicast RPF. Thus, the **uRPF** flag is not displayed on interfaces for which you have not explicitly configured unicast RPF even though unicast RPF is implicitly enabled on all interfaces on EX3200 and EX4200 switches.

- Related Documentation**
- *show interfaces xe-*
 - *Example: Configuring Unicast RPF on an EX Series Switch*
 - [Configuring Unicast RPF \(CLI Procedure\) on page 124](#)

- [Disabling Unicast RPF \(CLI Procedure\) on page 125](#)
- *Troubleshooting Unicast RPF*

Understanding Unknown Unicast Forwarding

Unknown unicast traffic consists of unicast packets with unknown destination MAC addresses. By default, the switch floods these unicast packets that traverse a VLAN to all interfaces that are members of that VLAN. Forwarding this type of traffic can create unnecessary traffic that leads to poor network performance or even a complete loss of network service. This flooding of packets is known as a traffic storm.

To prevent a traffic storm, you can disable the flooding of unknown unicast packets to all VLAN interfaces by configuring specific VLANs or all VLANs to forward all unknown unicast traffic traversing them to a specific interface. You can configure multiple VLANs to forward unknown unicast packets to the same interface or configure different interfaces for different VLANs. This channels the unknown unicast traffic traversing VLANs to specific interfaces instead of flooding all interfaces.

Related Documentation

- *Configuring Unknown Unicast Forwarding (CLI Procedure)*
- [Configuring Unknown Unicast Forwarding \(CLI Procedure\) on page 129](#)
- *Understanding Storm Control on EX Series Switches*
- *Understanding Storm Control for Managing Traffic Levels on Switching Devices*
- *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches*
- *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches*

Configuring Unknown Unicast Forwarding (CLI Procedure)



NOTE: This task uses Junos OS for EX Series switches or QFX Series with support for the Enhanced Layer 2 Software (ELS) configuration style. If your EX Series switch runs software that does not support ELS, see *Configuring Unknown Unicast Forwarding (CLI Procedure)*. For ELS details, see *Getting Started with Enhanced Layer 2 Software*

Unknown unicast traffic consists of packets with unknown destination MAC addresses. By default, the switch floods these packets that traverse a VLAN to all interfaces associated with that VLAN. This flooding of packets is known as a traffic storm and can negatively impact network performance.

To prevent flooding unknown unicast traffic across the switch, configure unknown unicast forwarding to direct all unknown unicast packets within a VLAN to a specific interface.

You can configure each VLAN to divert unknown unicast traffic to a different interface or use the same interface for multiple VLANs.

- [Configuring Unknown Unicast Forwarding on EX4300 Switches on page 130](#)
- [Configuring Unknown Unicast Forwarding on EX9200 Switches on page 130](#)

Configuring Unknown Unicast Forwarding on EX4300 Switches

To configure unknown unicast forwarding options on EX4300 switches:

- Configure unknown unicast forwarding for a specific VLAN and specify the interface to which all unknown unicast traffic will be forwarded:

```
[edit switch-options]
user@switch# set unknown-unicast-forwarding vlan vlan-name interface interface-name
```

- Configure unknown unicast forwarding for all VLANs and specify the interface to which all unknown unicast traffic will be forwarded:

```
[edit switch-options]
user@switch# set unknown-unicast-forwarding vlan all interface interface-name
```

Configuring Unknown Unicast Forwarding on EX9200 Switches

To configure unknown unicast forwarding on EX9200 switches, you must configure a flood filter and apply it to VLANs for which you want to configure unknown unicast forwarding. Flood filters are firewall filters that are applied only to broadcast, unknown unicast, and multicast (BUM) traffic. If a flood filter is configured, only traffic packets that are of the packet type **unknown-unicast** are forwarded to the interface on which unicast forwarding is configured. A next-hop group redirects the packets according to the action specified in the flood filter.

To configure the next-hop group that receives Layer 2 packets and then configure the interface to which these packets are forwarded:

1. Configure the **next-hop-group** action for the Layer 2 interface expected to receive unknown unicast packets:

```
[edit forwarding-options]
user@switch# set next-hop-group next-hop-group-name group-type layer-2
[edit forwarding-options]
user@switch# set next-hop-group next-hop-group-name interface interface-name
```

For example:

```
[edit forwarding-options]
user@switch# set next-hop-group uuf-nhg group-type layer-2
[edit forwarding-options]
user@switch# set next-hop-group uuf-nhg interface ge-3/1/7.0
```

2. Configure a firewall filter with family address type **ethernet-switching**:

```
[edit firewall]
user@switch# set family ethernet-switching filter filter-name
```

For example:

```
[edit firewall]
user@switch# set family ethernet-switching filter uuf_filter
```

3. Configure a term in the firewall filter for the interface that receives unknown unicast packets (the interface specified in Step 1) to discard unknown unicast packets:

```
[edit firewall family ethernet-switching filter filter-name]
user@switch# set term term-name from interface interface-name
user@switch# set term term-name from traffic-type unknown-unicast
user@switch# set term term-name then discard
```

For example:

```
[edit firewall family ethernet-switching filter uuf_filter]
user@switch# set term source-drop from interface ge-3/1/7.0
user@switch# set term source-drop from traffic-type unknown-unicast
user@switch# set term source-drop then discard
```

4. Configure a term in the firewall filter for unknown unicast packets to be flooded to the interface enabled for unknown unicast forwarding by using **next-hop-group** (in step 1):

```
[edit firewall family ethernet-switching filter filter-name]
user@switch# set term term-name from traffic-type unknown-unicast
user@switch# set term term-name then next-hop-group group-name
```

For example:

```
[edit firewall family ethernet-switching filter uuf_filter]
user@switch# set term uuf-flood from traffic-type unknown-unicast
user@switch# set term uuf-flood then next-hop-group uuf-nhg
```

5. Configure a default term for the firewall filter to forward packets other than unknown unicast packets:

```
[edit firewall family ethernet-switching filter filter-name]
user@switch# set term term-name then accept
```

For example:

```
[edit firewall family ethernet-switching filter uuf_filter]
user@switch# set term fwd-default then accept
```

6. Apply the filter as a flood filter on the VLAN that includes the interface which will receive unknown unicast packets:

```
[edit vlans vlan-name]
user@switch# set forwarding-options flood input filter-name
```

For example:

```
[edit vlans v1]
user@switch# set forwarding-options flood input uuf_filter
```

Related Documentation

- [Understanding Unknown Unicast Forwarding on page 129](#)
- [Verifying That Unknown Unicast Packets Are Forwarded to a Single Interface](#)

PART 5

Configuration Statements and Operational Commands

- [Configuration Statements \(Firewall Filters\) on page 135](#)
- [Configuration Statements \(Policers\) on page 145](#)
- [Configuration Statements \(Device Security\) on page 165](#)
- [Configuration Statements \(Port Security\) on page 177](#)
- [Operational Commands \(Firewall Filters\) on page 191](#)
- [Operational Commands \(Port Security\) on page 203](#)

CHAPTER 5

Configuration Statements (Firewall Filters)

- [family on page 136](#)
- [filter on page 137](#)
- [filter \(Layer 2 and Layer 3 Interfaces\) on page 138](#)
- [filter \(VLANs\) on page 139](#)
- [firewall on page 140](#)
- [from on page 141](#)
- [interface-specific on page 142](#)
- [term on page 143](#)
- [then \(Filters\) on page 144](#)

family

Syntax	<pre> family <i>family-name</i> { filter <i>filter-name</i> { interface-specific; term <i>term-name</i> { from { match-conditions; } then { action; action-modifiers; } } } } </pre>
Hierarchy Level	[edit firewall]
Release Information	<p>Statement introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p> <p>evpn options introduced in Junos OS Release 15.1 for the MX Series.</p>
Description	Configure the fields a firewall filter can match on.
Options	<p><i>family-name</i>—Type of addressing protocol:</p> <ul style="list-style-type: none"> • ethernet-switching—Filter Layer 2 Ethernet packets and Layer 3 (IP) packets (allows some Layer 3 filtering). Not supported on OCX Series switches. • evpn—Filter Ethernet VPN (EVPN) packets. • inet—Filter Layer 3 IPv4 packets (provides additional Layer 3 filter options). • inet6—Filter Layer 3 IPv6 packets (provides additional Layer 3 filter options). • mpls—Filter multiprotocol label switched packets. Not supported on OCX Series switches. <p>The remaining statements are explained separately.</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Firewall Filter Match Conditions and Actions on page 12 • Configuring Firewall Filters on page 35 • Overview of Firewall Filters on page 3

filter

Syntax	<pre>filter <i>filter-name</i> { <i>interface-specific</i>; term <i>term-name</i> { from { <i>match-conditions</i>; } then { <i>action</i>; <i>action-modifiers</i>; } } }</pre>
Hierarchy Level	[edit firewall family <i>family-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure firewall filters.
Options	<p><i>filter-name</i>—Name that identifies the filter. The name can contain letters, numbers, and hyphens (-), and can be up to 64 characters long. To include spaces in the name, enclose it in quotation marks.</p> <p>The remaining statements are explained separately.</p>
Required Privilege Level	<p>firewall—To view this statement in the configuration.</p> <p>firewall-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Firewall Filter Match Conditions and Actions on page 12 • Configuring Firewall Filters on page 35 • Overview of Firewall Filters on page 3

filter (Layer 2 and Layer 3 Interfaces)

Syntax	<code>filter (input output) <i>filter-name</i>;</code>
Hierarchy Level	[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family <i>family-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series.
Description	Apply a firewall filter to traffic transiting a port or Layer 3 interface.
Default	All incoming traffic is accepted unmodified on the port or Layer 3 interface, and all outgoing traffic is sent unmodified from the port or Layer 3 interface.
Options	<p><i>filter-name</i>—Name of a firewall filter defined at the [edit firewall family <i>family-name</i> filter] hierarchy level.</p> <p>input—Apply a firewall filter to traffic entering the port or Layer 3 interface.</p> <p>output—Apply a firewall filter to traffic exiting the port or Layer 3 interface.</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none">Configuring Gigabit Ethernet Interfaces (CLI Procedure)Configuring Firewall Filters on page 35Overview of Firewall Filters on page 3

filter (VLANs)

Syntax	<code>filter (input output) <i>filter-name</i>;</code>
Hierarchy Level	<code>[edit vlans <i>vlan-name</i>],</code> <code>[edit vlans <i>vlan-name</i> forwarding-options]</code>
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
Description	Apply a firewall filter to traffic entering or exiting a VLAN.
Default	All incoming traffic is accepted unmodified to a VLAN, and all outgoing traffic is sent unmodified from a VLAN.
Options	<p><i>filter-name</i>—Name of a firewall filter defined at the <code>[edit firewall family <i>family-name</i> filter]</code> hierarchy level.</p> <p>input—Apply a firewall filter to VLAN ingress traffic.</p> <p>output—Apply a firewall filter to VLAN egress traffic.</p>
Required Privilege Level	<p>interface—To view this statement in the configuration.</p> <p>interface-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Configuring Firewall Filters on page 35 • Overview of Firewall Filters on page 3

firewall

```

Syntax  firewall {
        family family-name {
            filter filter-name {
                interface-specific;
                term term-name {
                    from {
                        match-conditions;
                    }
                    then {
                        action;
                        action-modifiers;
                    }
                }
            }
        }
        policer policer-name {
            filter-specific;
            if-exceeding {
                bandwidth-limit bps;
                burst-size-limit bytes;
            }
            then {
                policer-action;
            }
        }
        three-color-policer policer-name {
            action {
                loss-priority high then discard;
            }
            single-rate {
                (color-aware | color-blind);
                committed-information-rate bps;
                committed-burst-size bytes;
                excess-burst-size bytes;
            }
            two-rate {
                (color-aware | color-blind);
                committed-information-rate bps;
                committed-burst-size bytes;
                peak-information-rate bps;
                peak-burst-size bytes;
            }
        }
    }

```

Hierarchy Level [\[edit\]](#)

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description Configure firewall filters and policers.

The remaining statements are explained separately.

Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Firewall Filter Match Conditions and Actions on page 12 • Configuring Firewall Filters on page 35 • Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73 • Overview of Firewall Filters on page 3

from

Syntax	from { <i>match-conditions</i> ; }
Hierarchy Level	[edit firewall family <i>family-name</i> filter <i>filter-name</i> term <i>term-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Match packet fields to values specified in a match condition. If the from statement is not included in a firewall filter configuration, all packets are considered to match and the actions and action modifiers in the then statement are implemented.
Options	<i>match-conditions</i> —Conditions that define the values or fields that the incoming or outgoing packets must contain for a match. You can specify one or more match conditions. If you specify more than one, they all must match for a match to occur and for the action in the then statement to be implemented.
Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Firewall Filter Match Conditions and Actions on page 12 • Configuring Firewall Filters on page 35 • Understanding Firewall Filter Match Conditions on page 9

interface-specific

Syntax	interface-specific;
Hierarchy Level	[edit firewall family <i>family-name</i> filter <i>filter-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure separate counters for each interface to which a filter is applied.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Firewall Filter Match Conditions and Actions on page 12• Configuring Firewall Filters on page 35• Overview of Firewall Filters on page 3

term

Syntax	<pre>term <i>term-name</i> { from { <i>match-conditions</i>; } then { <i>action</i>; <i>action-modifiers</i>; } }</pre>
Hierarchy Level	[edit firewall family <i>family-name</i> filter <i>filter-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Define a firewall filter term.
Options	<p><i>term-name</i>—Name that identifies the term. The name can contain letters, numbers, and hyphens (-), and can be up to 64 characters long. To include spaces in the name, enclose it in quotation marks.</p> <p>The remaining statements are explained separately.</p>
Required Privilege Level	<p>firewall—To view this statement in the configuration.</p> <p>firewall-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Firewall Filter Match Conditions and Actions on page 12 • Configuring Firewall Filters on page 35 • Overview of Firewall Filters on page 3

then (Filters)

Syntax	<pre>then { action; action-modifiers; }</pre>
Hierarchy Level	[edit firewall family <i>family-name</i> filter <i>filter-name</i> term <i>term-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure a firewall filter action.
Options	<p>action—Actions to accept, discard, or forward packets that match all conditions specified in a filter term.</p> <p>action-modifiers—Additional actions to analyze, classify, count, or police packets that match all conditions specified in a filter term.</p>
Required Privilege Level	<p>firewall—To view this statement in the configuration.</p> <p>firewall-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none">• Firewall Filter Match Conditions and Actions on page 12• Configuring Firewall Filters on page 35• Understanding Firewall Filter Match Conditions on page 9

CHAPTER 6

Configuration Statements (Policers)

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- [three-color-policer on page 162](#)
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action

Syntax	<code>action { loss-priority high then discard; }</code>
Hierarchy Level	[edit <code>firewall three-color-policer name</code>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Discard traffic on a logical interface using tricolor marking policing.
Options	The statements are explained separately.
Required Privilege Level	<code>firewall</code> —To view this statement in the configuration. <code>firewall-control</code> —To add this statement to the configuration.

bandwidth-limit

Syntax	<code>bandwidth-limit bps;</code>
Hierarchy Level	[edit <code>firewall policer policer-name if-exceeding</code>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Specify the traffic rate in bits per second.
Options	<code>bps</code> —Traffic rate in bits per second. Specify <code>bps</code> as a decimal value or as a decimal number followed by one of the abbreviation <code>k</code> (1000), <code>m</code> (1,000,000), or <code>g</code> (1,000,000,000). Range: 32000 bps (32 Kbps) through 10,000,000,000 bps (10 Gbps)
Required Privilege Level	<code>firewall</code> —To view this statement in the configuration. <code>firewall-control</code> —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73• Overview of Policers on page 55

burst-size-limit

Syntax	<code>burst-size-limit bytes;</code>
Hierarchy Level	[edit <code>firewall policer policer-name if-exceeding</code>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Specify the maximum allowed burst size to control the amount of traffic bursting.
Options	bytes —Decimal value or a decimal number followed by k (thousand), m (million), or g (giga). Range: 1 through 2,147,450,880 bytes (2147 MB)
Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73• Overview of Policers on page 55

color-aware

Syntax	color-aware;
Hierarchy Level	[edit firewall three-color-policer <i>policer-name</i> single-rate], [edit firewall three-color-policer <i>policer-name</i> two-rate]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure the way preclassified packets are metered. In color-aware mode, the switch can assign a higher packet-loss priority, but cannot assign a lower packet loss priority (PLP). For example, suppose an upstream device assigns medium-high PLP to a packet because the packet exceeded its committed information rate (CIR). The switch cannot change the PLP to low even if the packet conforms to the configured CIR of the appropriate interface. On the other hand, if an upstream device assigns low PLP to a packet but the packet exceeds the CIR and committed burst size (CBS) of the switch interface, the switch can increase the PLP to medium-high.
Default	If you omit the color-aware statement, the default behavior is color-aware mode.
Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Overview of Policers on page 55• Understanding Color-Aware Mode for Single-Rate Tricolor Marking on page 62• Understanding Color-Aware Mode for Two-Rate Tricolor Marking on page 64• color-blind on page 149

color-blind

Syntax	color-blind;
Hierarchy Level	[edit firewall three-color-policer <i>policer-name</i> single-rate], [edit firewall three-color-policer <i>policer-name</i> two-rate]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure the way preclassified packets are metered. In color-blind mode, the switch ignores any preclassification of packets and can assign a higher or lower packet loss priority (PLP). For example, suppose an upstream device assigns medium-high PLP to a packet because the packet exceeded the CIR on the upstream device. The switch can change the PLP to low if the packet conforms to the CIR of the appropriate interface.
Default	If you omit the color-blind statement, the default behavior is color-aware mode.
Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Overview of Policers on page 55 • Understanding Color-Blind Mode for Single-Rate Tricolor Marking on page 61 • Understanding Color-Blind Mode for Two-Rate Tricolor Marking on page 64 • Configuring Color-Blind Egress Policers for Medium-Low PLP on page 72 • color-aware on page 148

committed-burst-size


Syntax	<code>committed-burst-size bytes;</code>
Hierarchy Level	[edit firewall three-color-policer policer-name single-rate], [edit firewall three-color-policer policer-name two-rate]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure the maximum number of bytes allowed for incoming traffic to burst above the committed information rate and still be marked with low packet loss priority (green).




NOTE: When you include the `committed-burst-size` statement in the configuration, you must also include the `committed-information-rate` statement at the same hierarchy level.

Options	bytes —Number of bytes. You can specify a value in bytes either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). Range: 512 bytes through 268435456 bytes (268 MB)
Required Privilege Level	<code>firewall</code> —To view this statement in the configuration. <code>firewall-control</code> —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73• Overview of Policers on page 55

committed-information-rate

Syntax	<code>committed-information-rate <i>bits-per-second</i>;</code>
Hierarchy Level	[edit <code>firewall three-color-policer <i>policer-name</i> single-rate</code>], [edit <code>firewall three-color-policer <i>policer-name</i> two-rate</code>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure the guaranteed bandwidth under normal line conditions and the average rate up to which packets are marked with low packet loss priority (green).
<div>  <p>NOTE: When you include the <code>committed-information-rate</code> statement in the configuration, you must also include the <code>committed-burst-size</code> statement at the same hierarchy level.</p> </div>	
Options	<p><i>bits-per-second</i>—Number of bits per second. You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000).</p> <p>Range: 32,000 bps through 10,000,000,000 bps (10 gbps)</p>
Required Privilege Level	<p><code>firewall</code>—To view this statement in the configuration.</p> <p><code>firewall-control</code>—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73 • Overview of Policers on page 55

excess-burst-size

Syntax	<code>excess-burst-size bytes;</code>
Hierarchy Level	[edit <code>firewall three-color-policer policer-name</code> single-rate]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure the maximum number of bytes allowed for incoming traffic to burst above the committed information rate and still be marked with medium-high packet loss priority (yellow). Packets that exceed the excess burst size (EBS) are marked with high packet loss priority (red).
<div> NOTE: When you include the <code>excess-burst-size</code> statement in the configuration, you must also include the <code>committed-burst-size</code> and <code>committed-information-rate</code> statements at the same hierarchy level.</div>	
Options	bytes —Number of bytes. You can specify a value in bytes either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). Range: 512 bytes through 268435456 bytes (268 MB)
Required Privilege Level	<code>firewall</code> —To view this statement in the configuration. <code>firewall-control</code> —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73• Overview of Policers on page 55

filter-specific

Syntax	filter-specific;
Hierarchy Level	[edit firewall policer <i>policer-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	<p>Configure a policer to be filter-specific, which means that Junos OS creates only one policer instance regardless of how many times the policer is referenced. If you use a filter-specific policer in multiple terms, both of the following are true:</p> <ul style="list-style-type: none"> • Traffic is policed at the aggregate rate. For example, if you create a policer that has a bandwidth limit of 100 Mbps and use the policer in two terms, the total allowed bandwidth for both terms is 100 Mbps—not 100 Mbps for each term. • The implicit counter counts all the packets are that matched by any of the terms. For example, if you reference the same filter-specific policer in term1 and term2, and term1 matches 1000 packets and term2 matches 500 packets, the implicit counter shows 1500 matches for the policer.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration
Related Documentation	<ul style="list-style-type: none"> • Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73 • Overview of Policers on page 55

firewall

```
Syntax  firewall {
        family family-name {
            filter filter-name {
                interface-specific;
                term term-name {
                    from {
                        match-conditions;
                    }
                    then {
                        action;
                        action-modifiers;
                    }
                }
            }
        }
        policer policer-name {
            filter-specific;
            if-exceeding {
                bandwidth-limit bps;
                burst-size-limit bytes;
            }
            then {
                policer-action;
            }
        }
        three-color-policer policer-name {
            action {
                loss-priority high then discard;
            }
            single-rate {
                (color-aware | color-blind);
                committed-information-rate bps;
                committed-burst-size bytes;
                excess-burst-size bytes;
            }
            two-rate {
                (color-aware | color-blind);
                committed-information-rate bps;
                committed-burst-size bytes;
                peak-information-rate bps;
                peak-burst-size bytes;
            }
        }
    }
```

Hierarchy Level [\[edit\]](#)

Release Information Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description Configure firewall filters and policers.

The remaining statements are explained separately.

Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Firewall Filter Match Conditions and Actions on page 12 • Configuring Firewall Filters on page 35 • Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73 • Overview of Firewall Filters on page 3


if-exceeding

Syntax	<pre>if-exceeding { bandwidth-limit <i>bps</i>; burst-size-limit <i>bytes</i>; }</pre>
Hierarchy Level	[edit firewall policer <i>policer-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure policer rate limits. The remaining statements are explained separately.
Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73 • Overview of Policers on page 55


loss-priority high then discard (Three-Color Policer)

Syntax	loss-priority high then discard;
Hierarchy Level	[edit firewall three-color-policer <i>policer-name</i> action]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	<p>For packets with high loss priority, discard the packets. The loss priority setting is not configurable. Include this statement if you do not want the switch to forward packets that have high packet-loss priority.</p> <p>For single-rate three-color policers, Junos OS assigns high loss priority to packets that exceed the committed information rate and the excess burst size.</p> <p>For two-rate three-color policers, Junos OS assigns high loss priority to packets that exceed the peak information rate and the peak burst size.</p>
Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73• Overview of Policers on page 55

peak-burst-size

Syntax	<code>peak-burst-size bytes;</code>
Hierarchy Level	[edit firewall three-color-policer <i>policer-name</i> two-rate]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure the maximum number of bytes allowed for incoming packets to burst above the peak information rate (PIR) and still be marked with medium-high packet loss priority (yellow). Packets that exceed the peak burst size (PBS) are marked with high packet loss priority (red).
<div>  <p>NOTE: When you include the <code>peak-burst-size</code> statement in the configuration, you must also include the <code>committed-burst-size</code> and <code>peak-information-rate</code> statements at the same hierarchy level.</p> </div>	
Options	<p>bytes—Number of bytes. You can specify a value in bytes either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000).</p> <p>Range: 1500 bytes through 100,000,000,000 bytes (100 GB)</p>
Required Privilege Level	<p>firewall—To view this statement in the configuration.</p> <p>firewall-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73 • Overview of Policers on page 55

peak-information-rate

Syntax	<code>peak-information-rate <i>bits-per-second</i>;</code>
Hierarchy Level	[edit <code>firewall three-color-policer policer-name two-rate</code>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure the maximum achievable rate. Packets that exceed the committed information rate (CIR) but are below the peak information rate (PIR) are marked with medium-high packet loss priority (yellow). Packets that exceed the PIR are marked with high packet loss priority (red). You can configure a discard action for packets that exceed the PIR.
<div> NOTE: When you include the <code>peak-information-rate</code> statement in the configuration, you must also include the <code>committed-information-rate</code> and <code>peak-burst-size</code> statements at the same hierarchy level.</div>	
Options	<i>bits-per-second</i> —Number of bits per second. You can specify a value in bits per second either as a complete decimal number or as a decimal number followed by the abbreviation k (1000), m (1,000,000), or g (1,000,000,000). Range: 32,000 bps through 10,000,000,000 bps (10 gbps)
Required Privilege Level	<code>firewall</code> —To view this statement in the configuration. <code>firewall-control</code> —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73• Overview of Policers on page 55


policer

Syntax	<pre> policer <i>policer-name</i> { filter-specific; if-exceeding { bandwidth-limit <i>bps</i>; burst-size-limit <i>bytes</i>; } then { <i>policer-action</i>; } } </pre>
Hierarchy Level	[edit firewall]
Release Information	<p>Statement introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	<p>Configure policer rate limits and actions. To activate a policer, you must include the policer action modifier in the then statement in a firewall filter term.</p> <p>Each policer that you configure includes an implicit counter that counts the number of packets that exceed the rate limits that are specified for the policer. If you use the same policer in multiple terms—either within the same filter or across filters—the policer’s implicit counter is used to count packets that are policed in all of these terms. If you want to obtain separate packet counts for each term, use these approaches:</p> <ul style="list-style-type: none"> • Configure a unique policer for each term. • Configure only one policer, but use a unique, explicit counter in each term.
Options	<p><i>policer-name</i>—Name that identifies the policer. The name can contain letters, numbers, hyphens (-), and can be up to 64 characters long.</p> <p>The remaining statements are explained separately.</p>
Required Privilege Level	<p>firewall—To view this statement in the configuration.</p> <p>firewall-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73 • Configuring Firewall Filters on page 35 • Overview of Policers on page 55

single-rate

Syntax	<pre>single-rate { (color-aware color-blind); committed-information-rate <i>bps</i>; committed-burst-size <i>bytes</i>; excess-burst-size <i>bytes</i>; }</pre>
Hierarchy Level	[edit firewall three-color-policer <i>policer-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	<p>Configure a single-rate three-color policer in which marking is based on the committed information rate (CIR), committed burst size (CBS), and excess burst size (EBS).</p> <p>Packets that conform to the CIR or the CBS are assigned low loss priority (green). Packets that exceed the CIR and the CBS but are within the EBS are assigned medium-high loss priority (yellow). Packets that exceed the EBS are assigned high loss priority (red).</p> <p>Green and yellow packets are always forwarded; this action is not configurable. You can configure red packets to be discarded. By default, red packets are forwarded.</p> <p>The remaining statements are explained separately.</p>
Options	<i>policer-name</i> —Name of the three-color policer. Use this name when you apply the policer to an interface.
Required Privilege Level	firewall —To view this statement in the configuration. firewall-control —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73• Overview of Policers on page 55

then (Policers)

Syntax	then { <i>policer-action</i> ; }
Hierarchy Level	[edit firewall policer <i>policer-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure a policer action.
Options	<i>policer-action</i> —Allowed policer actions are discard , loss-priority high , and loss-priority low . discard causes the system to drop traffic that exceeds the rate limits defined by the policer. Use loss-priority high to allow the system to forward matching traffic in some cases.
<div>  NOTE: If you specify a policer in an egress firewall filter, the only supported action is discard. </div>	
Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73 • Configuring Firewall Filters on page 35 • Overview of Policers on page 55

three-color-policer

Syntax	<pre> three-color-policer <i>policer-name</i> { action { loss-priority high then discard; } single-rate { (color-aware color-blind); committed-information-rate <i>bps</i>; committed-burst-size <i>bytes</i>; excess-burst-size <i>bytes</i>; } two-rate { (color-aware color-blind); committed-information-rate <i>bps</i>; committed-burst-size <i>bytes</i>; peak-information-rate <i>bps</i>; peak-burst-size <i>bytes</i>; } } </pre>
Hierarchy Level	[edit firewall], [edit logical-systems <i>logical-system-name</i> firewall]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Configure a three-color policer.
Options	<p><i>policer-name</i>—Name of the three-color policer. Use this name when you apply the policer to an interface.</p> <p>The remaining statements are explained separately.</p>
Required Privilege Level	firewall—To view this statement in the configuration. firewall-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> Configuring Two-Color and Three-Color Policers to Control Traffic Rates on page 73 Overview of Policers on page 55

two-rate

Syntax	<pre>two-rate { (color-aware color-blind); committed-information-rate <i>bps</i>; committed-burst-size <i>bytes</i>; peak-information-rate <i>bps</i>; peak-burst-size <i>bytes</i>; }</pre>
Hierarchy Level	[edit firewall three-color-policer <i>policer-name</i>]
Release Information	<p>Statement introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	<p>Configure a two-rate three-color policer in which marking is based on the committed information rate (CIR), committed burst size (CBS), peak information rate (PIR), and peak burst size (PBS).</p> <p>Packets that conform to the CIR or the CBS are assigned low loss priority (green). Packets that exceed the CIR and the CBS but are within the PIR or the PBS are assigned medium-high loss priority (yellow). Packets that exceed the PIR and the PBS are assigned high loss priority (red).</p> <p>Green and yellow packets are always forwarded; this action is not configurable. You can configure red packets to be discarded. By default, red packets are forwarded.</p> <p>The remaining statements are explained separately.</p>
Required Privilege Level	<p>firewall—To view this statement in the configuration.</p> <p>firewall-control—To add this statement to the configuration.</p>

CHAPTER 7


Configuration Statements (Device Security)

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action-shutdown

Syntax	action-shutdown;
Hierarchy Level	For platforms without ELS: [edit ethernet-switching-options storm-control] For platforms with ELS: [edit forwarding-options storm-control-profiles]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series.
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 affected interfaces are disabled temporarily and recover automatically when the disable timeout expires.• If you set the action-shutdown statement and do not set the port-error-disable statement, the affected interfaces are shut down when the storm control level is exceeded, and they do not recover automatically. 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 feature is disabled. If the storm control level is exceeded, the switch drops broadcast and unknown unicast messages on the specified interfaces.
Required Privilege Level	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Understanding Storm Control on page 115• <i>Example: Configuring Storm Control to Prevent Network Outages</i>• port-error-disable on page 186• clear ethernet-switching port-error on page 206

bandwidth-level

Syntax	<code>bandwidth-level <i>kbps</i>;</code>
Hierarchy Level	[edit forwarding-options storm-control-profiles <i>profile-name</i> all]
Release Information	Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches. Statement introduced in Junos OS Release 13.2 for the QFX Series. Statement introduced in Junos OS Release 14.1 for MX Series routers.
Description	Configure the storm control level as the bandwidth in kilobits per second of the available bandwidth used by the combined broadcast, multicast, and unknown unicast traffic streams.
<div>  <p>NOTE: When you configure storm control level on an aggregated Ethernet interface, the storm control level for each member of the aggregated Ethernet interface is set to that bandwidth. For example, if you configure a storm control level of 15,000 Kbps on ae1, and ae1 has two members, ge-0/0/0 and ge-0/0/1, each member has a storm control level of 15,000 Kbps. Thus, the storm control level on ae1 allows a traffic rate of up to 30,000 Kbps of combined broadcast, multicast, and unknown unicast traffic.</p> </div>	
Default	<p>On EX4300 switches—If you do not specify the storm control level using either the bandwidth-level or the bandwidth-percentage statements, the storm control level defaults to 80 percent of the available bandwidth used by the combined broadcast, unknown unicast, and multicast traffic streams.</p> <p>On EX9200 switches—Storm control is not enabled by default.</p> <p>On MX Series routers—Storm control is not enabled by default.</p>
Options	<p>bandwidth-level <i>kbps</i>—Traffic rate in kilobits per second of the combined broadcast, multicast, and unknown unicast traffic streams.</p> <p>Range: 100 through 10,000,000</p> <p>Range: 100 through 100,000,000 on QFX10000 Series switches</p> <p>Default: None</p>
Required Privilege Level	<p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • bandwidth-percentage on page 168 • <i>Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches</i> • <i>Example: Configuring Storm Control to Prevent Network Outages on MX Series Routers</i> • <i>Configuring or Disabling Storm Control (CLI Procedure)</i>

bandwidth-percentage

Syntax	<code>bandwidth-percentage percentage;</code>
Hierarchy Level	[edit forwarding-options storm-control-profiles <i>profile-name</i> all]
Release Information	Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches. Statement introduced in Junos OS Release 13.2 for the QFX series. Statement introduced in Junos OS Release 14.1 for MX Series routers.
Description	Configure the storm control level as the percentage of available bandwidth used by the combined broadcast, multicast, and unknown unicast traffic streams on an interface. The storm control level is configured as part of the storm control profile.
<div>  <p>NOTE: When you configure storm control level on an aggregated Ethernet interface, the storm control level for each member of the aggregated Ethernet interface is set to that bandwidth. For example, if you configure a storm control level of 15,000 Kbps on ae1, and ae1 has two members, ge-0/0/0 and ge-0/0/1, each member has a storm control level of 15,000 Kbps. Thus, the storm control level on ae1 allows a traffic rate of up to 30,000 Kbps of combined broadcast, multicast, and unknown unicast traffic.</p> </div>	
Default	<p>On EX4300 switches—The storm control level is 80 percent of the available bandwidth used by the combined broadcast, unknown unicast, and multicast traffic streams.</p> <p>On EX9200 switches—Storm control is not enabled by default.</p> <p>On MX Series routers—Storm control is not enabled by default.</p>
Required Privilege Level	<p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • bandwidth-level on page 167 • <i>Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches</i> • <i>Example: Configuring Storm Control to Prevent Network Outages on MX Series Routers</i> • <i>Configuring or Disabling Storm Control (CLI Procedure)</i>

interface (Unknown Unicast Forwarding)

Syntax	<code>interface <i>interface-name</i>;</code>
Hierarchy Level	<ul style="list-style-type: none"> For platforms with ELS: [edit switch-options unknown-unicast-forwarding vlan <i>vlan-name</i>] For platforms without ELS: [edit ethernet-switching-options unknown-unicast-forwarding vlan <i>vlan-name</i>]
Release Information	<p>Statement introduced in Junos OS Release 9.3 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 13.2 for the QFX Series.</p> <p>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p> <p>Hierarchy level [edit switch-options] introduced in Junos OS Release 13.2X50-D10. (See <i>Getting Started with Enhanced Layer 2 Software</i> for information about ELS.)</p>
Description	Specify the interface to which unknown unicast packets will be forwarded.
Required Privilege Level	<p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> <code>show vlans</code> <code>show ethernet-switching table</code> <i>Configuring Unknown Unicast Forwarding (CLI Procedure)</i> Understanding Unknown Unicast Forwarding on page 129

no-broadcast

Syntax	no-broadcast;
Hierarchy Level	For platforms without ELS: [edit ethernet-switching-options storm-control interface (all <i>interface-name</i>)] For platforms with ELS: [edit forwarding-options storm-control-profiles]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
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 broadcast traffic (as well as multicast and unknown unicast traffic).
Required Privilege Level	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Understanding Storm Control on page 115• <i>Example: Configuring Storm Control to Prevent Network Outages</i>

no-multicast

Syntax	no-multicast;
Hierarchy Level	<p>For platforms without ELS:</p> <p>[edit ethernet-switching-options storm-control interface (all <i>interface-name</i>)]</p> <p>For platforms with ELS:</p> <p>[edit forwarding-options storm-control-profiles]</p>
Release Information	<p>Statement introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	Disable storm control for all multicast traffic (both registered multicast and unregistered multicast) for the specified interface or for all interfaces.
Default	Storm control is enabled for unknown unicast traffic, multicast traffic, and broadcast traffic.
Required Privilege Level	<p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> • Understanding Storm Control on page 115 • <i>Example: Configuring Storm Control to Prevent Network Outages</i>


no-unknown-unicast

Syntax	no-unknown-unicast;
Hierarchy Level	For platforms without ELS: [edit ethernet-switching-options storm-control interface (all <i>interface-name</i>)] For platforms with ELS: [edit forwarding-options storm-control-profiles]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
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 Documentation	<ul style="list-style-type: none">• Understanding Storm Control on page 115• <i>Example: Configuring Storm Control to Prevent Network Outages</i>

rpf-check

Syntax	rpf-check;
Hierarchy Level	[edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet], [edit interfaces <i>interface-name</i> unit <i>logical-unit-number</i> family inet6]
Release Information	Statement introduced in Junos OS Release 9.3 for EX Series switches. Statement introduced in Junos OS Release 13.2 for the QFX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	<p>On EX3200 and EX4200 switches, enable a reverse-path forwarding (RPF) check on unicast traffic (except ECMP packets) on all ingress interfaces.</p> <p>On EX4300 switches, enable a reverse-path forwarding (RPF) check on unicast traffic, including ECMP packets, on all ingress interfaces.</p> <p>On EX8200 and EX6200 switches, enable an RPF check on unicast traffic, including ECMP packets, on the selected ingress interfaces.</p> <p>On QFX Series switches, enable an RPF check on unicast traffic (except ECMP packets) on the selected ingress interfaces.</p>
Default	Unicast RPF is disabled on all interfaces.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • <i>Example: Configuring Unicast RPF on an EX Series Switch</i> • Configuring Unicast RPF (CLI Procedure) on page 124 • Disabling Unicast RPF (CLI Procedure) on page 125 • Understanding Unicast RPF on page 120

storm-control

Syntax	<code>storm-control storm-control-profile;</code>
Hierarchy Level	[edit interfaces <i>interface-name</i> unit <i>number</i> family ethernet-switching], [edit interfaces <i>interface-name</i> unit <i>number</i> family bridge] [edit interfaces <i>interface-name</i> ether-options ethernet-switch-profile]
Release Information	Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches. Statement introduced in Junos OS Release 13.2 for the QFX series. Statement introduced in Junos OS Release 14.1 for the MX Series routers.
Description	<p>Bind a storm control profile to a logical interface.</p> <p>On switches running ELS software, storm control is enabled by default on all switch interfaces at a level of 80 percent of the combined broadcast and unknown unicast streams. (For the equivalent statement for platforms running non-ELS software, see <i>storm-control</i>.)</p>
<div> NOTE: If you configure storm control on an aggregated Ethernet interface, the storm-control level is applied to each member interface individually. For example, if the aggregated interface has two members and you configure a storm-control level of 20 kbps, Junos will not detect a storm if one or both of the member interfaces receives traffic at 15 kbps because in neither of these cases does an individual member receive traffic at a rate greater than the configured storm-control level. In this example, Junos detects a storm only if at least one member interface receives traffic at greater than 20 Kbps.</div>	
Required Privilege Level	system—To view this statement in the configuration. system-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• <i>Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches</i>• <i>Understanding Storm Control for Managing Traffic Levels on Switching Devices</i>

storm-control-profiles

Syntax `storm-control-profiles profile-name {
 action-shutdown;
 all {
 bandwidth-level;
 bandwidth-percentage;
 no-broadcast;
 no-multicast;
 no-registered-multicast;
 no-unknown-unicast;
 no-unregistered-multicast;
 }
 }`

Hierarchy Level [edit forwarding-options]

Release Information Statement introduced in Junos OS Release 13.2X50-D10 for EX Series switches.
 Statement introduced in Junos OS Release 13.2 for the QFX Series.
 Statement introduced in Junos OS Release 14.1 for MX Series routers.

Description Configure a storm control profile on a switch or router. Storm control is used to prevent network outages that are caused by broadcast traffic storms. Storm control enables the switching device to monitor traffic levels and to drop broadcast, multicast, and unknown unicast packets when a specified traffic level—called the storm control level or storm control bandwidth—is exceeded, thus preventing packets from proliferating and degrading the LAN.



NOTE: The name of the storm control profile can contain no more than 127 characters.


The remaining statements are explained separately.

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

Related Documentation

- *Example: Configuring Storm Control to Prevent Network Outages on EX Series Switches*
- *Understanding Storm Control for Managing Traffic Levels on Switching Devices*

unknown-unicast-forwarding


Syntax	<pre>unknown-unicast-forwarding { vlan (Unknown Unicast Forwarding) (all <i>vlan-name</i>){ interface (Unknown Unicast Forwarding) <i>interface-name</i>; } }</pre>
Hierarchy Level	<ul style="list-style-type: none"> For platforms with ELS: [edit switch-options] For platforms without ELS: [edit ethernet-switching-options]
Release Information	<p>Statement introduced in Junos OS Release 9.3 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 13.2 for the QFX Series.</p> <p>Hierarchy level [edit switch-options] introduced in Junos OS Release 13.2X50-D10. (See <i>Getting Started with Enhanced Layer 2 Software</i> for information about ELS.)</p> <p>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	Configure the switch to forward all unknown unicast packets in a VLAN or on all VLANs to a particular interface.
<div style="display: flex; align-items: center;">  <div> <p>NOTE: Before you can configure unknown unicast forwarding within a VLAN, you must first configure that VLAN.</p> </div> </div> <p>The remaining statements are explained separately.</p>	
Default	Unknown unicast packets are flooded to all interfaces that belong to the same VLAN.
Required Privilege Level	<p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>
Related Documentation	<ul style="list-style-type: none"> <i>show vlans</i> <i>show ethernet-switching table</i> <i>Configuring Unknown Unicast Forwarding (CLI Procedure)</i> Understanding Unknown Unicast Forwarding on page 129

CHAPTER 8

Configuration Statements (Port Security)

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- [persistent-learning on page 185](#)
- [port-error-disable on page 186](#)
- [vendor-id on page 188](#)
- [write-interval on page 189](#)

circuit-id

Syntax	<pre> circuit-id { prefix { host-name; logical-system-name; routing-instance-name; } use-interface-description (device logical); use-vlan-id; } </pre>
Hierarchy Level	<ul style="list-style-type: none"> For platforms with Enhanced Layer 2 Software (ELS): [edit vlans <i>vlan-name</i> forwarding-options dhcp-security option-82] For platforms without ELS: [edit ethernet-switching-options secure-access-port vlan (all <i>vlan-name</i>) dhcp-option82], [edit forwarding-options helpers bootp dhcp-option82] , [edit forwarding-options helpers bootp interface <i>interface-name</i> dhcp-option82] For MX Series platforms: [edit bridge-domains <i>bridge-domain-name</i> forwarding-options dhcp-security option-82]
Release Information	<p>Statement introduced in Junos OS Release 9.3 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 11.3 for the QFX Series.</p> <p>Hierarchy level [edit vlans <i>vlan-name</i> forwarding-options dhcp-security] introduced in Junos OS Release 13.2X50-D10. (See <i>Getting Started with Enhanced Layer 2 Software</i> for information about ELS.)</p> <p>Statement introduced in Junos OS Release 14.1 for the MX Series.</p> <p>Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.</p>
Description	<p>Configure the circuit-id suboption (suboption 1) of DHCP option 82 (the DHCP relay agent information option) in DHCP packets destined for a DHCP server. This suboption identifies the circuit (the interface, the VLAN, or both) on which the DHCP request arrived.</p> <p>The remaining statements are explained separately.</p>
Default	<p>If DHCP option 82 is enabled on the switch, the circuit ID is supplied by default in the format <i>interface-name:vlan-name</i> or, on a Layer 3 interface, just <i>interface-name</i>.</p>
<div>  <p>NOTE: When you configure circuit-id, remote-id is also enabled, even if you do not explicitly configure remote-id.</p> </div>	
Required Privilege Level	<p>system—To view this statement in the configuration.</p> <p>system-control—To add this statement to the configuration.</p>

Related Documentation	<ul style="list-style-type: none"> • <i>Configuring DHCP Option 82 to Help Protect the Switching Devices Against Attacks (CLI Procedure)</i> • <i>Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server</i> • <i>Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server</i> • <i>Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)</i> • <i>Setting Up DHCP Option 82 with the Switch as a Relay Agent Between Clients and DHCP Server (CLI Procedure)</i> • <i>Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)</i> • RFC 3046, DHCP Relay Agent Information Option, at http://tools.ietf.org/html/rfc3046
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dhcp-snooping-file

Syntax	<pre>dhcp-snooping-file { location <i>local_pathname</i> <i>remote_URL</i>; timeout <i>seconds</i>; write-interval <i>seconds</i>; }</pre>
Hierarchy Level	<p>For platforms without ELS:</p> <pre>[edit ethernet-switching-options secure-access-port]</pre> <p>For platforms with ELS:</p> <pre>[edit system processes] dhcp-service]</pre>
Release Information	Statement introduced in Junos OS Release 12.1 for the QFX Series.
Description	<p>Specify a local pathname or remote URL for the DHCP snooping database file to maintain persistence of IP-MAC bindings.</p> <p>The remaining statements are explained separately.</p>
Default	The IP-MAC bindings in the DHCP snooping database file are not persistent. If the switch is rebooted, the bindings are lost.
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 Documentation	<ul style="list-style-type: none"> • Understanding DHCP Snooping for Monitoring DHCP Messages Received from Untrusted Devices on page 88

fc-map

Syntax `fc-map fc-map-value;`

Hierarchy Level Original CLI

[edit ethernet-switching options secure-access-port vlan (all | *vlan-name*) examine-fip]

ELS CLI for Platforms that Support FCoE

[edit vlans *vlan-name* forwarding-options fip-security]



NOTE: The `fc-map` configuration statement is in a different hierarchy on the original CLI than on the Enhanced Layer 2 Software (ELS) CLI.

QFX Series that Support FCoE-FC Gateway Configuration

[edit fc-fabrics *fc-fabric-name* protocols fip]

Release Information Statement introduced in Junos OS Release 10.4 for EX Series switches.
Statement introduced in Junos OS Release 11.1 for the QFX Series.
Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.

Description Set the FCoE mapped address prefix (FC-MAP) value for the FCoE VLAN to match the FC switch (or FCoE forwarder) FC-MAP value for the FC fabric. The FC-MAP value is a unique MAC address prefix an FC switch uses to identify FCoE traffic for a given FC fabric (traffic on a particular FCoE VLAN).

You can configure the FC-MAP value or use the default value. The default FC-MAP value is different for VN_Port to VF_Port (VN2VF_Port) FIP snooping (0x0EFC00) than for VN_Port to VN_Port (VN2VN_Port) FIP snooping.

The FC switch provides the FC-MAP value to FCoE nodes (ENodes) in the FIP discovery advertisement message. If the EX Series switch or the QFX Series FCoE VLAN FC-MAP value does not match the FC switch FC-MAP value, neither device discovers the FC switch on that VLAN, and the ENodes on that VLAN cannot access the FC switch. The FC switch accepts only FCoE traffic that uses the correct FC-MAP value as part of the VN_Port MAC address.

When the QFX Series acts as an FCoE-FC gateway, the FC-MAP value for the gateway and the FCoE devices must match the FC switch FC-MAP value in order to communicate with the FC switch.



NOTE: Changing the FC-MAP value causes all logins to drop and forces the ENodes to log in again.

Options `fc-map-value`—FC-MAP value, hexadecimal value preceded by "0x".

Range: 0x0EFC00 through 0x0EFCFF


Default: 0x0EFC00 for VN2VF_Port FIP snooping 0x0EFD00 for VN2VN_Port FIP snooping

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


Related Documentation

- *examine-fip*
- *show fip snooping*
- *Example: Configuring an FCoE Transit Switch*
- *Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch*

fcoe-trusted

Syntax	fcoe-trusted;
Hierarchy Level	Original CLI [edit ethernet-switching-options secure-access-port interface <i>interface-name</i>] ELS CLI for Platforms that Support FCoE [edit vlans <i>vlan-name</i> forwarding-options fip-security interface <i>interface-name</i>]
	<div>  <p>NOTE: The fcoe-trusted configuration statement is in a different hierarchy on the original CLI than on the Enhanced Layer 2 Software (ELS) CLI.</p> </div>
	<p>QFX Series that Support FCoE-FC Gateway Configuration</p> <p>[edit fc-fabrics <i>fc-fabric-name</i> protocols fip]</p>
Release Information	<p>Statement introduced in Junos OS Release 10.4 for EX Series switches.</p> <p>Statement introduced in Junos OS Release 11.1 for the QFX Series.</p> <p>Statement introduced for the FC fabric in Junos OS Release 11.3 for the QFX Series.</p> <p>Statement introduced for the ELS CLI in Junos OS Release 13.2 for the QFX Series.</p>
Description	<p>Configure the specified 10-Gigabit Ethernet interface to trust Fibre Channel over Ethernet (FCoE) traffic. If an interface is connected to another switch such as an FCoE forwarder (FCF) or a transit switch, you can configure the interface as trusted so that the interface forwards FCoE traffic from the switch to the FCoE devices without installing FIP snooping filters.</p> <p>(QFX Series FCoE-FC gateway) Configure the specified local Fibre Channel fabric to trust FCoE traffic on all ports in the fabric. Changing the fabric ports from untrusted to trusted removes any existing FIP snooping filters from the ports. Changing the fabric ports from trusted to untrusted by removing the fcoe-trusted configuration from the fabric forces all of the FCoE sessions on those ports to log out so that when the ENodes and VN_Ports log in again, the switch can build the appropriate FIP snooping filters.</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 Documentation	<ul style="list-style-type: none"> • <i>show fip snooping</i> • <i>Example: Configuring an FCoE Transit Switch</i> • <i>Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch</i> • <i>Configuring VN2VF_Port FIP Snooping and FCoE Trusted Interfaces on an FCoE Transit Switch</i>

mac-move-limit

Syntax	<code>mac-move-limit <i>limit</i> <fabric-limit <i>limit</i>> action <i>action</i>;</code>
Hierarchy Level	<p>For platforms without ELS:</p> <pre>[edit ethernet-switching-options secure-access-port (all <i>vlan-name</i>)]</pre> <p>For platforms with ELS:</p> <pre>[edit vlans <i>vlan-name</i> switch-options],</pre>
Release Information	Statement introduced in Junos OS Release 12.1 for the QFX Series.
Description	Specify the number of times a MAC address can move to a new interface (port) in 1 second and the action to be taken by the switch if the MAC address move limit is exceeded.
	<div>  <p>CAUTION: Mac move limiting does not work properly on a QFX5100 switch used as a Node device in a QFabric system. Do not use this feature on a QFX5100 switch in a QFabric system.</p> </div>
Default	The default move limit is unlimited. The default action is drop .
Options	<p>fabric-limit—Specify the maximum number of moves in a QFabric system. If you do not specify a fabric limit, the value for mac-move-limit applies to the QFabric system.</p> <p>limit—Maximum number of moves to a new interface per second.</p> <p>action <i>action</i>—(Optional) Action to take when the MAC address move limit is reached:</p> <ul style="list-style-type: none"> • drop—Drop the packet and generate an alarm, an SNMP trap, or a system log entry. This is the default. • log—Do not drop the packet but generate an alarm, an SNMP trap, or a system log entry. • none—No action. • shutdown—Logically disable the interface and generate a system log entry. If you have configured the switch with the port-error-disable statement, the disabled interfaces recover automatically upon expiration of the specified disable timeout. If you have not configured the switch for autorecovery from port error disabled conditions, you can bring up the disabled interfaces by running the clear-ethernet-switch-port command.
Required Privilege Level	<p>system—To view this statement in the configuration.</p> <p>system—control—To add this statement to the configuration.</p>

- Related Documentation**
- *Example: Configuring Basic Port Security Features*
 - *Configuring MAC Move Limiting (CLI Procedure)*
 - *Configuring Autorecovery From the Disabled State on Secure or Storm Control Interfaces (CLI Procedure)*

no-allowed-mac-log

- Syntax** no-allowed-mac-log;
- Hierarchy Level**
- For platforms without ELS:
[edit ethernet-switching-options secure-access-port interface (all | *interface-name*)]
 - For platforms with ELS:
[edit switch-options interface *interface-name*]
- Release Information** Statement introduced in Junos OS Release 11.1 for the QFX Series.
- Description** Specify that the switch should not log messages when it receives packets from invalid MAC addresses on an interface that has been configured for allowed MAC addresses.
- Default** The switch logs messages when it receives packets from invalid MAC addresses on an interface that has been configured for particular allowed (specific) MAC addresses.
- Required Privilege Level**
- routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.
- Related Documentation**
- [Understanding MAC Limiting and MAC Move Limiting for Port Security on page 99](#)
 - *Configuring MAC Limiting*
 - *mac-limit*


no-gratuitous-arp-request

Syntax	no-gratuitous-arp-request;
Hierarchy Level	[edit interfaces <i>interface-name</i>], [edit interfaces interface-range <i>interface-name</i>]
Release Information	Statement introduced in Junos OS Release 11.1 for the QFX Series.
Description	Configure the switch not to respond to gratuitous ARP requests. You can disable responses to gratuitous ARP requests on both Layer 2 Ethernet switching interfaces and routed VLAN interfaces (RVIs).
Default	Gratuitous ARP responses are enabled on all Ethernet switching interfaces and RVIs.
Required Privilege Level	interface—To view this statement in the configuration. interface-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • <i>Configuring IRB Interfaces</i>

persistent-learning

Syntax	persistent-learning;
Hierarchy Level	<ul style="list-style-type: none"> • For platforms without ELS: [edit ethernet-switching-options secure-access-port interface (all <i>interface-name</i>)] • For platforms with ELS: [edit switch-options interface <i>interface-name</i>]
Release Information	Statement introduced in Junos OS Release 11.4 for EX Series switches. Statement introduced in Junos OS Release 12.1 for the QFX Series. Hierarchy level [edit switch-options interface <i>interface-name</i>] introduced in Junos OS Release 13.2X50-D10
Description	Specify that learned MAC addresses persist on the specified interfaces across restarts of the switch and link-down conditions. This feature is also known as sticky MAC.
Required Privilege Level	system—To view this statement in the configuration. system-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> • <i>Example: Configuring Basic Port Security Features</i> • <i>Configuring Persistent MAC Learning (CLI Procedure)</i> • <i>Configuring Persistent MAC Learning (CLI Procedure)</i>

port-error-disable

Syntax	<pre>port-error-disable { (disable-timeout <i>seconds</i> recovery-timeout <i>seconds</i>); }</pre>
Hierarchy Level	<ul style="list-style-type: none"> For platforms without ELS: [edit ethernet-switching-options] For platforms with ELS: [edit switch-options]
Release Information	Statement introduced in Junos OS Release 11.1 on the QFX Series.
Description	Disable rather than block an interface when enforcing MAC limiting, MAC move limiting, and storm control, and allow the interface to recover automatically from the error condition after a specified period of time:
	<p> NOTE: The port-error-disable configuration does not apply to preexisting error conditions. It affects only error conditions that are detected after you enable and commit the port-error-disable statement. To clear a preexisting error condition and restore the interface to service, use the clear ethernet-switching port-error command.</p> <ul style="list-style-type: none"> If you enable the <i>mac-limit</i> statement with the shutdown option and also enable the port-error-disable statement, the switch disables (rather than shuts down) the interface when the MAC address limit is reached. If you have enabled the mac-move-limit statement with the shutdown option and you enable the port-error-disable statement, the switch disables (rather than shuts down) the interface when the maximum number of moves to a new interface is reached. If you enable the storm-control statement with the action-shutdown option and you also enable port-error-disable, the switch disables (rather than shuts down) the interface when broadcast traffic and unknown unicast traffic exceed the specified levels.
Default	Not enabled.
Required Privilege Level	routing—To view this statement in the configuration. routing—control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> Understanding MAC Limiting and MAC Move Limiting for Port Security on page 99 Understanding Storm Control on page 115 Example: Configuring Storm Control to Prevent Network Outages

- *Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure)*
- [action-shutdown on page 166](#)
- *disable-timeout*
- [clear ethernet-switching port-error on page 206](#)

vendor-id

Syntax	<code>vendor-id <string>;</code>
For Platforms with Enhanced Layer 2 Software (ELS)	<code>[edit vlans <i>vlan-name</i> forwarding-options dhcp-security option-82]</code>
For Platforms Without ELS	<code>[edit ethernet-switching-options secure-access-port vlan (all <i>vlan-name</i>) dhcp-option82],</code> <code>[edit forwarding-options helpers bootp dhcp-option82],</code> <code>[edit forwarding-options helpers bootp interface <i>interface-name</i> dhcp-option82]</code>
For MX Series Platforms	<code>[edit bridge-domains <i>bridge-domain-name</i> forwarding-options dhcp-security option-82]</code>
Release Information	Statement introduced in Junos OS Release 9.3 for EX Series switches. Statement introduced in Junos OS Release 11.3 for the QFX Series. Hierarchy level <code>[edit vlans <i>vlan-name</i> forwarding-options dhcp-security]</code> introduced in Junos OS Release 13.2X50-D10. (See <i>Getting Started with Enhanced Layer 2 Software</i> for information about ELS.) Hierarchy level <code>[edit bridge-domains <i>bridge-domain-name</i> forwarding-options dhcp-security]</code> introduced in Junos OS Release 14.1 for the MX Series. Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Insert a vendor ID in the DHCP option 82 information in a DHCP request packet header before forwarding or relaying the request to a DHCP server.
Default	If vendor-id is not explicitly configured for DHCP option 82, then no vendor ID is set.
Options	string —(Optional) A single string that designates the vendor ID. Range: 1–255 characters Default: If you specify vendor-id with no string value, then the default vendor ID Juniper Networks is configured.
Required Privilege Level	system —To view this statement in the configuration. system-control —To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none"> <i>Configuring DHCP Option 82 to Help Protect the Switching Devices Against Attacks (CLI Procedure)</i> <i>Example: Setting Up DHCP Option 82 with a Switch with No Relay Agent Between Clients and a DHCP Server</i> <i>Example: Setting Up DHCP Option 82 with a Switch as a Relay Agent Between Clients and a DHCP Server</i> <i>Setting Up DHCP Option 82 on the Switch with No Relay Agent Between Clients and DHCP Server (CLI Procedure)</i>

write-interval

Syntax	<code>write-interval <i>seconds</i>;</code>
Hierarchy Level	For platforms without ELS: [edit ethernet-switching-options secure-access-port dhcp-snooping-file] For platforms with ELS: [edit system processes] dhcp-service dhcp-snooping-file]
Release Information	Statement introduced in Junos OS Release 12.1 for the QFX Series.
Description	Specify how frequently the switch writes the database entries from memory into the specified DHCP snooping database file.
Default	None
Options	<i>seconds</i> —Value in seconds. Range: 60 through 86400
Required Privilege Level	routing—To view this statement in the configuration. routing-control—To add this statement to the configuration.
Related Documentation	<ul style="list-style-type: none">• Understanding DHCP Snooping for Monitoring DHCP Messages Received from Untrusted Devices on page 88

CHAPTER 9

Operational Commands (Firewall Filters)

- `clear firewall`
- `show firewall`
- `show firewall policer`
- `show interfaces filters`
- `show pfe filter hw summary`

clear firewall

Syntax	<code>clear firewall (all counter <i>counter-name</i> filter <i>filter-name</i>)</code>
Release Information	Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	<p>Clear statistics provided by firewall filters.</p> <p>When you clear the counters of a filter, this not only impacts the counters shown by the CLI, but also the ones tracked by SNMP 2.</p>
Options	<p>all—Clear the packet and byte counts for all firewall filter counters and clear the packet counts for all policer counters.</p> <p>counter <i>counter-name</i>—Clear the packet and byte counts for the specified firewall filter counter.</p> <p>filter <i>filter-name</i>—Clear the packet and byte counts for the specified firewall filter.</p>
Required Privilege Level	clear
Related Documentation	<ul style="list-style-type: none">• Verifying That Firewall Filters Are Operational on page 42• Verifying That Two-Color Policers Are Operational on page 75• Overview of Firewall Filters on page 3• Overview of Policers on page 55

Sample Output

clear firewall all

```
user@switch> clear firewall all
```

clear firewall counter

```
user@switch> clear firewall counter port-filter-counter
```

clear firewall filter

```
user@switch> clear firewall filter ingress-port-filter
```

show firewall

Syntax	show firewall <counter <i>counter-name</i> > <filter <i>filter-name</i> > <log <detail interface <i>interface-name</i> >> <terse>
Release Information	Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Display statistics about configured firewall filters.
Options	<p>counter <i>counter-name</i>—(Optional) Display statistics about a particular firewall filter counter.</p> <p>filter <i>filter-name</i>—(Optional) Display statistics about a particular firewall filter.</p> <p>log—(Optional) Display log entries for all firewall filter activity.</p> <p>terse—(Optional) Display firewall filter names only.</p>
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • Verifying That Firewall Filters Are Operational on page 42 • Verifying That Two-Color Policers Are Operational on page 75 • Overview of Firewall Filters on page 3 • Overview of Policers on page 55
List of Sample Output	show firewall on page 194 show firewall filter <i>filter-name</i> on page 195 show firewall counter <i>counter-name</i> on page 195 show firewall log on page 195 show firewall log detail on page 195
Output Fields	Table 17 on page 193 lists the output fields for the show firewall command. Output fields are listed in the approximate order in which they appear.

Table 17: show firewall Output Fields

Field Name	Field Description	Level of Output
Filter	Name of the filter that is configured at the [edit firewall family <i>family-name</i> filter] hierarchy level.	All levels

Table 17: show firewall Output Fields (*continued*)

Field Name	Field Description	Level of Output
Counters	Display filter counter information: <ul style="list-style-type: none"> Name—Name of a filter counter that has been configured with the count firewall filter action modifier. Bytes—Number of bytes that match the filter term where the count action modifier was specified. Packets—Number of packets that matched the filter term where the count action modifier was specified. 	All levels
Policers	Display policer information: <ul style="list-style-type: none"> Name—Name of the policer that is configured at the [edit firewall policer] hierarchy level. Packets—Number of packets that matched the filter term where the policer action modifier was specified. This is the number of packets that exceeded the rate limits that the policer specifies. 	All levels
Action	Filter action: <ul style="list-style-type: none"> A—Accept D—Discard 	All levels
Interface	Interface on which the firewall filter is applied.	All levels
Protocol	Name of the packet protocol.	All levels
Packet Length	Length of the packet.	All levels
Src Addr	Source address of the packet.	All levels
Dest Addr	Destination address of the packet.	All levels

Sample Output

show firewall

```

user@switch> show firewall
Filter: egress-vlan-watch-employee
Counters:
Name                               Bytes      Packets
counter-employee-web              0           0
Filter: ingress-port-limit-tcp-icmp
Counters:
Name                               Bytes      Packets
icmp-counter                      560        10
Policers:
Name                               Packets
icmp-connection-policer           10
tcp-connection-policer            0
Filter: ingress-vlan-rogue-block
Filter: ingress-vlan-limit-guest

```

show firewall filter filter-name

```

user@switch> show firewall filter ingress-port-limit-tcp-icmp
Filter: ingress-port-limit-tcp-icmp
Counters:
Name                                     Bytes          Packets
icmp-counter                             560            10
Policers:
Name                                     Packets
icmp-connection-policer                  10
tcp-connection-policer                    0

```

show firewall counter counter-name

```

user@switch> show firewall counter icmp-counter
Filter: ingress-port-voip-class-filter
Counters:
Name                                     Bytes          Packets
icmp-counter                             560            10

```

show firewall log

```

user@switch> show firewall log
Log :

Time      Filter  Action Interface  Protocol  Src Addr
Dest Addr
08:00:53  pfe      R      ge-1/0/6.0    ICMP      192.168.3.5
192.168.3.4
08:00:52  pfe      R      ge-1/0/6.0    ICMP      192.168.3.5
192.168.3.4
08:00:51  pfe      R      ge-1/0/6.0    ICMP      192.168.3.5
192.168.3.4
08:00:50  pfe      R      ge-1/0/6.0    ICMP      192.168.3.5
192.168.3.4
08:00:49  pfe      R      ge-1/0/6.0    ICMP      192.168.3.5
192.168.3.4
08:00:48  pfe      R      ge-1/0/6.0    ICMP      192.168.3.5
192.168.3.4
08:00:47  pfe      R      ge-1/0/6.0    ICMP      192.168.3.5
192.168.3.4

```

show firewall log detail

```

user@switch> show firewall log detail
Log :

Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0Name of protocol: TCP, Packet Length: 50824, Source address:
172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0
Name of protocol: TCP, Packet Length: 1020, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0
Name of protocol: TCP, Packet Length: 49245, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of

```

```
interface: fxp0.0
Name of protocol: TCP, Packet Length: 49245, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0
Name of protocol: TCP, Packet Length: 49245, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
Time of Log: 2010-10-13 10:37:17 PDT, Filter: f, Filter action: accept, Name of
interface: fxp0.0
Name of protocol: TCP, Packet Length: 49245, Source address: 172.17.22.108:829,
Destination address: 192.168.70.66:513
```

show firewall policer

Syntax	<code>show firewall policer</code> <code><policer-name></code>
Release Information	Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Display statistics about configured policers.
Options	none —Display the count of policed packets for all configured policers. policer-name —(Optional) Display the count of policed packets for the specified policer.
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • Verifying That Firewall Filters Are Operational on page 42 • Verifying That Two-Color Policers Are Operational on page 75 • Overview of Firewall Filters on page 3 • Overview of Policers on page 55
List of Sample Output	show firewall policer on page 197 show firewall policer policer-name on page 198
Output Fields	Table 18 on page 197 lists the output fields for the show firewall policer command. Output fields are listed in the approximate order in which they appear.

Table 18: show firewall policer Output Fields

Field Name	Field Description	Level of Output
Filter	Name of the filter that is configured at the <code>[edit firewall family <i>family-name</i> filter]</code> hierarchy level.	All levels
Policers	Display policer information: <ul style="list-style-type: none"> • Filter—Name of filter that specifies the policer action modifier. • Name—Name of policer. • Packets—Number of packets that matched the filter term in which the policer action modifier is specified. This is the number of packets that exceed the rate limits that the policer specifies. 	All levels

Sample Output

show firewall policer

```
user@switch> show firewall policer
Filter: egress-vlan-filter
Filter: ingress-port-filter
```

```
Policies:
Name                                     Packets
icmp-connection-policer                 0
tcp-connection-policer                 0
Filter: ingress-vlan-roguе-block
```

show firewall policer policer-name

```
user@switch> show firewall policer tcp-connection-policer
Filter: ingress-port-filter
Policies:
Name                                     Packets
tcp-connection-policer                 0
```


show interfaces filters

Syntax	<code>show interfaces filters</code> <code><interface-name></code>
Release Information	Command introduced in Junos OS Release 11.1 for the QFX Series. Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Description	Display firewall filters that are configured on each interface in a switch.
Options	none —Display firewall filter information about all interfaces. interface-name —(Optional) Display firewall filter information about a particular interface.
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • show firewall on page 193
List of Sample Output	show interfaces filters on page 199 show interfaces filters interface-name on page 200
Output Fields	Table 19 on page 199 lists the output fields for the show interfaces filters command. Output fields are listed in the approximate order in which they appear.

Table 19: show interfaces filters Output Fields

Field Name	Field Description	Level of Output
Interface	Name of the physical interface.	All levels
Admin	Interface state: up or down .	All levels
Link	Link state: up or down .	All levels
Proto	Protocol that is configured on the interface.	All levels
Input Filter	Name of the firewall filter to be evaluated when packets are received on the interface.	All levels
Output Filter	Name of the firewall filter to be evaluated when packets are transmitted on the interface.	All levels

Sample Output

show interfaces filters

```

user@switch> show interfaces filters
Interface      Admin Link Proto Input Filter      Output Filter
ge-0/0/6      up    up
ge-0/0/6.0    up    up    inet

```

ge-0/0/7	up	down
ge-0/0/8	up	down
ge-0/0/9	up	down
ge-0/0/10	up	down
ge-0/0/10.0	up	down

show interfaces filters interface-name

```
user@switch> show interfaces filters ge-0/0/6
```

Interface	Admin	Link	Proto	Input Filter	Output Filter
ge-0/0/6	up	up			
ge-0/0/6.0	up	up	inet		

show pfe filter hw summary

Syntax	show pfe filter hw summary
Release Information	Command introduced in Junos OS Release 14.1X53-D10 for the QFX Series.
Description	<p>Display a summary of the access control list (ACL; also known as firewall filter) ternary content-addressable memory (TCAM) hardware utilization to show the allocated, used, and free TCAM entry space.</p> <p>Command supported on standalone QFX Series switches, QFX5100-only (pure QFX5100) Virtual Chassis Fabric (VCF), QFX5100-only (pure QFX5100) Virtual Chassis (VC), and QFX3500-only (pure QFX3500) VC.</p>
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • Planning the Number of Firewall Filters to Create on page 30
List of Sample Output	show pfe filter hw summary on page 202
Output Fields	<p>Table 20 on page 201 lists the output fields for the show pfe filter hw summary command. Output fields are listed in the approximate order in which they appear.</p>

Table 20: show pfe filter hw summary Output Fields

Field Name	Field Description
Group	<p>ACL ingress and egress filter groups:</p> <ul style="list-style-type: none"> • iRACL group—ingress routing ACL filter group • iVACL group—ingress VLAN ACL filter group • iPACL group—ingress port ACL filter group • ePACL group—egress port ACL filter group • eVACL group—egress VLAN ACL filter group • eRACL group—egress routing ACL filter group • eRACL IPv6 group—egress IPv6 routing ACL filter group
Group-ID	Internal identification number of the filter group.
Allocated	Number of TCAM filter entries allocated to the filter group.
Used	Number of TCAM filter entries used by the filter group.
Free	Number of TCAM filter entries available for use by the filter group.

Sample Output

show pfe filter hw summary

```
user@switch> show pfe filter hw summary
```

Group	Group-ID	Allocated	Used	Free

> Ingress filter groups:				
iRACL group	14	512	4	508
iVACL group	13	512	2	510
iPACL group	12	256	2	254
> Egress filter groups:				
ePACL group	20	256	3	253
eVACL group	21	256	4	252
eRACL group	22	256	245	11
eRACL IPV6 group	24	256	3	253

CHAPTER 10

Operational Commands (Port Security)

- clear arp inspection statistics
- clear dhcp snooping binding
- clear ethernet-switching port-error
- show dhcp snooping binding

clear arp inspection statistics

Syntax	clear arp inspection statistics <interface <i>interface</i> >
Release Information	Command introduced in Junos OS Release 9.0 for EX Series switches. Command introduced in Junos OS Release 12.1 for the QFX Series.
Description	Clear ARP inspection statistics.
Options	none —Clears ARP statistics on all interfaces. interface <i>interface-names</i> —(Optional) Clear ARP statistics on one or more interfaces.
Required Privilege Level	clear
Related Documentation	<ul style="list-style-type: none">• <i>show arp inspection statistics</i>• <i>Example: Configuring Basic Port Security Features</i>• Verifying That DAI Is Working Correctly on page 99
List of Sample Output	clear arp inspection statistics on page 204
Output Fields	This command produces no output.

Sample Output

clear arp inspection statistics

```
user@switch> clear arp inspection statistics
```

clear dhcp snooping binding

Syntax	clear dhcp snooping binding <mac (all <i>mac-address</i>)> <vlan (all <i>vlan-name</i>)> <vlan (all <i>vlan-name</i>) mac (all <i>mac-address</i>)>
Release Information	Command introduced in Junos OS Release 12.1 for the QFX Series.
Description	Clear the DHCP snooping database information.
Options	<p>mac (all <i>mac-address</i>)—(Optional) Clear DHCP snooping information for the specified MAC address or all MAC addresses.</p> <p>vlan (all <i>vlan-name</i>)—(Optional) Clear DHCP snooping information for the specified VLAN or all VLANs.</p>
Required Privilege Level	clear
Related Documentation	<ul style="list-style-type: none"> • <i>Example: Configuring Basic Port Security Features</i> • show dhcp snooping binding on page 207
List of Sample Output	clear dhcp snooping binding on page 205
Output Fields	This command produces no output.

Sample Output

clear dhcp snooping binding

```
user@switch> clear dhcp snooping binding
```

clear ethernet-switching port-error

Syntax	clear ethernet-switching port-error <interface <i>interface-name</i> >
Release Information	Command introduced in Junos OS Release 11.1 for the QFX Series.
Description	Clear all MAC limiting, MAC move limiting, and storm control errors from all the Ethernet switching interfaces on the switch or from the specified interface, and restore the interfaces or the specified interface to service.
Options	none —Clear all MAC limiting, MAC move limiting, and storm control errors from all the Ethernet switching interfaces on the switch and restore the interfaces to service. interface <i>interface-name</i> —(Optional) Clear all MAC limiting, MAC move limiting, and storm control errors from the specified interface and restore the interface to service.
Required Privilege Level	clear
Related Documentation	<ul style="list-style-type: none">• <i>Configuring MAC Limiting</i>• <i>Example: Configuring Storm Control to Prevent Network Outages</i>• <i>Configuring Port Security (CLI Procedure)</i>• port-error-disable on page 186• <i>Configuring Autorecovery for MAC Limited or Storm Control Interfaces (CLI Procedure)</i>
Output Fields	This command produces no output.

show dhcp snooping binding

Syntax	show dhcp snooping binding <interface <i>interface-name</i>> <vlan <i>vlan-name</i>>
Release Information	Command introduced in Junos OS Release 9.0 for EX Series switches. Command introduced in Junos OS Release 12.1 for the QFX Series.
Description	Display the DHCP snooping database information.
Options	interface <i>interface-name</i> —(Optional) Display the DHCP snooping database information for an interface. vlan <i>vlan-name</i> —(Optional) Display the DHCP snooping database information for a VLAN.
Required Privilege Level	view
Related Documentation	<ul style="list-style-type: none"> • <i>clear dhcp snooping binding</i> • <i>Example: Configuring Basic Port Security Features</i> • Verifying That DHCP Snooping Is Working Correctly on page 95
List of Sample Output	show dhcp snooping binding on page 207
Output Fields	Table 21 on page 207 lists the output fields for the show dhcp snooping binding command. Output fields are listed in the approximate order in which they appear.

Table 21: show dhcp snooping binding Output Fields

Field Name	Field Description	Level of Output
MAC Address	MAC address of the network device; bound to the IP address.	All levels
IP Address	IP address of the network device; bound to the MAC address.	All levels
Lease	Lease granted to the IP address.	All levels
Type	How the MAC address was acquired.	All levels
VLAN	VLAN name of the network device whose MAC address is shown.	All levels
Interface	Interface address (port).	All levels

Sample Output

show dhcp snooping binding

```
user@switch> show dhcp snooping binding
```

DHCP Snooping Information:

MAC Address	IP Address	Lease	Type	VLAN	Interface
00:00:01:00:00:03	192.0.2.0	640	dynamic	guest	ge-0/0/12.0
00:00:01:00:00:04	192.0.2.1	720	dynamic	guest	ge-0/0/12.0
00:00:01:00:00:05	192.0.2.5	800	dynamic	guest	ge-0/0/13.0