Port-Based Traffic Control

Port-based traffic control is a set of Layer 2 features on the Cisco devices used to filter or block packets at the port level in response to specific traffic conditions. The following port-based traffic control features are supported:

- Storm Control
- Protected Ports
- Port Blocking

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Restrictions for Storm Control

The following restrictions are applicable for Cisco Catalyst 9500X Series Switches:

- When Storm Control broadcast level is set to zero, it does not suppress the broadcast APR request completely as the minimum granularity rate limit for packet to get dropped is 250kbps.
- Storm Control is not supported on Layer 3 ports.
- When Storm Control is configured on ether channel, it will not generate notification if not load balanced.
- PPS rate limiting is not supported. Only BPS rate limiting, and percentage is supported.

Information About Port-Based Traffic Control

Storm Control

Storm control prevents traffic on a LAN from being disrupted by a broadcast, multicast, or unicast storm on one of the physical interfaces. A LAN storm occurs when packets flood the LAN, creating excessive traffic

and degrading network performance. Errors in the protocol-stack implementation, mistakes in network configurations, or users issuing a denial-of-service attack can cause a storm.

Storm control (or traffic suppression) monitors packets passing from an interface to the switching bus and determines if the packet is unicast, multicast, or broadcast. The switch counts the number of packets of a specified type received within the 1-second time interval and compares the measurement with a predefined suppression-level threshold.

With the hardware rate limiter feature of the Storm Control Policer, all broadcast, multicast, and unicast packets with less than 1000 packets per second are blocked. This behavior is due to a hardware limitation on ASIC-based platforms. On these platforms, storm control will work with 1K and above packets per second, and 8K and above bits per second.

Measured Traffic Activity

Storm control uses one of these methods to measure traffic activity:

- Bandwidth as a percentage of the total available bandwidth of the port that can be used by the broadcast, multicast, or unicast traffic
- Traffic rate in packets per second at which broadcast, multicast, or unicast packets are received
- Traffic rate in bits per second at which broadcast, multicast, or unicast packets are received

With each method, the port blocks traffic when the rising threshold is reached. The port remains blocked until the traffic rate drops below the falling threshold (if one is specified) and then resumes normal forwarding. If the falling suppression level is not specified, the device blocks all traffic until the traffic rate drops below the rising suppression level. In general, the higher the level, the less effective the protection against broadcast storms.

Note When the storm control threshold for any type of traffic is reached, Hardware Rate Limiter drops the traffic exceeding the threshold set. However, the rest of the traffic within the threshold set continues to be forwarded even after the storm is detected. Starting with Cisco IOS XE Gibraltar 16.11.1 release, this behavior is applicable to Cisco Catalyst 9500 Series Switches - High Performance only.

Storm control for unicast is a combination of known unicast and unknown unicast traffic. When storm control for unicast is configured, and it exceeds the configured value, the storm will hit each type of traffic through the hardware policer. The following example describes how the unicast traffic is filtered, when the configured storm is 10%:

- Incoming traffic is unknown unicast 8% + known unicast 7%. Total of 15% storm is not filtered in hardware by the hardware policer.
- Incoming traffic is unknown unicast 11% + known unicast 7%. Total of 18% storm will hit unknown unicast traffic type, and the hardware policer will filter unknown traffic that exceeds 11%.
- Incoming traffic is unknown unicast 11% + known unicast 11%. Total of 22% storm will hit unknown unicast traffic and known unicast traffic, and the hardware policer will filter both unknown and known unicast traffic.

Note Do not configure both **storm-control unicast** and **storm-control unknown unicast** commands on an interface. If you configure both these commands, it might result in the unknown unicast storm control values to be modified in the hardware.

Traffic Patterns

Broadcast traffic being forwarded exceeded the configured threshold between time intervals T1 and T2 and between T4 and T5. When the amount of specified traffic exceeds the threshold, all traffic of that kind is dropped for the next time period. Therefore, broadcast traffic is blocked during the intervals following T2 and T5. At the next time interval (for example, T3), if broadcast traffic does not exceed the threshold, it is again forwarded.

The combination of the storm-control suppression level and the 1-second time interval controls the way the storm control algorithm works. A higher threshold allows more packets to pass through. A threshold value of 100 percent means that no limit is placed on the traffic. A value of 0.0 means that all broadcast, multicast, or unicast traffic on that port is blocked.

Note Because packets do not arrive at uniform intervals, the 1-second time interval during which traffic activity is measured can affect the behavior of storm control.

You use the **storm-control** interface configuration commands to set the threshold value for each traffic type.

Storm Control Using a Hardware Rate Limiter

Traffic storm control monitors incoming traffic levels over a configured interval. However, the reaction time taken by storm control is slightly slower as it is based on statistics counters to identify a storm. With the hardware rate limiter, the action is taken at the ASIC level, and as a result, the storm control action starts immediately; as soon as the traffic rate reaches the set threshold level. The hardware rate limiter implements policers for broadcast, multicast, unicast, and unknown unicast traffic.

Protected Ports

Some applications require that no traffic be forwarded at Layer 2 between ports on the same device so that one neighbor does not see the traffic generated by another neighbor. In such an environment, the use of protected ports ensures that there is no exchange of unicast, broadcast, or multicast traffic between these ports on the device.

Protected ports have these features:

- A protected port does not forward any traffic (unicast, multicast, or broadcast) to any other port that is also a protected port. Data traffic cannot be forwarded between protected ports at Layer 2; only control traffic, such as PIM packets, is forwarded because these packets are processed by the CPU and forwarded in software. All data traffic passing between protected ports must be forwarded through a Layer 3 device.
- Forwarding behavior between a protected port and a nonprotected port proceeds as usual.

Protected Ports Guidelines

You can configure protected ports on a physical interface (for example, Gigabit Ethernet port 1) or an EtherChannel group (for example, port-channel 5). When you enable protected ports for a port channel, it is enabled for all ports in the port-channel group.

By default no protected ports are defined.

Port Blocking

By default, the device floods packets with unknown destination MAC addresses out of all ports. If unknown unicast and multicast traffic is forwarded to a protected port, there could be security issues. To prevent unknown unicast or multicast traffic from being forwarded from one port to another, you can block a port (protected or nonprotected) from flooding unknown unicast or multicast packets to other ports.

Note With multicast traffic, the port blocking feature blocks only pure Layer 2 packets. Multicast packets that contain IPv4 or IPv6 information in the header are not blocked.

How to Configure Port-Based Traffic Control

Configuring Storm Control and Threshold Levels

You configure storm control on a port and enter the threshold level that you want to be used for a particular type of traffic.

However, because of hardware limitations and the way in which packets of different sizes are counted, threshold percentages are approximations. Depending on the sizes of the packets making up the incoming traffic, the actual enforced threshold might differ from the configured level by several percentage points.

Note Storm control is supported on physical interfaces. You can also configure storm control on an EtherChannel. When storm control is configured on an EtherChannel, the storm control settings propagate to the EtherChannel physical interfaces.

Follow these steps to storm control and threshold levels:

Before you begin

Storm control is supported on physical interfaces. You can also configure storm control on an EtherChannel. When storm control is configured on an EtherChannel, the storm control settings propagate to the EtherChannel physical interfaces.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/0/1`	Specifies the interface to be configured, and enters interface configuration mode.
Step 4	**storm-control** {**broadcast** | **multicast** | **unicast**} **level** {*level* [*level-low*] | **bps** *bps* [*bps-low*] | **pps** *pps* [*pps-low*]} **Example:** `Device(config-if)# storm-control unicast level 87 65`	Configures broadcast, multicast, or unicast storm control. By default, storm control is disabled. • For *level*, specifies the rising threshold level for broadcast, multicast, or unicast traffic as a percentage (up to two decimal places) of the bandwidth. The port blocks traffic when the rising threshold is reached. The range is 0.00 to 100.00. • (Optional) For *level-low*, specifies the falling threshold level as a percentage (up to two decimal places) of the bandwidth. This value must be less than or equal to the rising suppression value. The port forwards traffic when traffic drops below this level. If you do not configure a falling suppression level, it is set to the rising suppression level. The range is 0.00 to 100.00. If you set the threshold to the maximum value (100 percent), no limit is placed on the traffic. If you set the threshold to 0.0, all broadcast, multicast, and unicast traffic on that port is blocked. • For **bps** *bps*, specifies the rising threshold level for broadcast, multicast, or unicast traffic in bits per second (up to one decimal place). The port blocks traffic

	Command or Action	Purpose
		when the rising threshold is reached. The range is 0.0 to 10000000000.0. • (Optional) For *bps-low*, specifies the falling threshold level in bits per second (up to one decimal place). It can be less than or equal to the rising threshold level. The port forwards traffic when traffic drops below this level. The range is 0.0 to 10000000000.0. • For **pps** *pps*, specifies the rising threshold level for broadcast, multicast, or unicast traffic in packets per second (up to one decimal place). The port blocks traffic when the rising threshold is reached. The range is 0.0 to 10000000000.0. • (Optional) For *pps-low*, specifies the falling threshold level in packets per second (up to one decimal place). It can be less than or equal to the rising threshold level. The port forwards traffic when traffic drops below this level. The range is **0.0 to** 10000000000.0. **Note** Cisco Catalyst 9500X Series Switches do not support the **pps** keyword. For BPS and PPS settings, you can use metric suffixes such as k, m, and g for large number thresholds.
Step 5	**storm-control action** {**shutdown** | **trap**} **Example:** `Device(config-if)# storm-control action trap`	Specifies the action to be taken when a storm is detected. Once a storm is detected, the **shutdown** or **trap** action is applied on all the traffic. The default is to filter out the traffic and not to send traps. • Select the **shutdown** keyword to error-disable the port during a storm. • Select the **trap** keyword to generate an SNMP trap when a storm is detected.
Step 6	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

	Command or Action	Purpose
Step 7	**show storm-control** [*interface-id*] [**broadcast** | **multicast** | **unicast**] **Example:** `Device# show storm-control gigabitethernet1/0/1 unicast`	Verifies the storm control suppression levels set on the interface for the specified traffic type. If you do not enter a traffic type, details for all traffic types (broadcast, multicast and unicast) are displayed.

Configuring a Protected Port

Before you begin

Protected ports are not pre-defined. This is the task to configure one.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet 1/0/1`	Specifies the interface to be configured, and enters interface configuration mode.
Step 4	**switchport protected** **Example:** `Device(config-if)# switchport protected`	Configures the interface to be a protected port.
Step 5	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Monitoring Protected Ports

Table 1: Commands for Displaying Protected Port Settings

Command	Purpose
show interfaces [*interface-id*] **switchport**	Displays the administrative and operational status of all switch (nonrouting) ports or the specified port, including port blockin protection settings.

Blocking Flooded Traffic on an Interface

The interface can be a physical interface or an EtherChannel group. When you block multicast or unicast traffic for a port channel, it is blocked on all ports in the port-channel group.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet 1/0/1`	Specifies the interface to be configured, and enter interface configuration mode.
Step 4	**switchport block multicast** **Example:** `Device(config-if)# switchport block multicast`	Blocks unknown multicast forwarding out of the port.
Step 5	**switchport block unicast** **Example:** `Device(config-if)# switchport block unicast`	Blocks unknown unicast forwarding out of the port.

	Command or Action	Purpose
Step 6	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Monitoring Port Blocking

Table 2: Commands for Displaying Port Blocking Settings

Command	Purpose
show interfaces [*interface-id*] **switchport**	Displays the administrative and operational status of all sw (nonrouting) ports or the specified port, including port bloc protection settings.

Additional References for Port-Based Traffic Control

Related Documents

Related Topic	Document Title
Port Security	Port Security chapter in the *Security Configuration Guide*

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature History for Port-Based Traffic Control

This table provides release and related information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Everest 16.5.1a	Port-Based Traffic Control	Port-based traffic control is a set of Layer 2 features on the Cisco Catalyst switches used to filter or block packets at the port level in response to specific traffic conditions. Support for this feature was introduced on all the models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Fuji 16.8.1a	Port-Based Traffic Control	Support for this feature was introduced on the C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Gibraltar 16.11.1	Storm Control with a Hardware Rate Limiter	With the hardware rate limiter, the storm control action is taken at the ASIC level, and as a result, the action starts immediately; as soon as the traffic rate reaches the set threshold level. Support for this feature was introduced on the C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Cupertino 17.7.1	Port-Based Traffic Control	This feature was implemented on the C9500X-28C8D model.
Cisco IOS XE Dublin 17.10.1b	Port-Based Traffic Control	This feature was implemented on the C9500X-60L4D model.

Use the Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to https://cfnng.cisco.com.