



# Configuring Port-Based Traffic Control

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# Overview of 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. The following port-based traffic control features are supported in the Cisco IOS Release for which this guide is written:

- Storm Control
- Protected Ports
- Port Blocking
- Port Security
- Protocol Storm Protection

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

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## Information About Storm 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.

### How Traffic Activity is Measured

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
- Traffic rate in packets per second and for small frames. This feature is enabled globally. The threshold for small frames is configured for each interface.

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 switch 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.

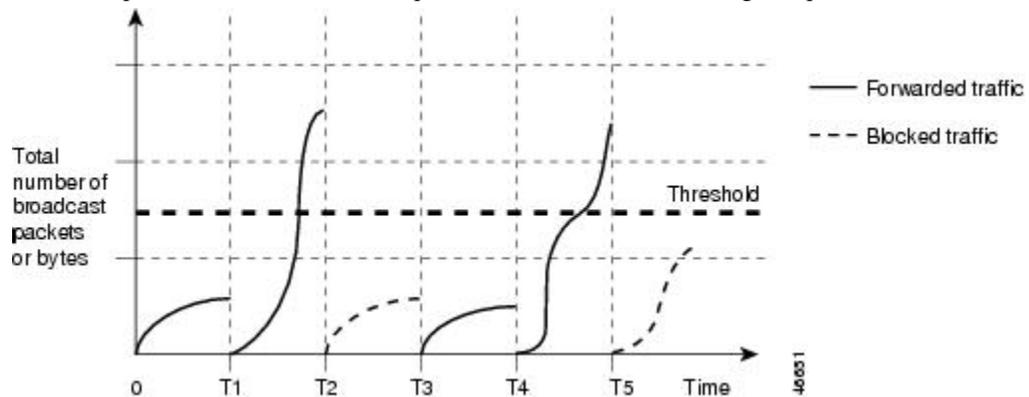


**Note** When the storm control threshold for multicast traffic is reached, all multicast traffic except control traffic, such as bridge protocol data unit (BDPU) and Cisco Discovery Protocol (CDP) frames, are blocked. However, the switch does not differentiate between routing updates, such as OSPF, and regular multicast data traffic, so both types of traffic are blocked.

## Traffic Patterns

**Figure 1: Broadcast Storm Control Example**

This example shows broadcast traffic patterns on an interface over a given period of time.



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.

## How to Configure Storm 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  |
|---------------|---|--|
| <b>Step 1</b> | <b>enable</b><br><b>Example:</b><br>Switch> <b>enable</b>                         | Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul> |
| <b>Step 2</b> | <b>configure terminal</b><br><b>Example:</b><br>Switch# <b>configure terminal</b> | Enters global configuration mode.  |

|               | Command or Action  | Purpose  |
|---------------|--|--|
| <b>Step 3</b> | <p><b>interface</b> <i>interface-id</i></p> <p><b>Example:</b></p> <pre>Switch(config)# interface gigabitethernet 0/1</pre>  | <p>Specifies the interface to be configured, and enter interface configuration mode.</p>   |
| <b>Step 4</b> | <p><b>storm-control action</b> {<b>shutdown</b>   <b>trap</b>}</p> <p><b>Example:</b></p> <pre>Switch(config-if)# storm-control action trap</pre>  | <p>Specifies the action to be taken when a storm is detected. The default is to filter out the traffic and not to send traps.</p> <ul style="list-style-type: none"> <li>• Select the <b>shutdown</b> keyword to error-disable the port during a storm.</li> <li>• Select the <b>trap</b> keyword to generate an SNMP trap when a storm is detected.</li> </ul>  |
| <b>Step 5</b> | <p><b>storm-control</b> {<b>broadcast</b>   <b>multicast</b>   <b>unicast</b>} <b>level</b> {<i>level</i> [<i>level-low</i>]   <b>bps</b> <i>bps</i> [<i>bps-low</i>]   <b>pps</b> <i>pps</i> [<i>pps-low</i>]}</p> <p><b>Example:</b></p> <pre>Switch(config-if)# storm-control unicast level 87 65</pre> | <p>Configures broadcast, multicast, or unicast storm control. By default, storm control is disabled.</p> <p>The keywords have these meanings:</p> <ul style="list-style-type: none"> <li>• For <i>level</i>, 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.</li> <li>• (Optional) For <i>level-low</i>, 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.</li> </ul> <p>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.</p> <ul style="list-style-type: none"> <li>• For <b>bps</b> <i>bps</i>, specifies the rising threshold level for broadcast, multicast, or unicast traffic in bits 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.</li> </ul> |

|               | Command or Action  | Purpose  |
|---------------|--|--|
|               |  | <ul style="list-style-type: none"> <li>• (Optional) For <i>bps-low</i>, 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.</li> <li>• For <b>pps</b> <i>pps</i>, 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.</li> <li>• (Optional) For <i>pps-low</i>, 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 <b>0.0 to</b> 10000000000.0.</li> </ul> <p>For BPS and PPS settings, you can use metric suffixes such as k, m, and g for large number thresholds.</p> |
| <b>Step 6</b> | <b>end</b><br><b>Example:</b><br><pre>Switch(config-if)# end</pre>   | Returns to privileged EXEC mode.   |
| <b>Step 7</b> | <b>show storm-control</b> [ <i>interface-id</i> ] [ <b>broadcast</b>   <b>multicast</b>   <b>unicast</b> ]<br><b>Example:</b><br><pre>Switch# show storm-control gigabitethernet 0/1 unicast</pre> | 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.   |
| <b>Step 8</b> | <b>copy running-config startup-config</b><br><b>Example:</b><br><pre>Switch# copy running-config startup-config</pre>  | (Optional) Saves your entries in the configuration file.   |

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

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## Information About Protected Ports

### Protected Ports

Some applications require that no traffic be forwarded at Layer 2 between ports on the same switch 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 switch.

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.

### Default Protected Port Configuration

The default is to have no protected ports defined.

### 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.

# How to Configure Protected Ports

## 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  |
|---------------|--|--|
| <b>Step 1</b> | <b>enable</b><br><b>Example:</b><br>Switch> <b>enable</b>  | Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul> |
| <b>Step 2</b> | <b>configure terminal</b><br><b>Example:</b><br>Switch# <b>configure terminal</b>  | Enters global configuration mode.  |
| <b>Step 3</b> | <b>interface <i>interface-id</i></b><br><b>Example:</b><br>Switch(config)# <b>interface gigabitethernet</b><br><b>0/1</b>  | Specifies the interface to be configured, and enter interface configuration mode.                                  |
| <b>Step 4</b> | <b>switchport protected</b><br><b>Example:</b><br>Switch(config-if)# <b>switchport protected</b>                           | Configures the interface to be a protected port.   |
| <b>Step 5</b> | <b>end</b><br><b>Example:</b><br>Switch(config)# <b>end</b>  | Returns to privileged EXEC mode.   |
| <b>Step 6</b> | <b>show interfaces <i>interface-id</i> switchport</b><br><b>Example:</b><br>Switch# <b>show interfaces gigabitethernet</b> | Verifies your entries.   |

|               | Command or Action   | Purpose  |
|---------------|---|--|
|               | 0/1 switchport  |  |
| <b>Step 7</b> | <b>show running-config</b><br><b>Example:</b><br>Switch# <code>show running-config</code>                               | Verifies your entries.                                   |
| <b>Step 8</b> | <b>copy running-config startup-config</b><br><b>Example:</b><br>Switch# <code>copy running-config startup-config</code> | (Optional) Saves your entries in the configuration file. |

## Monitoring Protected Ports

Table 1: Commands for Displaying Protected Port Settings

| Command  | Purpose   |
|--|---|
| <code>show interfaces [interface-id] switchport</code> | Displays the administrative and operational status of all switching (nonrouting) ports or the specified port, including port blocking and port protection settings. |

## Where to Go Next

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## Additional References

### Error Message Decoder

| Description   | Link  |
|---|---|
| To help you research and resolve system error messages in this release, use the Error Message Decoder tool. | <a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a> |

**MIBs**

| MIB                                      | MIBs Link  |
|--|--|
| All the supported MIBs for this release. | To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:<br><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a> |

**Technical Assistance**

| Description   | Link  |
|---|---|
| <p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p> | <a href="http://www.cisco.com/support">http://www.cisco.com/support</a> |

## Feature Information

| Release                    | Feature Information          |
|----------------------------|------------------------------|
| Cisco IOS Release 15.2(5)E | This feature was introduced. |

## Finding Feature Information

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## Information About Port Blocking

### Port Blocking

By default, the switch 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.

# How to Configure Port Blocking

## Blocking Flooded Traffic on an Interface

### Before you begin

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  |
|---------------|---|--|
| <b>Step 1</b> | <b>enable</b><br><b>Example:</b><br><pre>Switch&gt; enable</pre>  | Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>   |
| <b>Step 2</b> | <b>configure terminal</b><br><b>Example:</b><br><pre>Switch# configure terminal</pre>                                   | Enters global configuration mode.  |
| <b>Step 3</b> | <b>interface <i>interface-id</i></b><br><b>Example:</b><br><pre>Switch(config)# interface gigabitethernet<br/>0/1</pre> | Specifies the interface to be configured, and enter interface configuration mode.  |
| <b>Step 4</b> | <b>switchport block multicast</b><br><b>Example:</b><br><pre>Switch(config-if)# switchport block<br/>multicast</pre>    | Blocks unknown multicast forwarding out of the port.<br><br><b>Note</b> Pure Layer 2 multicast traffic as well as multicast packets that contain IPv6 information in the header are blocked. |
| <b>Step 5</b> | <b>switchport block unicast</b><br><b>Example:</b><br><pre>Switch(config-if)# switchport block<br/>unicast</pre>        | Blocks unknown unicast forwarding out of the port.   |

|               | Command or Action   | Purpose  |
|---------------|---|--|
| <b>Step 6</b> | <b>end</b><br><b>Example:</b><br><pre>Switch(config)# end</pre>   | Returns to privileged EXEC mode.                         |
| <b>Step 7</b> | <b>show interfaces <i>interface-id</i> switchport</b><br><b>Example:</b><br><pre>Switch# show interfaces gigabitethernet 0/1 switchport</pre> | Verifies your entries.                                   |
| <b>Step 8</b> | <b>show running-config</b><br><b>Example:</b><br><pre>Switch# show running-config</pre>   | Verifies your entries.                                   |
| <b>Step 9</b> | <b>copy running-config startup-config</b><br><b>Example:</b><br><pre>Switch# copy running-config startup-config</pre>                         | (Optional) Saves your entries in the configuration file. |

## Monitoring Port Blocking

Table 2: Commands for Displaying Port Blocking Settings

| Command   | Purpose   |
|---|---|
| <b>show interfaces [<i>interface-id</i>] switchport</b> | Displays the administrative and operational status of all switching (nonrouting) ports or the specified port, including port blocking and port protection settings. |

## Where to Go Next

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# Additional References

## Related Documents

| Related Topic | Document Title |
|---------------|----------------|
|               |                |

## Error Message Decoder

| Description   | Link  |
|---|---|
| To help you research and resolve system error messages in this release, use the Error Message Decoder tool. | <a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a> |

## Standards and RFCs

| Standard/RFC | Title |
|--------------|-------|
|              |       |

## MIBs

| MB | MIBs Link  |
|----|--|
|    | To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:<br><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a> |

## Technical Assistance

| Description   | Link  |
|---|---|
| <p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p> | <a href="http://www.cisco.com/support">http://www.cisco.com/support</a> |

## Feature Information

| Release                    | Feature Information          |
|----------------------------|------------------------------|
| Cisco IOS Release 15.2(5)E | This feature was introduced. |

## Prerequisites for Port Security



**Note** If you try to set the maximum value to a number less than the number of secure addresses already configured on an interface, the command is rejected.

## Restrictions for Port Security

The maximum number of secure MAC addresses that you can configure on a switch is set by the maximum number of available MAC addresses allowed in the system. This number is the total of available MAC addresses, including those used for other Layer 2 functions and any other secure MAC addresses configured on interfaces.

## Information About Port Security

### Port Security

You can use the port security feature to restrict input to an interface by limiting and identifying MAC addresses of the stations allowed to access the port. When you assign secure MAC addresses to a secure port, the port does not forward packets with source addresses outside the group of defined addresses. If you limit the number of secure MAC addresses to one and assign a single secure MAC address, the workstation attached to that port is assured the full bandwidth of the port.

If a port is configured as a secure port and the maximum number of secure MAC addresses is reached, when the MAC address of a station attempting to access the port is different from any of the identified secure MAC addresses, a security violation occurs. Also, if a station with a secure MAC address configured or learned on one secure port attempts to access another secure port, a violation is flagged.

#### Related Topics

[Enabling and Configuring Port Security](#)

[Configuration Examples for Port Security](#), on page 26

## Types of Secure MAC Addresses

The switch supports these types of secure MAC addresses:

- Static secure MAC addresses—These are manually configured by using the **switchport port-security mac-address *mac-address*** interface configuration command, stored in the address table, and added to the switch running configuration.
- Dynamic secure MAC addresses—These are dynamically configured, stored only in the address table, and removed when the switch restarts.
- Sticky secure MAC addresses—These can be dynamically learned or manually configured, stored in the address table, and added to the running configuration. If these addresses are saved in the configuration file, when the switch restarts, the interface does not need to dynamically reconfigure them.

## Sticky Secure MAC Addresses

You can configure an interface to convert the dynamic MAC addresses to sticky secure MAC addresses and to add them to the running configuration by enabling sticky learning. The interface converts all the dynamic secure MAC addresses, including those that were dynamically learned before sticky learning was enabled, to sticky secure MAC addresses. All sticky secure MAC addresses are added to the running configuration.

The sticky secure MAC addresses do not automatically become part of the configuration file, which is the startup configuration used each time the switch restarts. If you save the sticky secure MAC addresses in the configuration file, when the switch restarts, the interface does not need to relearn these addresses. If you do not save the sticky secure addresses, they are lost.

If sticky learning is disabled, the sticky secure MAC addresses are converted to dynamic secure addresses and are removed from the running configuration.

## Security Violations

It is a security violation when one of these situations occurs:

- The maximum number of secure MAC addresses have been added to the address table, and a station whose MAC address is not in the address table attempts to access the interface.
- An address learned or configured on one secure interface is seen on another secure interface in the same VLAN.
- Running diagnostic tests with port security enabled.

You can configure the interface for one of three violation modes, based on the action to be taken if a violation occurs:

- protect—when the number of secure MAC addresses reaches the maximum limit allowed on the port, packets with unknown source addresses are dropped until you remove a sufficient number of secure MAC addresses to drop below the maximum value or increase the number of maximum allowable addresses. You are not notified that a security violation has occurred.



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**Note** We do not recommend configuring the protect violation mode on a trunk port. The protect mode disables learning when any VLAN reaches its maximum limit, even if the port has not reached its maximum limit.

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- **restrict**—when the number of secure MAC addresses reaches the maximum limit allowed on the port, packets with unknown source addresses are dropped until you remove a sufficient number of secure MAC addresses to drop below the maximum value or increase the number of maximum allowable addresses. In this mode, you are notified that a security violation has occurred. An SNMP trap is sent, a syslog message is logged, and the violation counter increments.
- **shutdown**—a port security violation causes the interface to become error-disabled and to shut down immediately, and the port LED turns off. When a secure port is in the error-disabled state, you can bring it out of this state by entering the **errdisable recovery cause psecure-violation** global configuration command, or you can manually re-enable it by entering the **shutdown** and **no shut down** interface configuration commands. This is the default mode.
- **shutdown vlan**—Use to set the security violation mode per-VLAN. In this mode, the VLAN is error disabled instead of the entire port when a violation occurs

This table shows the violation mode and the actions taken when you configure an interface for port security.

**Table 3: Security Violation Mode Actions**

| Violation Mode | Traffic is forwarded<br><a href="#">1</a> | Sends SNMP trap | Sends syslog message | Displays error message<br><a href="#">2</a> | Violation counter increments | Shuts down port         |
|----------------|---|-----------------|----------------------|---|------------------------------|-------------------------|
| protect        | No  | No              | No                   | No  | No                           | No                      |
| restrict       | No  | Yes             | Yes                  | No  | Yes                          | No                      |
| shutdown       | No  | No              | No                   | No  | Yes                          | Yes                     |
| shutdown vlan  | No  | No              | Yes                  | No  | Yes                          | No<br><a href="#">3</a> |

<sup>1</sup> Packets with unknown source addresses are dropped until you remove a sufficient number of secure MAC addresses.

<sup>2</sup> The switch returns an error message if you manually configure an address that would cause a security violation.

<sup>3</sup> Shuts down only the VLAN on which the violation occurred.

## Port Security Aging

You can use port security aging to set the aging time for all secure addresses on a port. Two types of aging are supported per port:

- **Absolute**—The secure addresses on the port are deleted after the specified aging time.
- **Inactivity**—The secure addresses on the port are deleted only if the secure addresses are inactive for the specified aging time.

### Related Topics

[Enabling and Configuring Port Security Aging](#), on page 24

## Default Port Security Configuration

Table 4: Default Port Security Configuration

| Feature   | Default Setting  |
|---|--|
| Port security                                   | Disabled on a port.  |
| Sticky address learning                         | Disabled.  |
| Maximum number of secure MAC addresses per port | 1.   |
| Violation mode                                  | Shutdown. The port shuts down when the maximum number of secure MAC addresses is exceeded. |
| Port security aging                             | Disabled. Aging time is 0.<br>Static aging is disabled.<br>Type is absolute.               |

## Port Security Configuration Guidelines

- Port security can only be configured on static access ports or trunk ports. A secure port cannot be a dynamic access port.
- A secure port cannot be a destination port for Switched Port Analyzer (SPAN).




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**Note** Voice VLAN is only supported on access ports and not on trunk ports, even though the configuration is allowed.

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- When you enable port security on an interface that is also configured with a voice VLAN, set the maximum allowed secure addresses on the port to two. When the port is connected to a Cisco IP phone, the IP phone requires one MAC address. The Cisco IP phone address is learned on the voice VLAN, but is not learned on the access VLAN. If you connect a single PC to the Cisco IP phone, no additional MAC addresses are required. If you connect more than one PC to the Cisco IP phone, you must configure enough secure addresses to allow one for each PC and one for the phone.
- When a trunk port configured with port security and assigned to an access VLAN for data traffic and to a voice VLAN for voice traffic, entering the **switchport voice** and **switchport priority extend** interface configuration commands has no effect.  
  
When a connected device uses the same MAC address to request an IP address for the access VLAN and then an IP address for the voice VLAN, only the access VLAN is assigned an IP address.
- When you enter a maximum secure address value for an interface, and the new value is greater than the previous value, the new value overwrites the previously configured value. If the new value is less than the previous value and the number of configured secure addresses on the interface exceeds the new value, the command is rejected.
- The switch does not support port security aging of sticky secure MAC addresses.

This table summarizes port security compatibility with other port-based features.

**Table 5: Port Security Compatibility with Other Switch Features**

| Type of Port or Feature on Port                      | Compatible with Port Security |
|--|-------------------------------|
| DTP <sup>4</sup> port <sup>5</sup>                   | No                            |
| Trunk port   | Yes                           |
| Dynamic-access port <sup>6</sup>                     | No                            |
| Routed port  | No                            |
| SPAN source port                                     | Yes                           |
| SPAN destination port                                | No                            |
| EtherChannel   | Yes                           |
| Tunneling port                                       | Yes                           |
| Protected port                                       | Yes                           |
| IEEE 802.1x port                                     | Yes                           |
| Voice VLAN port <sup>7</sup>                         | Yes                           |
| IP source guard                                      | Yes                           |
| Dynamic Address Resolution Protocol (ARP) inspection | Yes                           |
| Flex Links   | Yes                           |

<sup>4</sup> DTP=Dynamic Trunking Protocol

<sup>5</sup> A port configured with the **switchport mode dynamic** interface configuration command.

<sup>6</sup> A VLAN Query Protocol (VQP) port configured with the **switchport access vlan dynamic** interface configuration command.

<sup>7</sup> You must set the maximum allowed secure addresses on the port to two plus the maximum number of secure addresses allowed on the access VLAN.

## How to Configure Port Security

### Enabling and Configuring Port Security

#### Before you begin

This task restricts input to an interface by limiting and identifying MAC addresses of the stations allowed to access the port:

## Procedure

|               | Command or Action   | Purpose   |
|---------------|---|---|
| <b>Step 1</b> | <b>enable</b><br><b>Example:</b><br><pre>Switch&gt; enable</pre>  | Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>                            |
| <b>Step 2</b> | <b>configure terminal</b><br><b>Example:</b><br><pre>Switch# configure terminal</pre>   | Enters global configuration mode.   |
| <b>Step 3</b> | <b>port-security mac-address forbidden mac address</b><br><b>Example:</b><br><pre>Switch(config)# port-security mac-address forbidden 2.2.2</pre> | Specifies a MAC address that should be forbidden by port-security on all the interfaces.  |
| <b>Step 4</b> | <b>interface interface-id</b><br><b>Example:</b><br><pre>Switch(config)# interface gigabitethernet 0/1</pre>                                      | Specifies the interface to be configured, and enter interface configuration mode.   |
| <b>Step 5</b> | <b>switchport mode {access   trunk}</b><br><b>Example:</b><br><pre>Switch(config-if)# switchport mode access</pre>                                | Sets the interface switchport mode as access or trunk; an interface in the default mode (dynamic auto) cannot be configured as a secure port. |
| <b>Step 6</b> | <b>switchport voice vlan vlan-id</b><br><b>Example:</b><br><pre>Switch(config-if)# switchport voice vlan 22</pre>                                 | Enables voice VLAN on a port.<br>vlan-id—Specifies the VLAN to be used for voice traffic.   |
| <b>Step 7</b> | <b>switchport port-security</b><br><b>Example:</b><br><pre>Switch(config-if)# switchport port-security</pre>                                      | Enable port security on the interface.  |

|        | Command or Action   | Purpose   |
|--------|---|---|
| Step 8 | <p><b>switchport port-security</b> [<b>maximum</b> <i>value</i> [<b>vlan</b> {<i>vlan-list</i>   {<b>access</b>   <b>voice</b>}}]]</p> <p><b>Example:</b></p> <pre>Switch(config-if)# switchport port-security maximum 20</pre> | <p>(Optional) Sets the maximum number of secure MAC addresses for the interface. The maximum number of secure MAC addresses that you can configure on a switch is set by the maximum number of available MAC addresses allowed in the system. This number is the total of available MAC addresses, including those used for other Layer 2 functions and any other secure MAC addresses configured on interfaces.</p> <p>(Optional) <b>vlan</b>—sets a per-VLAN maximum value</p> <p>Enter one of these options after you enter the <b>vlan</b> keyword:</p> <ul style="list-style-type: none"> <li>• <b>vlan-list</b>—On a trunk port, you can set a per-VLAN maximum value on a range of VLANs separated by a hyphen or a series of VLANs separated by commas. For nonspecified VLANs, the per-VLAN maximum value is used.</li> <li>• <b>access</b>—On an access port, specifies the VLAN as an access VLAN.</li> <li>• <b>voice</b>—On an access port, specifies the VLAN as a voice VLAN.</li> </ul> <p><b>Note</b> The <b>voice</b> keyword is available only if a voice VLAN is configured on a port and if that port is not the access VLAN. If an interface is configured for voice VLAN, configure a maximum of two secure MAC addresses.</p> |
| Step 9 | <p><b>switchport port-security violation</b> {<b>protect</b>   <b>restrict</b>   <b>shutdown</b>   <b>shutdown vlan</b>}</p> <p><b>Example:</b></p> <pre>Switch(config-if)# switchport port-security violation restrict</pre>   | <p>(Optional) Sets the violation mode, the action to be taken when a security violation is detected, as one of these:</p> <ul style="list-style-type: none"> <li>• <b>protect</b>—When the number of port secure MAC addresses reaches the maximum limit allowed on the port, packets with unknown source addresses are dropped until you remove a sufficient number of secure MAC addresses to drop below the maximum value or increase the number of maximum allowable addresses. You are not notified that a security violation has occurred.</li> </ul>   |

|                       | Command or Action  | Purpose   |
|-----------------------|--|---|
|                       |  | <p><b>Note</b> We do not recommend configuring the protect mode on a trunk port. The protect mode disables learning when any VLAN reaches its maximum limit, even if the port has not reached its maximum limit.</p> <ul style="list-style-type: none"> <li>• <b>restrict</b>—When the number of secure MAC addresses reaches the limit allowed on the port, packets with unknown source addresses are dropped until you remove a sufficient number of secure MAC addresses or increase the number of maximum allowable addresses. An SNMP trap is sent, a syslog message is logged, and the violation counter increments.</li> <li>• <b>shutdown</b>—The interface is error-disabled when a violation occurs, and the port LED turns off. An SNMP trap is sent, a syslog message is logged, and the violation counter increments.</li> <li>• <b>shutdown vlan</b>—Use to set the security violation mode per VLAN. In this mode, the VLAN is error disabled instead of the entire port when a violation occurs.</li> </ul> <p><b>Note</b> When a secure port is in the error-disabled state, you can bring it out of this state by entering the <b>errdisable recovery cause psecure-violation</b> global configuration command. You can manually re-enable it by entering the <b>shutdown</b> and <b>no shutdown</b> interface configuration commands or by using the <b>clear errdisable interface vlan</b> privileged EXEC command.</p> |
| <p><b>Step 10</b></p> | <p><b>switchport port-security</b> [<b>mac-address</b> <i>mac-address</i> [<b>vlan</b> {<i>vlan-id</i>} {<b>access</b>   <b>voice</b>}]]</p> <p><b>Example:</b></p> <pre>Switch(config-if)# switchport</pre> | <p>(Optional) Enters a secure MAC address for the interface. You can use this command to enter the maximum number of secure MAC addresses. If you configure fewer secure MAC</p>  |

|                | Command or Action  | Purpose  |
|----------------|--|--|
|                | <pre>port-security mac-address 00:A0:C7:12:C9:25 vlan 3 voice</pre>  | <p>addresses than the maximum, the remaining MAC addresses are dynamically learned.</p> <p><b>Note</b> If you enable sticky learning after you enter this command, the secure addresses that were dynamically learned are converted to sticky secure MAC addresses and are added to the running configuration.</p> <p>(Optional) <b>vlan</b>—sets a per-VLAN maximum value.</p> <p>Enter one of these options after you enter the <b>vlan</b> keyword:</p> <ul style="list-style-type: none"> <li>• <b>vlan-id</b>—On a trunk port, you can specify the VLAN ID and the MAC address. If you do not specify a VLAN ID, the native VLAN is used.</li> <li>• <b>access</b>—On an access port, specifies the VLAN as an access VLAN.</li> <li>• <b>voice</b>—On an access port, specifies the VLAN as a voice VLAN.</li> </ul> <p><b>Note</b> The <b>voice</b> keyword is available only if a voice VLAN is configured on a port and if that port is not the access VLAN. If an interface is configured for voice VLAN, configure a maximum of two secure MAC addresses.</p> |
| <b>Step 11</b> | <pre>switchport port-security mac-address sticky</pre> <p><b>Example:</b></p> <pre>Switch(config-if)# switchport port-security mac-address sticky</pre>  | (Optional) Enables sticky learning on the interface.   |
| <b>Step 12</b> | <pre>switchport port-security mac-address sticky [mac-address   vlan {vlan-id   {access   voice}}]</pre> <p><b>Example:</b></p> <pre>Switch(config-if)# switchport port-security mac-address sticky 00:A0:C7:12:C9:25 vlan voice</pre> | (Optional) Enters a sticky secure MAC address, repeating the command as many times as necessary. If you configure fewer secure MAC addresses than the maximum, the remaining MAC addresses are dynamically learned, are converted to sticky secure MAC addresses, and are added to the running configuration.  |

|                | Command or Action   | Purpose  |
|----------------|---|--|
|                |   | <p><b>Note</b> If you do not enable sticky learning before this command is entered, an error message appears, and you cannot enter a sticky secure MAC address.</p> <p>(Optional) <b>vlan</b>—sets a per-VLAN maximum value.</p> <p>Enter one of these options after you enter the <b>vlan</b> keyword:</p> <ul style="list-style-type: none"> <li>• <b>vlan-id</b>—On a trunk port, you can specify the VLAN ID and the MAC address. If you do not specify a VLAN ID, the native VLAN is used.</li> <li>• <b>access</b>—On an access port, specifies the VLAN as an access VLAN.</li> <li>• <b>voice</b>—On an access port, specifies the VLAN as a voice VLAN.</li> </ul> <p><b>Note</b> The <b>voice</b> keyword is available only if a voice VLAN is configured on a port and if that port is not the access VLAN.</p> |
| <b>Step 13</b> | <p><b>switchport port-security mac-address forbidden</b> <i>mac address</i></p> <p><b>Example:</b></p> <pre>Switch(config-if)# switchport port-security mac-address forbidden 2.2.2</pre> | Specifies a MAC address that should be forbidden by port-security on the particular interface.   |
| <b>Step 14</b> | <p><b>end</b></p> <p><b>Example:</b></p> <pre>Switch(config)# end</pre>   | Returns to privileged EXEC mode.   |
| <b>Step 15</b> | <p><b>show port-security</b></p> <p><b>Example:</b></p> <pre>Switch# show port-security</pre>   | Verifies your entries.   |
| <b>Step 16</b> | <p><b>show running-config</b></p> <p><b>Example:</b></p>  | Verifies your entries.   |

|                | Command or Action   | Purpose  |
|----------------|---|--|
|                | Switch# <code>show running-config</code>  |  |
| <b>Step 17</b> | <b>copy running-config startup-config</b><br><b>Example:</b><br>Switch# <code>copy running-config startup-config</code> | (Optional) Saves your entries in the configuration file. |

## Enabling and Configuring Port Security Aging

Use this feature to remove and add devices on a secure port without manually deleting the existing secure MAC addresses and to still limit the number of secure addresses on a port. You can enable or disable the aging of secure addresses on a per-port basis.

### Procedure

|               | Command or Action  | Purpose   |
|---------------|--|---|
| <b>Step 1</b> | <b>enable</b><br><b>Example:</b><br>Switch> <code>enable</code>  | Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>  |
| <b>Step 2</b> | <b>configure terminal</b><br><b>Example:</b><br>Switch# <code>configure terminal</code>  | Enters global configuration mode.   |
| <b>Step 3</b> | <b>interface <i>interface-id</i></b><br><b>Example:</b><br>Switch(config)# <code>interface gigabitethernet 0/1</code>  | Specifies the interface to be configured, and enter interface configuration mode.   |
| <b>Step 4</b> | <b>switchport port-security aging {static   time <i>time</i>   type {absolute   inactivity}}</b><br><b>Example:</b><br>Switch(config-if)# <code>switchport port-security aging time 120</code> | Enables or disable static aging for the secure port, or set the aging time or type. <p><b>Note</b> The switch does not support port security aging of sticky secure addresses.</p> Enter <b>static</b> to enable aging for statically configured secure addresses on this port. |

|               | Command or Action   | Purpose  |
|---------------|---|--|
|               |   | <p>For <i>time</i>, specifies the aging time for this port. The valid range is from 0 to 1440 minutes.</p> <p>For <i>type</i>, select one of these keywords:</p> <ul style="list-style-type: none"> <li>• <b>absolute</b>—Sets the aging type as absolute aging. All the secure addresses on this port age out exactly after the time (minutes) specified lapses and are removed from the secure address list.</li> <li>• <b>inactivity</b>—Sets the aging type as inactivity aging. The secure addresses on this port age out only if there is no data traffic from the secure source addresses for the specified time period.</li> </ul> |
| <b>Step 5</b> | <p><b>end</b></p> <p><b>Example:</b></p> <pre>Switch(config)# end</pre>   | Returns to privileged EXEC mode.   |
| <b>Step 6</b> | <p><b>show port-security [interface <i>interface-id</i>]<br/>[address]</b></p> <p><b>Example:</b></p> <pre>Switch# show port-security interface<br/>gigabitethernet 0/1</pre> | Verifies your entries.   |
| <b>Step 7</b> | <p><b>show running-config</b></p> <p><b>Example:</b></p> <pre>Switch# show running-config</pre>   | Verifies your entries.   |
| <b>Step 8</b> | <p><b>copy running-config startup-config</b></p> <p><b>Example:</b></p> <pre>Switch# copy running-config<br/>startup-config</pre>   | (Optional) Saves your entries in the configuration file.   |

**Related Topics**

[Port Security Aging](#), on page 16

## Configuration Examples for Port Security

This example shows how to enable port security on a port and to set the maximum number of secure addresses to 50. The violation mode is the default, no static secure MAC addresses are configured, and sticky learning is enabled.

```
Switch(config)# interface gigabitethernet 0/1
Switch(config-if)# switchport mode access
Switch(config-if)# switchport port-security
Switch(config-if)# switchport port-security maximum 50
Switch(config-if)# switchport port-security mac-address sticky
```

This example shows how to configure a static secure MAC address on VLAN 3 on a port:

```
Switch(config)# interface gigabitethernet 0/2
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport port-security
Switch(config-if)# switchport port-security mac-address 0000.0200.0004 vlan 3
```

This example shows how to enable sticky port security on a port, to manually configure MAC addresses for data VLAN and voice VLAN, and to set the total maximum number of secure addresses to 20 (10 for data VLAN and 10 for voice VLAN).

```
Switch(config)# interface tengigabitethernet 0/1
Switch(config-if)# switchport access vlan 21
Switch(config-if)# switchport mode access
Switch(config-if)# switchport voice vlan 22
Switch(config-if)# switchport port-security
Switch(config-if)# switchport port-security maximum 20
Switch(config-if)# switchport port-security violation restrict
Switch(config-if)# switchport port-security mac-address sticky
Switch(config-if)# switchport port-security mac-address sticky 0000.0000.0002
Switch(config-if)# switchport port-security mac-address 0000.0000.0003
Switch(config-if)# switchport port-security mac-address sticky 0000.0000.0001 vlan voice
Switch(config-if)# switchport port-security mac-address 0000.0000.0004 vlan voice
Switch(config-if)# switchport port-security maximum 10 vlan access
Switch(config-if)# switchport port-security maximum 10 vlan voice
```

### Related Topics

[Port Security](#), on page 14

[Enabling and Configuring Port Security](#)

## Additional References

### Error Message Decoder

| Description   | Link  |
|---|---|
| To help you research and resolve system error messages in this release, use the Error Message Decoder tool. | <a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a> |

### MIBs

| MIB                                      | MIBs Link  |
|--|--|
| All the supported MIBs for this release. | To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:<br><br><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a> |

### Technical Assistance

| Description   | Link  |
|---|---|
| <p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p> | <a href="http://www.cisco.com/support">http://www.cisco.com/support</a> |

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

# Information About Protocol Storm Protection

## Protocol Storm Protection

When a switch is flooded with Address Resolution Protocol (ARP) or control packets, high CPU utilization can cause the CPU to overload. These issues can occur:

- Routing protocol can flap because the protocol control packets are not received, and neighboring adjacencies are dropped.
- Spanning Tree Protocol (STP) reconverges because the STP bridge protocol data unit (BPDU) cannot be sent or received.
- CLI is slow or unresponsive.

Using protocol storm protection, you can control the rate at which control packets are sent to the switch by specifying the upper threshold for the packet flow rate. The supported protocols are ARP, ARP snooping, Dynamic Host Configuration Protocol (DHCP) v4, DHCP snooping, Internet Group Management Protocol (IGMP), and IGMP snooping.

When the packet rate exceeds the defined threshold, the switch drops all traffic arriving on the specified virtual port for 30 seconds. The packet rate is measured again, and protocol storm protection is again applied if necessary.

For further protection, you can manually error disable the virtual port, blocking all incoming traffic on the virtual port. You can manually enable the virtual port or set a time interval for automatic re-enabling of the virtual port.




---

**Note** Excess packets are dropped on no more than two virtual ports.

Virtual port error disabling is not supported for EtherChannel and Flexlink interfaces

---

## Default Protocol Storm Protection Configuration

Protocol storm protection is disabled by default. When it is enabled, auto-recovery of the virtual port is disabled by default.

# How to Configure Protocol Storm Protection

## Enabling Protocol Storm Protection

### Procedure

|        | Command or Action | Purpose                       |
|--------|-------------------|-------------------------------|
| Step 1 | enable            | Enables privileged EXEC mode. |

|               | Command or Action   | Purpose  |
|---------------|---|--|
|               | <b>Example:</b><br><br>Switch> <code>enable</code>  | <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>   |
| <b>Step 2</b> | <b>configure terminal</b><br><br><b>Example:</b><br><br>Switch# <code>configure terminal</code>                           | Enters global configuration mode.  |
| <b>Step 3</b> | <b>psp {arp   dhcp   igmp} pps value</b><br><br><b>Example:</b><br><br>Switch(config)# <code>psp dhcp pps 35</code>       | Configures protocol storm protection for ARP, IGMP, or DHCP.<br><br>For <i>value</i> , specifies the threshold value for the number of packets per second. If the traffic exceeds this value, protocol storm protection is enforced. The range is from 5 to 50 packets per second. |
| <b>Step 4</b> | <b>errdisable detect cause psp</b><br><br><b>Example:</b><br><br>Switch(config)# <code>errdisable detect cause psp</code> | (Optional) Enables error-disable detection for protocol storm protection. If this feature is enabled, the virtual port is error disabled. If this feature is disabled, the port drops excess packets without error disabling the port.   |
| <b>Step 5</b> | <b>errdisable recovery interval time</b><br><br><b>Example:</b><br><br>Switch   | (Optional) Configures an auto-recovery time (in seconds) for error-disabled virtual ports. When a virtual port is error-disabled, the switch auto-recovers after this time. The range is from 30 to 86400 seconds.   |
| <b>Step 6</b> | <b>end</b><br><br><b>Example:</b><br><br>Switch(config)# <code>end</code>   | Returns to privileged EXEC mode.   |
| <b>Step 7</b> | <b>show psp config {arp   dhcp   igmp}</b><br><br><b>Example:</b><br><br>Switch# <code>show psp config dhcp</code>        | Verifies your entries.   |

# Monitoring Protocol Storm Protection

| Command  | Purpose              |
|--|----------------------|
| <code>show psp config {arp   dhcp   igmp}</code> | Verify your entries. |

## Additional References

### Error Message Decoder

| Description   | Link  |
|---|---|
| To help you research and resolve system error messages in this release, use the Error Message Decoder tool. | <a href="https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi">https://www.cisco.com/cgi-bin/Support/Errordecoder/index.cgi</a> |

### MIBs

| MIB                                      | MIBs Link  |
|--|--|
| All the supported MIBs for this release. | To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:<br><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a> |

### Technical Assistance

| Description   | Link  |
|---|---|
| <p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p> | <a href="http://www.cisco.com/support">http://www.cisco.com/support</a> |