



# Configuring Network Security with ACLs

This chapter describes how to configure network security on the IE 4000, IE 4010 and IE5000 switches by using access control lists (ACLs), also referred to as access lists. In this chapter, references to IP ACLs are specific to IP Version 4 (IPv4) ACLs, Port ACLs, VLAN ACLs and VLAN Maps.

- [Understanding ACLs](#)
- [Configuring IPv4 ACLs](#)
- [How to Configure Network Security with ACLs](#)
- [Monitoring and Maintaining Network Security with ACLs](#)
- [Configuration Examples for Network Security with ACLs](#)
- [Configuring VLAN Maps with ACLs](#)
- [Additional References](#)

## Understanding ACLs

Packet filtering can help limit network traffic and restrict network use by certain users or devices. ACLs filter traffic as it passes through a router or switch and permit or deny packets crossing specified interfaces or VLANs. An ACL is a sequential collection of permit and deny conditions that apply to packets. When a packet is received on an interface, the switch compares the fields in the packet against any applied ACLs to verify that the packet has the required permissions to be forwarded, based on the criteria specified in the access lists. One by one, it tests packets against the conditions in an access list. The first match decides whether the switch accepts or rejects the packets. Because the switch stops testing after the first match, the order of conditions in the list is critical. If no conditions match, the switch rejects the packet. If there are no restrictions, the switch forwards the packet; otherwise, the switch drops the packet. The switch can use ACLs on all packets it forwards, including packets bridged within a VLAN.

You configure access lists on a router or Layer 3 switch to provide basic security for your network. If you do not configure ACLs, all packets passing through the switch could be allowed onto all parts of the network. You can use ACLs to control which hosts can access different parts of a network or to decide which types of traffic are forwarded or blocked at router interfaces. For example, you can allow e-mail traffic to be forwarded but not Telnet traffic. ACLs can be configured to block inbound traffic, outbound traffic, or both.

An ACL contains an ordered list of access control entries (ACEs). Each ACE specifies *permit* or *deny* and a set of conditions the packet must satisfy in order to match the ACE. The meaning of *permit* or *deny* depends on the context in which the ACL is used.

The switch supports IP ACLs and Ethernet (MAC) ACLs:

- IP ACLs filter IPv4 traffic, including TCP, User Datagram Protocol (UDP), Internet Group Management Protocol (IGMP), and Internet Control Message Protocol (ICMP).
- Ethernet ACLs filter non-IP traffic.

This switch also supports quality of service (QoS) classification ACLs. For more information, see [Classification Based on QoS ACLs, page 622](#).

These sections contain this conceptual information:

- [Supported ACLs, page 576](#)
- [Handling Fragmented and Unfragmented Traffic, page 578](#)

## Supported ACLs

**Note:** Router ACLs and VLAN maps are supported only on switches running the IP services image.

Port ACLs access-control traffic entering a Layer 2 interface. The switch does not support port ACLs in the outbound direction. You can apply only one IP access list and one MAC access list to a Layer 2 interface. For more information, see [Port ACLs, page 576](#).

If IEEE 802.1Q tunneling is configured on an interface, any IEEE 802.1Q encapsulated IP packets received on the tunnel port can be filtered by MAC ACLs, but not by IP ACLs. This is because the switch does not recognize the protocol inside the IEEE 802.1Q header. This restriction applies to router ACLs and port ACLs.

## Port ACLs

Port ACLs are ACLs that are applied to Layer 2 interfaces on a switch. Port ACLs are supported only on physical interfaces and not on EtherChannel interfaces and can be applied only on interfaces in the inbound direction. These access lists are supported:

- Standard IP access lists using source addresses
- Extended IP access lists using source and destination addresses and optional protocol type information
- MAC extended access lists using source and destination MAC addresses and optional protocol type information

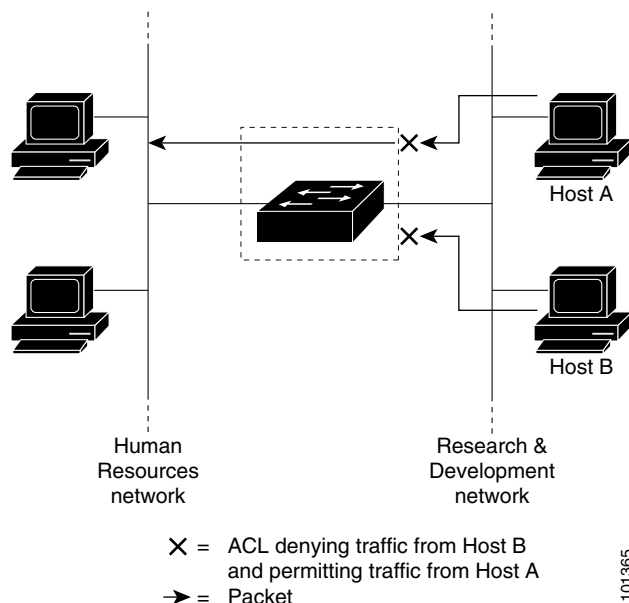
The switch examines ACLs associated with all inbound features configured on a given interface and permits or denies packet forwarding based on how the packet matches the entries in the ACL. In this way, ACLs control access to a network or to part of a network. [Figure 74 on page 577](#) is an example of using port ACLs to control access to a network when all workstations are in the same VLAN. ACLs applied at the Layer 2 input would allow Host A to access the Human Resources network, but prevent Host B from accessing the same network. Port ACLs can only be applied to Layer 2 interfaces in the inbound direction.

When you apply a port ACL to a trunk port, the ACL filters traffic on all VLANs present on the trunk port. When you apply a port ACL to a port with voice VLAN, the ACL filters traffic on both data and voice VLANs.

With port ACLs, you can filter IP traffic by using IP access lists and non-IP traffic by using MAC addresses. You can filter both IP and non-IP traffic on the same Layer 2 interface by applying both an IP access list and a MAC access list to the interface.

**Note:** You cannot apply more than one IP access list and one MAC access list to a Layer 2 interface. If an IP access list or MAC access list is already configured on a Layer 2 interface and you apply a new IP access list or MAC access list to the interface, the new ACL replaces the previously configured one.

**Figure 74 Using ACLs to Control Traffic to a Network**



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## Router ACLs

You can apply router ACLs on switch virtual interfaces (SVIs), which are Layer 3 interfaces to VLANs; on physical Layer 3 interfaces; and on Layer 3 EtherChannel interfaces. You apply router ACLs on interfaces for specific directions (inbound or outbound). You can apply one router ACL in each direction on an interface.

An ACL can be used with multiple features for a given interface, and one feature can use multiple ACLs. When a single router ACL is used by multiple features, it is examined multiple times.

Supported access lists for IPv4 traffic:

- Standard IP access lists use source addresses for matching operations.
- Extended IP access lists use source and destination addresses and optional protocol information for matching operations.

As with port ACLs, the switch examines ACLs associated with features configured on a given interface. However, you can apply only inbound port ACLs, while router ACLs are supported in both directions. As packets enter the switch on an interface, ACLs associated with all inbound features configured on that interface are examined. After packets are routed and before they are forwarded to the next hop, all ACLs associated with outbound features configured on the egress interface are examined.

ACLs permit or deny packet forwarding based on how the packet matches the entries in the ACL and can be used to control access to a network or to part of a network. In Figure 37-1, ACLs applied at the router input allow Host A to access the Human Resources network but prevent Host B from accessing the same network.

## VLAN Maps

Use VLAN ACLs or VLAN maps to access-control all traffic. You can apply VLAN maps to all packets that are routed into or out of a VLAN or are bridged within a VLAN in the switch.

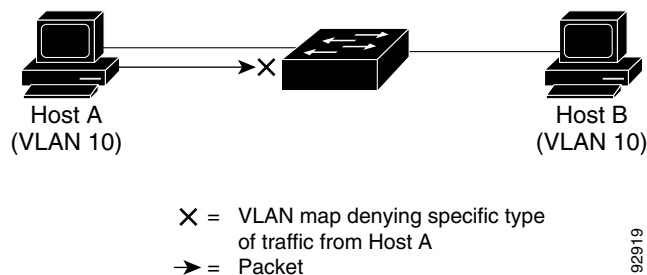
Use VLAN maps for security packet filtering. VLAN maps are not defined by direction (input or output).

You can configure VLAN maps to match Layer 3 addresses for IPv4 traffic.

All non-IP protocols are access-controlled through MAC addresses and Ethertype using MAC VLAN maps. (IP traffic is not access controlled by MAC VLAN maps.) You can enforce VLAN maps only on packets going through the switch; you cannot enforce VLAN maps on traffic between hosts on a hub or on another switch connected to this switch.

With VLAN maps, forwarding of packets is permitted or denied, based on the action specified in the map. Figure 37-2 shows how a VLAN map is applied to prevent a specific type of traffic from Host A in VLAN 10 from being forwarded. You can apply only one VLAN map to a VLAN.

**Figure 75 Using VLAN Maps to Control Traffic**



## Handling Fragmented and Unfragmented Traffic

IP packets can be fragmented as they cross the network. When this happens, only the fragment containing the beginning of the packet contains the Layer 4 information, such as TCP or UDP port numbers, ICMP type and code, and so on. All other fragments are missing this information.

Some ACEs do not check Layer 4 information and therefore can be applied to all packet fragments. ACEs that do test Layer 4 information cannot be applied in the standard manner to most of the fragments in a fragmented IP packet. When the fragment contains no Layer 4 information and the ACE tests some Layer 4 information, the matching rules are modified:

- Permit ACEs that check the Layer 3 information in the fragment (including protocol type, such as TCP, UDP, and so on) are considered to match the fragment regardless of what the missing Layer 4 information might have been.
- Deny ACEs that check Layer 4 information never match a fragment unless the fragment contains Layer 4 information.

Consider access list 102, configured with these commands, applied to three fragmented packets:

```
Switch(config)# access-list 102 permit tcp any host 10.1.1.1 eq smtp
Switch(config)# access-list 102 deny tcp any host 10.1.1.2 eq telnet
Switch(config)# access-list 102 permit tcp any host 10.1.1.2
Switch(config)# access-list 102 deny tcp any any
```

**Note:** In the first and second ACEs in the examples, the `eq` keyword after the destination address means to test for the TCP-destination-port well-known numbers equaling Simple Mail Transfer Protocol (SMTP) and Telnet, respectively.

- Packet A is a TCP packet from host 10.2.2.2., port 65000, going to host 10.1.1.1 on the SMTP port. If this packet is fragmented, the first fragment matches the first ACE (a permit) as if it were a complete packet because all Layer 4 information is present. The remaining fragments also match the first ACE, even though they do not contain the SMTP port information, because the first ACE only checks Layer 3 information when applied to fragments. The information in this example is that the packet is TCP and that the destination is 10.1.1.1.
- Packet B is from host 10.2.2.2, port 65001, going to host 10.1.1.2 on the Telnet port. If this packet is fragmented, the first fragment matches the second ACE (a deny) because all Layer 3 and Layer 4 information is present. The remaining fragments in the packet do not match the second ACE because they are missing Layer 4 information. Instead, they match the third ACE (a permit).

Because the first fragment was denied, host 10.1.1.2 cannot reassemble a complete packet, so packet B is effectively denied. However, the later fragments that are permitted will consume bandwidth on the network and resources of host 10.1.1.2 as it tries to reassemble the packet.

- Fragmented packet C is from host 10.2.2.2, port 65001, going to host 10.1.1.3, port ftp. If this packet is fragmented, the first fragment matches the fourth ACE (a deny). All other fragments also match the fourth ACE because that ACE does not check any Layer 4 information and because Layer 3 information in all fragments shows that they are being sent to host 10.1.1.3, and the earlier permit ACEs were checking different hosts.

## Configuring IPv4 ACLs

Configuring IPv4 ACLs on the switch is the same as configuring IPv4 ACLs on other Cisco switches and routers.

1. Create an ACL by specifying an access list number or name and the access conditions.
2. Apply the ACL to interfaces or terminal lines.

Refer to the following sections for configuration information:

- [Creating Standard and Extended IPv4 ACLs](#)
- [Applying an IPv4 ACL to a Terminal Line](#)
- [IPv4 ACL Application to an Interface Guidelines](#)
- [Hardware and Software Handling of IP ACLs](#)
- [Troubleshooting ACLs](#)

## Creating Standard and Extended IPv4 ACLs

This section describes IP ACLs. An ACL is a sequential collection of permit and deny conditions. One by one, the switch tests packets against the conditions in an access list. The first match determines whether the switch accepts or rejects the packet. Because the switch stops testing after the first match, the order of the conditions is critical. If no conditions match, the switch denies the packet.

The software supports these types of ACLs or access lists for IPv4:

- Standard IP access lists use source addresses for matching operations.
- Extended IP access lists use source and destination addresses for matching operations and optional protocol-type information for finer granularity of control.

The switch always rewrites the order of standard access lists so that entries with **host** matches and entries with matches having a *don't care* mask of 0.0.0.0 are moved to the top of the list, above any entries with non-zero *don't care* masks. Therefore, in **show** command output and in the configuration file, the ACEs do not necessarily appear in the order in which they were entered.

After creating a numbered standard IPv4 ACL, you can apply it to terminal lines (see [Applying an IPv4 ACL to a Terminal Line, page 595](#)), to interfaces (see [Applying an IPv4 ACL to an Interface, page 596](#)), or to VLANs (see [Monitoring and Maintaining Network Security with ACLs, page 598](#)).

## Access List Numbers

The number you use to denote your ACL shows the type of access list that you are creating. [Table 56 on page 580](#) lists the access-list number and corresponding access list type and shows whether or not they are supported in the switch. The switch supports IPv4 standard and extended access lists, numbers 1 to 199 and 1300 to 2699.

**Table 56 Access List Number Support**

Access List Number	Type	Supported
1-99	IP standard access list	Yes
100-199	IP extended access list	Yes
200-299	Protocol type-code access list	No
300-399	DECnet access list	No
400-499	XNS standard access list	No
500-599	XNS extended access list	No
600-699	AppleTalk access list	No
700-799	48-bit MAC address access list	No
800-899	IPX standard access list	No
900-999	IPX extended access list	No
1000-1099	IPX SAP access list	No
1100-1199	Extended 48-bit MAC address access list	No
1200-1299	IPX summary address access list	No
1300-1999	IP standard access list (expanded range)	Yes
2000-2699	IP extended access list (expanded range)	Yes

**Note:** In addition to numbered standard and extended ACLs, you can also create standard and extended named IP ACLs by using the supported numbers. That is, the name of a standard IP ACL can be 1 to 99; the name of an extended IP ACL can be 100 to 199. The advantage of using named ACLs instead of numbered lists is that you can delete individual entries from a named list.

## ACL Logging

The switch software can provide logging messages about packets permitted or denied by a standard IP access list. That is, any packet that matches the ACL causes an informational logging message about the packet to be sent to the console. The level of messages logged to the console is controlled by the logging console commands controlling the syslog messages.

**Note:** Because routing is done in hardware and logging is done in software, if a large number of packets match a *permit* or *deny* ACE containing a **log** keyword, the software might not be able to match the hardware processing rate, and not all packets will be logged.

The first packet that triggers the ACL causes a logging message right away, and subsequent packets are collected over 5-minute intervals before they appear or logged. The logging message includes the access list number, whether the packet was permitted or denied, the source IP address of the packet, and the number of packets from that source permitted or denied in the prior 5-minute interval.

## Creating a Numbered Standard ACL

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>access-list</b> access-list-number {deny   permit} source [source-wildcard] [log]	<p>Define a standard IPv4 access list by using a source address and wildcard.</p> <p>The <i>access-list-number</i> is a decimal number from 1 to 99 or 1300 to 1999.</p> <p>Enter <b>deny</b> or <b>permit</b> to specify whether to deny or permit access if conditions are matched.</p> <p>The <i>source</i> is the source address of the network or host from which the packet is being sent specified as:</p> <p>The 32-bit quantity in dotted-decimal format.</p> <ul style="list-style-type: none"> <li>■ The keyword <b>any</b> as an abbreviation for source and source-wildcard of 0.0.0.0 255.255.255.255. You do not need to enter a source-wildcard.</li> <li>■ The keyword <b>host</b> as an abbreviation for source and source-wildcard of source 0.0.0.0.</li> </ul> <p>(Optional) The <i>source-wildcard</i> applies wildcard bits to the source.</p> <p>(Optional) Enter <b>log</b> to cause an informational logging message about the packet that matches the entry to be sent to the console.</p> <p>(Optional) Enter <b>log</b> to cause an informational logging message about the packet that matches the entry to be sent to the console.</p>
Step 3	<b>end</b>	Return to privileged EXEC mode.
Step 4	<b>show access-lists</b> [number   name]	Show the access list configuration.
Step 5	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

**Note:** Use the **no access-list** *access-list-number* global configuration command to delete the entire ACL. You cannot delete individual ACEs from numbered access lists.

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This example shows how to create a standard ACL to deny access to IP host 171.69.198.102, permit access to any others, and display the results.

## Configuring IPv4 ACLs

```
Switch (config)# access-list 2 deny host 171.69.198.102
Switch (config)# access-list 2 permit any
Switch(config)# end
Switch# show access-lists
Standard IP access list 2
10 deny 171.69.198.102
20 permit any
```

The switch always rewrites the order of standard access lists so that entries with **host** matches and entries with matches having a don't care mask of 0.0.0.0 are moved to the top of the list, above any entries with non-zero don't care masks.

Therefore, in **show** command output and in the configuration file, the ACEs do not necessarily appear in the order in which they were entered.

## Creating a Numbered Extended ACL

Although standard ACLs use only source addresses for matching, you can use extended ACL source and destination addresses for matching operations and optional protocol type information for finer granularity of control. When you are creating ACEs in numbered extended access lists, remember that after you create the ACL, any additions are placed at the end of the list. You cannot reorder the list or selectively add or remove ACEs from a numbered list.

Some protocols also have specific parameters and keywords that apply to that protocol.

These IP protocols are supported (protocol keywords are in parentheses in **bold**):

Authentication Header Protocol (**ahp**), Enhanced Interior Gateway Routing Protocol (**eigrp**), Encapsulation Security Payload (**esp**), generic routing encapsulation (**gre**), Internet Control Message Protocol (**icmp**), Internet Group Management Protocol (**igmp**), any Interior Protocol (**ip**), IP in IP tunneling (**ipinip**), KA9Q NOS-compatible IP over IP tunneling (**nos**), Open Shortest Path First routing (**ospf**), Payload Compression Protocol (**pcp**), Protocol Independent Multicast (**pim**), Transmission Control Protocol (**tcp**), User Datagram Protocol (**udp**),

**Note:** ICMP echo-reply cannot be filtered. All other ICMP codes or types can be filtered.

**Note:** The switch does not support dynamic or reflexive access lists. It also does not support filtering based on the type of service (ToS) minimize-monetary-cost bit.

Supported parameters can be grouped into these categories: TCP, UDP, ICMP, IGMP, or other IP.

After an ACL is created, any additions (possibly entered from the terminal) are placed at the end of the list. You cannot selectively add or remove access list entries from a numbered access list.

**Note:** When you are creating an ACL, remember that, by default, the end of the access list contains an implicit deny statement for all packets if it did not find a match before reaching the end.

After creating a numbered extended ACL, you can apply it to terminal lines (see [Applying an IPv4 ACL to a Terminal Line, page 595](#)), to interfaces (see [Applying an IPv4 ACL to an Interface, page 596](#)), or to VLANs (see [Monitoring and Maintaining Network Security with ACLs, page 598](#))





	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2a	<p><b>access-list</b> <i>access-list-number</i> {deny   permit} <i>protocol source source-wildcard destination destination-wildcard</i> [<b>precedence</b> <i>precedence</i>] [<b>tos</b> <i>tos</i>] [<b>fragments</b>] [<b>log</b>] [<b>log-input</b>] [<b>time-range</b> <i>time-range-name</i>] [<b>dscp</b> <i>dscp</i>]</p> <p><b>Note:</b> If you enter a <b>dscp</b> value, you cannot enter <b>tos</b> or <b>precedence</b>. You can enter both a <b>tos</b> and a <b>precedence</b> value with no <b>dscp</b>.</p>	<p>Define an extended IPv4 access list and the access conditions. The <i>access-list-number</i> is a decimal number from 100 to 199 or 2000 to 2699.</p> <p>Enter <b>deny</b> or <b>permit</b> to specify whether to deny or permit the packet if conditions are matched. For protocol, enter the name or number of an IP protocol: <b>ahp</b>, <b>eigrp</b>, <b>esp</b>, <b>gre</b>, <b>icmp</b>, <b>igmp</b>, <b>igrp</b>, <b>ip</b>, <b>ipinip</b>, <b>nos</b>, <b>ospf</b>, <b>pcp</b>, <b>pim</b>, <b>tcp</b>, or <b>udp</b>, or an integer in the range 0 to 255 representing an IP protocol number. To match any Internet protocol (including ICMP, TCP, and UDP), use the keyword <b>ip</b>.</p> <p><b>Note:</b> This step includes options for most IP protocols. For additional specific parameters for TCP, UDP, ICMP, and IGMP, see steps 2b through 2e.</p> <p>The <i>source</i> is the number of the network or host from which the packet is sent.</p> <p>The <i>source-wildcard</i> applies wildcard bits to the source.</p> <p>The <i>destination</i> is the network or host number to which the packet is sent.</p> <p>The <i>destination-wildcard</i> applies wildcard bits to the destination.</p> <p>Source, <i>source-wildcard</i>, <i>destination</i>, and <i>destination-wildcard</i> can be specified as:</p> <ul style="list-style-type: none"> <li>■ The 32-bit quantity in dotted-decimal format.</li> <li>■ The keyword <b>any</b> for 0.0.0.0 255.255.255.255 (any host).</li> <li>■ The keyword <b>host</b> for a single host 0.0.0.0.</li> </ul>

	Command	Purpose
Step 2a, continued		<p>The other keywords are optional and have these meanings:</p> <ul style="list-style-type: none"> <li>■ <b>precedence</b>—Enter to match packets with a precedence level specified as a number from 0 to 7 or by name: <b>routine (0)</b>, <b>priority (1)</b>, <b>immediate (2)</b>, <b>flash (3)</b>, <b>flash-override (4)</b>, <b>critical (5)</b>, <b>internet (6)</b>, <b>network (7)</b>.</li> <li>■ <b>fragments</b>—Enter to check non-initial fragments.</li> <li>■ <b>tos</b>—Enter to match by type of service level, specified by a number from 0 to 15 or a name: normal (0), max-reliability (2), max-throughput (4), min-delay (8).</li> <li>■ <b>log</b>—Enter to create an informational logging message to be sent to the console about the packet that matches the entry or log-input to include the input interface in the log entry.</li> <li>■ If you enter a dscp value, you cannot enter tos or precedence. You can enter both a tos and a precedence value with no dscp</li> <li>■ <b>time-range</b>—For an explanation of this keyword, see the “Using Time Ranges with ACLs” section on page 37-17.</li> <li>■ <b>dscp</b>—Enter to match packets with the DSCP value specified by a number from 0 to 63, or use the question mark (?) to see a list of available values.</li> </ul>
or	<p><b>access-list</b> <i>access-list-number</i> {<b>deny</b>   <b>permit</b>} <i>protocol</i> <i>any</i> <i>any</i> [<b>precedence</b> <i>precedence</i>] [<b>tos</b> <i>tos</i>] [<b>fragments</b>] [<b>log</b>] [<b>log-input</b>] [<b>time-range</b> <i>time-range-name</i>] [<b>dscp</b> <i>dscp</i>]</p>	<p>In access-list configuration mode, define an extended IP access list using an abbreviation for a source and source wildcard of 0.0.0.0 255.255.255.255 and an abbreviation for a destination and destination wildcard of 0.0.0.0 255.255.255.255.</p> <p>You can use the any keyword in place of source and destination address and wildcard.</p>
or	<p><b>access-list</b> <i>access-list-number</i> {<b>deny</b>   <b>permit</b>} <i>protocol</i> <b>host</b> <i>source</i> <b>host</b> <i>destination</i> [<b>precedence</b> <i>precedence</i>] [<b>tos</b> <i>tos</i>] [<b>fragments</b>] [<b>log</b>] [<b>log-input</b>] [<b>time-range</b> <i>time-range-name</i>] [<b>dscp</b> <i>dscp</i>]</p>	<p>Define an extended IP access list by using an abbreviation for a source and a source wildcard of source 0.0.0.0 and an abbreviation for a destination and destination wildcard of destination 0.0.0.0.</p> <p>You can use the <b>host</b> keyword in place of the source and destination wildcard or mask.</p>

	Command	Purpose
Step 2b	<b>access-list</b> <i>access-list-number</i> <b>{deny   permit}</b> <b>tcp</b> <i>source source-wildcard</i> [ <i>operator port</i> ] <i>destination destination-wildcard</i> [ <i>operator port</i> ] <b>[established]</b> <b>[precedence precedence]</b> <b>[tos tos]</b> <b>[fragments]</b> <b>[log]</b> <b>[log-input]</b> <b>[time-range</b> <b>time-range-name]</b> <b>[dscp dscp]</b> <b>[flag]</b>	<p>(Optional) Define an extended TCP access list and the access conditions.</p> <p>Enter <b>tcp</b> for Transmission Control Protocol.</p> <p>The parameters are the same as those described in Step 2a, with these exceptions:</p> <p>(Optional) Enter an operator and port to compare source (if positioned after <i>source source-wildcard</i>) or destination (if positioned after <i>destination destination-wildcard</i>) port. Possible operators include <b>eq</b> (equal), <b>gt</b> (greater than), <b>lt</b> (less than), <b>neq</b> (not equal), and <b>range</b> (inclusive range). Operators require a port number (range requires two port numbers separated by a space).</p> <p>Enter the port number as a decimal number (from 0 to 65535) or the name of a TCP port. To see TCP port names, use the <b>?</b> or see the "Configuring IP Services" section in the "IP Addressing and Services" chapter of the Cisco IOS IP Configuration Guide, Release 12.2. Use only TCP port numbers or names when filtering TCP.</p> <p>The other optional keywords have these meanings:</p> <ul style="list-style-type: none"> <li>■ <b>established</b>—Enter to match an established connection. This has the same function as matching on the <b>ack</b> or <b>rst</b> flag.</li> <li>■ <b>flag</b>—Enter one of these flags to match by the specified TCP header bits: <b>ack</b> (acknowledge), <b>fin</b> (finish), <b>psh</b> (push), <b>rst</b> (reset), <b>syn</b> (synchronize), or <b>urg</b> (urgent)</li> </ul>
Step 2c	<b>access-list</b> <i>access-list-number</i> <b>{deny   permit}</b> <b>udp</b> <i>source source-wildcard</i> [ <i>operator port</i> ] <i>destination destination-wildcard</i> [ <i>operator port</i> ] <b>[precedence precedence]</b> <b>[tos tos]</b> <b>[fragments]</b> <b>[log]</b> <b>[log-input]</b> <b>[time-range time-range-name]</b> <b>[dscp dscp]</b>	<p>(Optional) Define an extended UDP access list and the access conditions.</p> <p>Enter <b>udp</b> for the User Datagram Protocol.</p> <p>The UDP parameters are the same as those described for TCP except that the [<i>operator [port]</i>] port number or name must be a UDP port number or name, and the <b>flag</b> and <b>established</b> parameters are not valid for UDP.</p>

	Command	Purpose
Step 2d	<b>access-list</b> <i>access-list-number</i> {deny   permit} <b>icmp</b> <i>source source-wildcard destination destination-wildcard</i> [ <i>icmp-type</i>   [ <i>icmp-type icmp-code</i> ]   [ <i>icmp-message</i> ]] [ <b>precedence</b> <i>precedence</i> ] [ <b>tos</b> <i>tos</i> ] [ <b>fragments</b> ] [ <b>log</b> ] [ <b>log-input</b> ] [ <b>time-range</b> <i>time-range-name</i> ] [ <b>dscp</b> <i>dscp</i> ]	<p>(Optional) Define an extended ICMP access list and the access conditions.</p> <p>Enter <b>icmp</b> for Internet Control Message Protocol.</p> <p>The ICMP parameters are the same as those described for most IP protocols in Step 2a, with the addition of the ICMP message type and code parameters. These optional keywords have these meanings:</p> <ul style="list-style-type: none"> <li>■ <b>icmp-type</b>—Enter to filter by ICMP message type, a number from 0 to 255.</li> <li>■ <b>icmp-code</b>—Enter to filter ICMP packets that are filtered by the ICMP message code type, a number from 0 to 255.</li> <li>■ <b>icmp-message</b>—Enter to filter ICMP packets by the ICMP message type name or the ICMP message type and code name. To see a list of ICMP message</li> </ul>
Step 2e	<b>access-list</b> <i>access-list-number</i> {deny   permit} <b>igmp</b> <i>source source-wildcard destination destination-wildcard</i> [ <i>igmp-type</i> ] [ <b>precedence</b> <i>precedence</i> ] [ <b>tos</b> <i>tos</i> ] [ <b>fragments</b> ] [ <b>log</b> ] [ <b>log-input</b> ] [ <b>time-range</b> <i>time-range-name</i> ] [ <b>dscp</b> <i>dscp</i> ]	<p>(Optional) Define an extended IGMP access list and the access conditions.</p> <p>Enter <b>igmp</b> for Internet Group Management Protocol.</p> <p>The IGMP parameters are the same as those described for most IP protocols in Step 2a, with this optional parameter.</p> <p><i>igmp-type</i>—To match IGMP message type, enter a number from 0 to 15, or enter the message name (<b>dvmp</b>, <b>host-query</b>, <b>host-report</b>, <b>pim</b>, or <b>trace</b>)</p>
Step 3	<b>end</b>	Return to privileged EXEC mode.
Step 4	<b>show access-lists</b> [ <i>number</i>   <i>name</i> ]	Verify the access list configuration.
Step 5	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

Use the **no access-list** *access-list-number* global configuration command to delete the entire access list. You cannot delete individual ACEs from numbered access lists.

This example shows how to create and display an extended access list to deny Telnet access from any host in network 171.69.198.0 to any host in network 172.20.52.0 and to permit any others. (The eq keyword after the destination address means to test for the TCP destination port number equaling Telnet.)

```
Switch(config)# access-list 102 deny tcp 171.69.198.0 0.0.0.255 172.20.52.0 0.0.0.255 eq telnet
Switch(config)# access-list 102 permit tcp any any
Switch(config)# end
Switch# show access-lists
Extended IP access list 102
 10 deny tcp 171.69.198.0 0.0.0.255 172.20.52.0 0.0.0.255 eq telnet
 20 permit tcp any any
```

After an ACL is created, any additions (possibly entered from the terminal) are placed at the end of the list. You cannot selectively add or remove access list entries from a numbered access list.

**Note:** When you are creating an ACL, remember that, by default, the end of the access list contains an implicit deny statement for all packets if it did not find a match before reaching the end.

After creating a numbered extended ACL, you can apply it to terminal lines (see the [Applying an IPv4 ACL to a Terminal Line](#) section), to interfaces (see the [Applying an IPv4 ACL to an Interface](#) section), or to VLANs (see the [Configuring VLAN Maps](#) section).

## Resequencing ACEs in an ACL

Sequence numbers for the entries in an access list are automatically generated when you create a new ACL. You can use the **ip access-list resequence** global configuration command to edit the sequence numbers in an ACL and change the order in which ACEs are applied. For example, if you add a new ACE to an ACL, it is placed at the bottom of the list. By changing the sequence number, you can move the ACE to a different position in the ACL.

## Named Standard and Extended ACLs

You can identify IPv4 ACLs with an alphanumeric string (a name) rather than a number. You can use named ACLs to configure more IPv4 access lists in a router than if you were to use numbered access lists. If you identify your access list with a name rather than a number, the mode and command syntax are slightly different. However, not all commands that use IP access lists accept a named access list.

**Note:** The name you give to a standard or extended ACL can also be a number in the supported range of access list numbers. That is, the name of a standard IP ACL can be 1 to 99; the name of an extended IP ACL can be 100 to 199. The advantage of using named ACLs instead of numbered lists is that you can delete individual entries from a named list.

Consider these guidelines and limitations before configuring named ACLs:

- Not all commands that accept a numbered ACL accept a named ACL. ACLs for packet filters and route filters on interfaces can use a name.
- A standard ACL and an extended ACL cannot have the same name.
- Numbered ACLs are also available, as described in the [Creating a Numbered Standard ACL, page 591](#).

When you are creating standard extended ACLs, remember that, by default, the end of the ACL contains an implicit deny statement for everything if it did not find a match before reaching the end. For standard ACLs, if you omit the mask from an associated IP host address access list specification, 0.0.0.0 is assumed to be the mask.

After you create an ACL, any additions are placed at the end of the list. You cannot selectively add ACL entries to a specific ACL. However, you can use **no permit** and **no deny** access-list configuration mode commands to remove entries from a named ACL. This example shows how you can delete individual ACEs from the named access list *border-list*:

```
Switch(config)# ip access-list extended border-list
Switch(config-ext-nacl)# no permit ip host 10.1.1.3 any
```

Being able to selectively remove lines from a named ACL is one reason you might use named ACLs instead of numbered ACLs.

## Time Ranges with ACLs

You can selectively apply extended ACLs based on the time of day and the week by using the **time-range** global configuration command. First, define a time-range name and set the times and the dates or the days of the week in the time range. Then enter the time-range name when applying an ACL to set restrictions to the access list. You can use the time range to define when the permit or deny statements in the ACL are in effect, for example, during a specified time period or on specified days of the week.

These are some of the many possible benefits of using time ranges:

- You have more control over permitting or denying a user access to resources, such as an application (identified by an IP address/mask pair and a port number).

## Configuring IPv4 ACLs

- You can control logging messages. ACL entries can be set to log traffic only at certain times of the day. Therefore, you can simply deny access without needing to analyze many logs generated during peak hours.

Time-based access lists trigger CPU activity because the new configuration of the access list must be merged with other features and the combined configuration loaded into the TCAM. For this reason, you should be careful not to have several access lists configured to take effect in close succession (within a small number of minutes of each other.)

**Note:** The time range relies on the switch system clock; therefore, you need a reliable clock source. We recommend that you use Network Time Protocol (NTP) to synchronize the switch clock.

## Comments in ACLs

You can use the **remark** keyword to include comments (remarks) about entries in any IP standard or extended ACL. The remarks make the ACL easier for you to understand and scan. Each remark line is limited to 100 characters.

The remark can go before or after a permit or deny statement. You should be consistent about where you put the remark so that it is clear which remark describes which permit or deny statement. For example, it would be confusing to have some remarks before the associated permit or deny statements and some remarks after the associated statements.

To include a comment for IP numbered standard or extended ACLs, use the **access-list access-list number remark remark** global configuration command. To remove the remark, use the **no** form of this command.

## Applying an IPv4 ACL to a Terminal Line

You can use numbered ACLs to control access to one or more terminal lines. You cannot apply named ACLs to lines. You must set identical restrictions on all the virtual terminal lines because a user can attempt to connect to any of them.

For procedures for applying ACLs to interfaces, see [Applying an IPv4 ACL to an Interface, page 596](#). For applying ACLs to VLANs, see [Monitoring and Maintaining Network Security with ACLs, page 598](#).

## IPv4 ACL Application to an Interface Guidelines

- Apply an ACL only to inbound Layer 2 ports.
- Apply an ACL to either outbound or inbound Layer 3 interfaces.
- When controlling access to an interface, you can use a named or numbered ACL.
- If you apply an ACL to a port that is a member of a VLAN, the port ACL takes precedence over an ACL applied to the VLAN interface.
- If you apply an ACL to a Layer 2 interface that is a member of a VLAN, the Layer 2 (port) ACL takes precedence over an input Layer 3 ACL applied to the VLAN interface. The port ACL always filters incoming packets received on the Layer 2 port.
- If you apply an ACL to a Layer 3 interface and routing is not enabled, the ACL only filters packets that are intended for the CPU, such as SNMP, Telnet, or web traffic. You do not have to enable routing to apply ACLs to Layer 2 interfaces.
- When private VLANs are configured, you can apply router ACLs only on the primary-VLAN SVIs. The ACL is applied to both primary and secondary VLAN Layer 3 traffic.

**Note:** By default, the router sends Internet Control Message Protocol (ICMP) unreachable messages when a packet is denied by an access group. These access-group denied packets are not dropped in hardware but are bridged to the switch CPU so that it can generate the ICMP-unreachable message. Port ACLs are an exception. They do not generate

ICMP unreachable messages.

ICMP unreachable messages can be disabled on router ACLs with the **no ip unreachable** interface command.

For inbound ACLs, after receiving a packet, the switch checks the packet against the ACL. If the ACL permits the packet, the switch continues to process the packet. If the ACL rejects the packet, the switch discards the packet.

For outbound ACLs, after receiving and sending a packet to a controlled interface, the switch checks the packet against the ACL. If the ACL permits the packet, the switch sends the packet. If the ACL rejects the packet, the switch discards the packet.

By default, the input interface sends ICMP Unreachable messages whenever a packet is discarded, regardless of whether the packet was discarded because of an ACL on the input interface or because of an ACL on the output interface. ICMP Unreachables are normally limited to no more than one every one-half second per input interface, but this can be changed by using the **ip icmp rate-limit unreachable** global configuration command.

When you apply an undefined ACL to an interface, the switch acts as if the ACL has not been applied to the interface and permits all packets. Remember this behavior if you use undefined ACLs for network security.

## Hardware and Software Handling of IP ACLs

ACL processing is primarily accomplished in hardware, but requires forwarding of some traffic flows to the CPU for software processing. If the hardware reaches its capacity to store ACL configurations, packets are sent to the CPU for forwarding. The forwarding rate for software-forwarded traffic is substantially less than for hardware-forwarded traffic.

**Note:** If an ACL configuration cannot be implemented in hardware due to an out-of-resource condition on a switch, then only the traffic in that VLAN arriving on that switch is affected (forwarded in software). Software forwarding of packets might adversely impact the performance of the switch, depending on the number of CPU cycles that this consumes.

For router ACLs, other factors can cause packets to be sent to the CPU:

- Using the **log** keyword
- Generating ICMP unreachable messages

When traffic flows are both logged and forwarded, forwarding is done by hardware, but logging must be done by software. Because of the difference in packet handling capacity between hardware and software, if the sum of all flows being logged (both permitted flows and denied flows) is of significant bandwidth, not all of the packets that are forwarded can be logged.

If router ACL configuration cannot be applied in hardware, packets arriving in a VLAN that must be routed are routed in software, but are bridged in hardware. If ACLs cause large numbers of packets to be sent to the CPU, the switch performance can be negatively affected.

When you enter the **show ip access-lists** privileged EXEC command, the match count displayed does not account for packets that are access controlled in hardware. Use the **show access-lists hardware counters** privileged EXEC command to obtain some basic hardware ACL statistics for switched and routed packets.

## Troubleshooting ACLs

If this ACL manager message appears, where [chars] is the access-list name, the switch then has insufficient resources to create a hardware representation of the ACL.

```
ACL MGR-2-NOVMR: Cannot generate hardware representation of access list [chars]
```

The resources include hardware memory and label space but not CPU memory. A lack of available logical operation units or specialized hardware resources causes this problem. Logical operation units are needed for a TCP flag match or a test other than **eq** (**ne**, **gt**, **lt**, or **range**) on TCP, UDP, or SCTP port numbers.

Use one of these workarounds:



## How to Configure Network Security with ACLs

- Modify the ACL configuration to use fewer resources.
- Rename the ACL with a name or number that alphanumerically precedes the ACL names or numbers.

To determine the specialized hardware resources, enter the **show platform layer4 acl map** privileged EXEC command. If the switch does not have available resources, the output shows that index 0 to index 15 are not available.

For more information about configuring ACLs with insufficient resources, see CSCsq63926 in the Bug Toolkit.

## Named MAC Extended ACLs

You can filter non-IPv4 traffic on a VLAN or on a Layer 2 interface by using MAC addresses and named MAC extended ACLs. The procedure is similar to that of configuring other extended named ACLs.

**Note:** You cannot apply named MAC extended ACLs to Layer 3 interfaces.

**Note:** Though visible in the command-line help strings, **appletalk** is not supported as a matching condition for the **deny** and **permit** MAC access-list configuration mode commands.

## MAC ACL to a Layer 2 Interface

After you create a MAC ACL, you can apply it to a Layer 2 interface to filter non-IP traffic coming in that interface. When you apply the MAC ACL, consider these guidelines:

- If you apply an ACL to a Layer 2 interface that is a member of a VLAN, the Layer 2 (port) ACL takes precedence over an input Layer 3 ACL applied to the VLAN interface. Incoming packets received on the Layer 2 port are always filtered by the port ACL.
- You can apply no more than one IP access list and one MAC access list to the same Layer 2 interface. The IP access list filters only IP packets, and the MAC access list filters non-IP packets.
- A Layer 2 interface can have only one MAC access list. If you apply a MAC access list to a Layer 2 interface that has a MAC ACL configured, the new ACL replaces the previously configured one.

## How to Configure Network Security with ACLs

### Creating a Numbered Standard ACL

**Note:** When creating an ACL, remember that, by default, the end of the ACL contains an implicit deny statement for all packets that it did not find a match for before reaching the end. With standard access lists, if you omit the mask from an associated IP host address ACL specification, 0.0.0.0 is assumed to be the mask.

	Command	Purpose
1.	<b>configure terminal</b>	Enters global configuration mode.
2.	<b>access-list</b> <i>access-list-number</i> { <b>deny</b>   <b>permit</b> } <i>source</i> [ <i>source-wildcard</i> ] [ <b>log</b> ]  <b>Note:</b> Use the <code>no access-list access-list-number global configuration command</code> to delete the entire ACL.	Defines a standard IPv4 access list by using a source address and wildcard.  <i>access-list-number</i> —Specifies a decimal number from 1 to 99 or 1300 to 1999.  <b>deny</b> or <b>permit</b> —Specifies whether to deny or permit access if conditions are matched.  <i>source</i> —Specifies the source address of the network or host from which the packet is being sent specified as: <ul style="list-style-type: none"> <li>■ The 32-bit quantity in dotted-decimal format.</li> <li>■ The keyword <b>any</b> as an abbreviation for <i>source</i> and <i>source-wildcard</i> of 0.0.0.0 255.255.255.255. You do not need to enter a source-wildcard.</li> <li>■ The keyword <b>host</b> as an abbreviation for source and source-wildcard of <i>source</i> 0.0.0.0.</li> </ul> (Optional) <i>source-wildcard</i> —Applies wildcard bits to the source.  (Optional) <b>log</b> —Causes an informational logging message about the packet that matches the entry to be sent to the console.
3.	<b>end</b>	Returns to privileged EXEC mode.
4.	<b>show access-lists</b> [ <i>number</i>   <i>name</i> ]	Show the access list configuration.
5.	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

## Creating a Numbered Extended ACL

Although standard ACLs use only source addresses for matching, you can use extended ACL source and destination addresses for matching operations and optional protocol type information for finer granularity of control. When you are creating ACEs in numbered extended access lists, remember that after you create the ACL, any additions are placed at the end of the list. You cannot reorder the list or selectively add or remove ACEs from a numbered list.

Some protocols also have specific parameters and keywords that apply to that protocol.

These IP protocols are supported (protocol keywords are in parentheses in bold):

Authentication Header Protocol (ahp), Enhanced Interior Gateway Routing Protocol (eigrp), Encapsulation Security Payload (esp), generic routing encapsulation (gre), Internet Control Message Protocol (icmp), Internet Group Management Protocol (igmp), any Interior Protocol (ip), IP in IP tunneling (ipinip), KA9Q NOS-compatible IP over IP tunneling (nos), Open Shortest Path First routing (ospf), Payload Compression Protocol (pcp), Protocol Independent.



	Command	Purpose
1.	<b>configure terminal</b>	Enters global configuration mode.
2. a	<p><b>access-list</b> <i>access-list-number</i>  { <b>deny</b>   <b>permit</b> } <i>protocol source</i>  <i>source-wildcard destination</i>  <i>destination-wildcard</i>  [ <b>precedence</b> <i>precedence</i> ] [ <b>tos</b> <i>tos</i> ]  [ <b>fragments</b> ] [ <b>log</b> ] [ <b>log-input</b> ]  [ <b>time-range</b> <i>time-range-name</i> ]  [ <b>dscp</b> <i>dscp</i> ]</p> <p><b>Note:</b> If you enter a dscp value, you cannot enter tos or precedence. You can enter both a tos and a precedence value with no dscp</p>	<p>Defines an extended IPv4 access list and the access conditions.</p> <p><i>access-list-number</i> – Specifies a decimal number from 100 to 199 or 2000 to 2699.</p> <p><i>deny or permit</i> – Specifies whether to deny or permit the packet if conditions are matched.</p> <p><i>protocol</i> – Specifies the name or number of an IP protocol: ahp, eigrp, esp, gre, icmp, igmp, igrp, ip, ipinip, nos, ospf, pcp, pim, tcp, or udp, or an integer in the range 0 to 255 representing an IP protocol number. To match any Internet protocol (including ICMP, TCP, and UDP), use the keyword ip.</p> <p><b>Note:</b> This step includes options for most IP protocols. For additional specific parameters for TCP, UDP, ICMP, and IGMP, see steps 2b through 2e.</p> <p><i>source</i> – The number of the network or host from which the packet is sent.</p> <p><i>source-wildcard</i> – Applies wildcard bits to the source.</p> <p><i>destination</i> – The network or host number to which the packet is sent.</p> <p><i>destination-wildcard</i> – Applies wildcard bits to the destination.</p> <p><i>source</i>, <i>source-wildcard</i>, <i>destination</i>, and <i>destination-wildcard</i> can be specified as:</p> <ul style="list-style-type: none"> <li>■ The 32-bit quantity in dotted-decimal format.</li> <li>■ The keyword any for 0.0.0.0 255.255.255.255 (any host).</li> <li>■ The keyword host for a single host 0.0.0.0.</li> </ul> <p>The other keywords are optional and have these meanings:</p> <ul style="list-style-type: none"> <li>■ <i>precedence</i> – Matches packets with a precedence level specified as a number from 0 to 7 or by name: routine (0), priority (1), immediate (2), flash (3), flash-override (4), critical (5), internet (6), network (7).</li> <li>■ <i>fragments</i> – Checks non-initial fragments.</li> <li>■ <i>tos</i> – Matches by type of service level, specified by a number from 0 to 15 or a name: normal (0), max-reliability (2), max-throughput (4), min-delay (8).</li> <li>■ <i>log</i> – Creates an informational logging message to be sent to the console about the packet that matches the entry or log-input to include the input interface in the log entry.</li> <li>■ <i>time-range</i> – For an explanation of this keyword, see Using Time Ranges with ACLs.</li> <li>■ <i>dscp</i> – Matches packets with the DSCP value specified by a number from 0 to 63, or use the question mark (?) to see a list of available values.</li> </ul>

	Command	Purpose
or	<b>access-list</b> <i>access-list-number</i> { <b>deny</b>   <b>permit</b> } <i>protocol any any</i> [ <b>precedence</b> <i>precedence</i> ] [ <b>tos</b> <i>tos</i> ] [ <b>fragments</b> ] [ <b>log</b> ] [ <i>log-input</i> ] [ <b>time-range</b> <i>time-range-name</i> ] [ <b>dscp</b> <i>dscp</i> ]	In access-list configuration mode, defines an extended IP access list using an abbreviation for a source and source wildcard of 0.0.0.0 255.255.255.255 and an abbreviation for a destination and destination wildcard of 0.0.0.0 255.255.255.255. You can use the any keyword in place of source and destination address and wildcard.

## Creating Named Standard and Extended ACLs

**Note:** When creating an ACL, remember that, by default, the end of the ACL contains an implicit deny statement for all packets that it did not find a match for before reaching the end. With standard access lists, if you omit the mask from an associated IP host address ACL specification, 0.0.0.0 is assumed to be the mask.

<insert tables/steps>

## Using Time Ranges with ACLs

	Command	Purpose
1.	<b>configure terminal</b>	Enters global configuration mode.
2.	<b>time-range</b> <i>time-range-name</i>	Assigns a meaningful name (for example, <i>workhours</i> ) to the time range to be created, and enters time-range configuration mode. The name cannot contain a space or quotation mark and must begin with a letter.
3.	<b>absolute</b> [ <b>start</b> <i>time date</i> ] [ <b>end</b> <i>time date</i> ]  or <b>periodic</b> <i>day-of-the-week hh:mm to [day-of-the-week] hh:mm</i>  or <b>periodic</b> { <b>weekdays</b>   <b>weekend</b>   <b>daily</b> } <i>hh:mm to hh:mm</i>	Specifies when the function it will be applied to is operational.  ■ You can use only one <b>absolute</b> statement in the time range. If you configure more than one absolute statement, only the one configured last is executed.  ■ You can enter multiple <b>periodic</b> statements. For example, you could configure different hours for weekdays and weekends.  See the example configurations.
4.	<b>end</b>	Returns to privileged EXEC mode.

## Applying an IPv4 ACL to a Terminal Line

This task restricts incoming and outgoing connections between a virtual terminal line and the addresses in an ACL:

	Command	Purpose
1.	<b>configure terminal</b>	Enters global configuration mode.
2.	<b>line</b> [ <b>console</b>   <b>vty</b> ] <i>line-number</i>	Identifies a specific line to configure, and enters in-line configuration mode. <ul style="list-style-type: none"> <li>■ <b>console</b>—Specifies the console terminal line. The console port is DCE.</li> <li>■ <b>vty</b>—Specifies a virtual terminal for remote console access.</li> </ul> <p>The <i>line-number</i> is the first line number in a contiguous group that you want to configure when the line type is specified. The range is from 0 to 16.</p>
3.	<b>access-class</b> <i>access-list-number</i> { <b>in</b>   <b>out</b> }	Restricts incoming and outgoing connections between a particular virtual terminal line (into a device) and the addresses in an access list.
4.	<b>end</b>	Returns to privileged EXEC mode.

## Applying an IPv4 ACL to an Interface

	Command	Purpose
1.	<b>configure terminal</b>	Enters global configuration mode.
2.	<b>interface</b> <i>interface-id</i>	Identifies a specific interface for configuration, and enters interface configuration mode. <p>The interface is a Layer 2 interface (port ACL).</p>
3.	<b>ip access-group</b> { <i>access-list-number</i> / <i>name</i> } { <b>in</b>   <b>out</b> }	Controls access to the specified interface. <p>The <b>out</b> keyword is not supported for Layer 2 interfaces (port ACLs).</p>
4.	<b>end</b>	Returns to privileged EXEC mode.

## Creating Named MAC Extended ACLs

Command	Purpose
1. <b>configure terminal</b>	Enters global configuration mode.
2. <b>mac access-list extended</b> <i>name</i>	Defines an extended MAC access list using a name.
3. <b>{deny   permit} {any   host</b> <i>source MAC address</i> <b>  source MAC address mask} {any   host</b> <i>destination MAC address</i> <b>  destination MAC address mask} [type mask   lsap</b> <i>lsap mask</i> <b>  aarp   amber   dec-spanning   decnet-iv   diagnostic   dsm   etype-6000   etype-8042   lat   larc-sca   mop-console   mop-dump   msdos   mumps   netbios   vines-echo   vines-ip   xns-idp   0-65535] [cos</b> <i>cos</i>	<p>In extended MAC access-list configuration mode, specifies to <b>permit</b> or <b>deny any</b> source MAC address, a source MAC address with a mask, or a specific <b>host</b> source MAC address and <b>any</b> destination MAC address, destination MAC address with a mask, or a specific destination MAC address.</p> <p>(Optional) You can also enter these options:</p> <ul style="list-style-type: none"> <li>■ <b>type mask</b>—Specifies an arbitrary EtherType number of a packet with Ethernet II or SNAP encapsulation in decimal, hexadecimal, or octal with optional mask of <i>don't care</i> bits applied to the EtherType before testing for a match.</li> <li>■ <b>lsap lsap mask</b>—Specifies an LSAP number of a packet with IEEE 802.2 encapsulation in decimal, hexadecimal, or octal with optional mask of <i>don't care</i> bits.</li> <li>■ <b>aarp   amber   dec-spanning   decnet-iv   diagnostic   dsm   etype-6000   etype-8042   lat   larc-sca   mop-console   mop-dump   msdos   mumps   netbios   vines-echo   vines-ip   xns-idp</b>—Specifies a non-IP protocol.</li> <li>■ <b>cos cos</b>—Specifies an IEEE 802.1Q cost of service number from 0 to 7 used to set priority.</li> </ul>
4. <b>end</b>	Returns to privileged EXEC mode.

## Applying a MAC ACL to a Layer 2 Interface

Command	Purpose
1. <b>configure terminal</b>	Enters global configuration mode.
2. <b>interface</b> <i>interface-id</i>	Identifies a specific interface, and enters interface configuration mode. The interface must be a physical Layer 2 interface (port ACL).
3. <b>mac access-group</b> <i>{name}</i> <b>{in}</b>	<p>Controls access to the specified interface by using the MAC access list.</p> <p>Port ACLs are supported only in the inbound direction.</p>
4. <b>end</b>	Returns to privileged EXEC mode.

## Monitoring and Maintaining Network Security with ACLs

Command	Purpose
<b>show access-lists</b> [ <i>number   name</i> ]	Displays the contents of one or all current IP and MAC address access lists or a specific access list (numbered or named).
<b>show ip access-lists</b> [ <i>number   name</i> ]	Displays the contents of all current IP access lists or a specific IP access list (numbered or named).
<b>show ip interface</b> <i>interface-id</i>	Displays detailed configuration and status of an interface. If IP is enabled on the interface and ACLs have been applied by using the <b>ip access-group</b> interface configuration command, the access groups are included in the display.
<b>show running-config</b> [ <b>interface</b> <i>interface-id</i> ]	Displays the contents of the configuration file for the switch or the specified interface, including all configured MAC and IP access lists and which access groups are applied to an interface.
<b>show mac access-group</b> [ <b>interface</b> <i>interface-id</i> ]	Displays MAC access lists applied to all Layer 2 interfaces or the specified Layer 2 interface.
<b>show access-lists</b> [ <i>number   name</i> ]	Displays the access list configuration.
<b>show time-range</b>	Verifies the time-range configuration.
<b>show mac access-group</b> [ <b>interface</b> <i>interface-id</i> ]	Displays the MAC access list applied to the interface or all Layer 2 interfaces.

## Configuration Examples for Network Security with ACLs

### Creating a Standard ACL: Example

This example shows how to create a standard ACL to deny access to IP host 171.69.198.102, permit access to any others, and display the results.

```
Switch (config)# access-list 2 deny host 171.69.198.102
Switch (config)# access-list 2 permit any
Switch(config)# end
Switch# show access-lists
Standard IP access list 2
 10 deny 171.69.198.102
 20 permit any
```

### Creating an Extended ACL: Example

This example shows how to create and display an extended access list to deny Telnet access from any host in network 171.69.198.0 to any host in network 172.20.52.0 and to permit any others. (The **eq** keyword after the destination address means to test for the TCP destination port number equaling Telnet.)

```
Switch(config)# access-list 102 deny tcp 171.69.198.0 0.0.0.255 172.20.52.0 0.0.0.255 eq telnet
Switch(config)# access-list 102 permit tcp any any
Switch(config)# end
Switch# show access-lists
Extended IP access list 102
 10 deny tcp 171.69.198.0 0.0.0.255 172.20.52.0 0.0.0.255 eq telnet
 20 permit tcp any any
```



## Configuring Time Ranges: Examples

This example shows how to configure time ranges for *workhours* and to configure January 1, 2006, as a company holiday and to verify your configuration.

```
Switch(config)# time-range workhours
Switch(config-time-range)# periodic weekdays 8:00 to 12:00
Switch(config-time-range)# periodic weekdays 13:00 to 17:00
Switch(config-time-range)# exit
Switch(config)# time-range new_year_day_2006
Switch(config-time-range)# absolute start 00:00 1 Jan 2006 end 23:59 1 Jan 2006
Switch(config-time-range)# end
Switch# show time-range
time-range entry: new_year_day_2006 (inactive)
    absolute start 00:00 01 January 2006 end 23:59 01 January 2006
time-range entry: workhours (inactive)
    periodic weekdays 8:00 to 12:00
    periodic weekdays 13:00 to 17:00
```

To apply a time range, enter the time-range name in an extended ACL that can implement time ranges. This example shows how to create and verify extended access list 188 that denies TCP traffic from any source to any destination during the defined holiday times and permits all TCP traffic during work hours.

```
Switch(config)# access-list 188 deny tcp any any time-range new_year_day_2006
Switch(config)# access-list 188 permit tcp any any time-range workhours
Switch(config)# end
Switch# show access-lists
Extended IP access list 188
    10 deny tcp any any time-range new_year_day_2006 (inactive)
    20 permit tcp any any time-range workhours (inactive)
```

## Using Named ACLs: Example

This example uses named ACLs to permit and deny the same traffic.

```
Switch(config)# ip access-list extended deny_access
Switch(config-ext-nacl)# deny tcp any any time-range new_year_day_2006
Switch(config-ext-nacl)# exit
Switch(config)# ip access-list extended may_access
Switch(config-ext-nacl)# permit tcp any any time-range workhours
Switch(config-ext-nacl)# end
Switch# show ip access-lists
Extended IP access list lpip_default
    10 permit ip any any
Extended IP access list deny_access
    10 deny tcp any any time-range new_year_day_2006 (inactive)
Extended IP access list may_access
    10 permit tcp any any time-range workhours (inactive)
```

## Including Comments in ACLs: Examples

In this example, the workstation that belongs to Jones is allowed access, and the workstation that belongs to Smith is not allowed access:

```
Switch(config)# access-list 1 remark Permit only Jones workstation through
Switch(config)# access-list 1 permit 171.69.2.88
Switch(config)# access-list 1 remark Do not allow Smith through
Switch(config)# access-list 1 deny 171.69.3.13
```

For an entry in a named IP ACL, use the **remark** access-list configuration command. To remove the remark, use the **no** form of this command.

In this example, the Jones subnet is not allowed to use outbound Telnet:

```
Switch(config)# ip access-list extended telnetting
Switch(config-ext-nacl)# remark Do not allow Jones subnet to telnet out
Switch(config-ext-nacl)# deny tcp host 171.69.2.88 any eq telnet
```

## Applying ACL to a Port: Example

This example shows how to apply access list 2 to a port to filter packets entering the port:

```
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# ip access-group 2 in
```

## Applying an ACL to an Interface: Example

For example, if you apply this ACL to an interface:

```
permit tcp source source-wildcard destination destination-wildcard range 5 60
permit tcp source source-wildcard destination destination-wildcard range 15 160
permit tcp source source-wildcard destination destination-wildcard range 115 1660
permit tcp source source-wildcard destination destination-wildcard
```

And if this message appears:

```
ACLMGR-2-NOVMR: Cannot generate hardware representation of access list [chars]
```

The flag-related operators are not available. To avoid this issue,

- Move the fourth ACE before the first ACE by using **ip access-list resequence** global configuration command:

```
permit tcp source source-wildcard destination destination-wildcard
permit tcp source source-wildcard destination destination-wildcard range 5 60
permit tcp source source-wildcard destination destination-wildcard range 15 160
permit tcp source source-wildcard destination destination-wildcard range 115 1660
```

or

- Rename the ACL with a name or number that alphanumerically precedes the other ACLs (for example, rename ACL 79 to ACL 1).

You can now apply the first ACE in the ACL to the interface. The switch allocates the ACE to available mapping bits in the Opselect index and then allocates flag-related operators to use the same bits in the TCAM.

Router ACLs function as follows:

- The hardware controls permit and deny actions of standard and extended ACLs (input and output) for security access control.
- If **log** has not been specified, the flows that match a *deny* statement in a security ACL are dropped by the hardware if *ip unreachable* is disabled. The flows matching a *permit* statement are switched in hardware.
- Adding the **log** keyword to an ACE in a router ACL causes a copy of the packet to be sent to the CPU for logging only. If the ACE is a *permit* statement, the packet is still switched and routed in hardware.

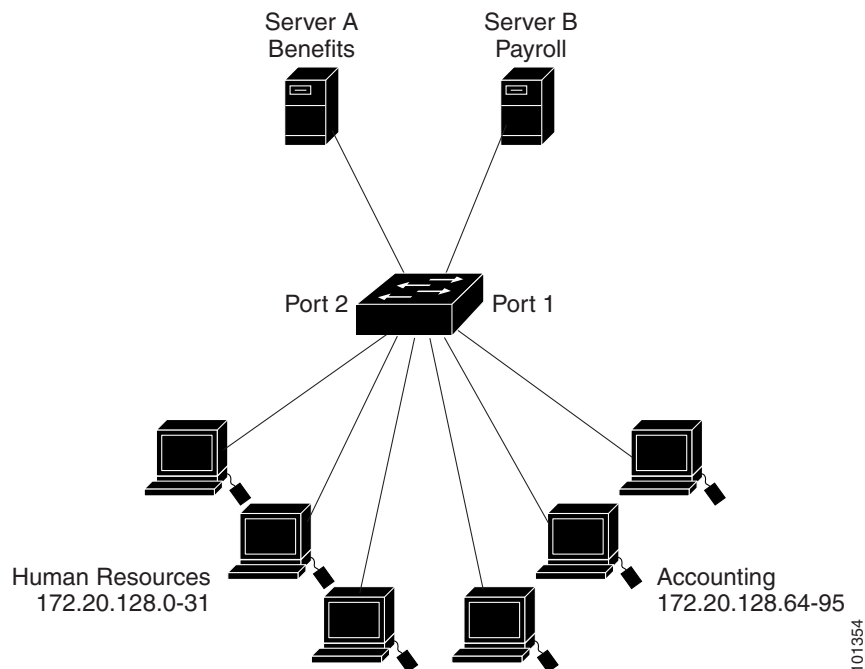
## Routed ACLs: Examples

Figure 76 on page 601 shows a small networked office environment with routed Port 2 connected to Server A, containing benefits and other information that all employees can access, and routed Port 1 connected to Server B, containing confidential payroll data. All users can access Server A, but Server B has restricted access.

Use router ACLs to do this in one of two ways:

- Create a standard ACL, and filter traffic coming to the server from Port 1.
- Create an extended ACL, and filter traffic coming from the server into Port 1.

**Figure 76 Using Router ACLs to Control Traffic**



This example uses a standard ACL to filter traffic coming into Server B from a port, permitting traffic only from Accounting's source addresses 172.20.128.64 to 172.20.128.95. The ACL is applied to traffic coming out of routed Port 1 from the specified source address.

```
Switch(config)# access-list 6 permit 172.20.128.64 0.0.0.31
Switch(config)# end
Switch# show access-lists
Standard IP access list 6
 permit 172.20.128.64, wildcard bits 0.0.0.31
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# ip access-group 6 out
```

This example uses an extended ACL to filter traffic coming from Server B into a port, permitting traffic from any source address (in this case Server B) to only the Accounting destination addresses 172.20.128.64 to 172.20.128.95. The ACL is applied to traffic going into routed Port 1, permitting it to go only to the specified destination addresses. Note that with extended ACLs, you must enter the protocol (IP) before the source and destination information.

```
Switch(config)# access-list 106 permit ip any 172.20.128.64 0.0.0.31
Switch(config)# end
Switch# show access-lists
Extended IP access list 106
```

```
permit ip any 172.20.128.64 0.0.0.31
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# ip access-group 106 in
```

## Configuring Numbered ACLs: Example

In this example, network 36.0.0.0 is a Class A network whose second octet specifies a subnet; that is, its subnet mask is 255.255.0.0. The third and fourth octets of a network 36.0.0.0 address specify a particular host. Using access list 2, the switch accepts one address on subnet 48 and reject all others on that subnet. The last line of the list shows that the switch accepts addresses on all other network 36.0.0.0 subnets. The ACL is applied to packets entering a port.

```
Switch(config)# access-list 2 permit 36.48.0.3
Switch(config)# access-list 2 deny 36.48.0.0 0.0.255.255
Switch(config)# access-list 2 permit 36.0.0.0 0.255.255.255
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# ip access-group 2 in
```

## Configuring Extended ACLs: Examples

In this example, the first line permits any incoming TCP connections with destination ports greater than 1023. The second line permits incoming TCP connections to the Simple Mail Transfer Protocol (SMTP) port of host 128.88.1.2. The third line permits incoming ICMP messages for error feedback.

```
Switch(config)# access-list 102 permit tcp any 128.88.0.0 0.0.255.255 gt 1023
Switch(config)# access-list 102 permit tcp any host 128.88.1.2 eq 25
Switch(config)# access-list 102 permit icmp any any
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# ip access-group 102 in
```

In this example, suppose that you have a network connected to the Internet, and you want any host on the network to be able to form TCP connections to any host on the Internet. However, you do not want IP hosts to be able to form TCP connections to hosts on your network, except to the mail (SMTP) port of a dedicated mail host.

SMTP uses TCP port 25 on one end of the connection and a random port number on the other end. The same port numbers are used throughout the life of the connection. Mail packets coming in from the Internet have a destination port of 25. Outbound packets have the port numbers reversed. Because the secure system of the network always accepts mail connections on port 25, the incoming and outgoing services are separately controlled. The ACL must be configured as an input ACL on the outbound interface and an output ACL on the inbound interface.

In this example, the network is a Class B network with the address 128.88.0.0, and the mail host address is 128.88.1.2. The **established** keyword is used only for the TCP to show an established connection. A match occurs if the TCP datagram has the ACK or RST bits set, which show that the packet belongs to an existing connection. Gigabit Ethernet interface 1 is the interface that connects the router to the Internet.

```
Switch(config)# access-list 102 permit tcp any 128.88.0.0 0.0.255.255 established
Switch(config)# access-list 102 permit tcp any host 128.88.1.2 eq 25
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# ip access-group 102 in
```

## Creating Named ACLs: Example

This example creates a standard ACL named *Internet\_filter* and an extended ACL named *marketing\_group*. The *Internet\_filter* ACL allows all traffic from the source address 1.2.3.4.

```
Switch(config)# ip access-list standard Internet_filter
Switch(config-ext-nacl)# permit 1.2.3.4
Switch(config-ext-nacl)# exit
```

## Configuration Examples for Network Security with ACLs

The *marketing\_group* ACL allows any TCP Telnet traffic to the destination address and wildcard 171.69.0.0 0.0.255.255 and denies any other TCP traffic. It permits ICMP traffic, denies UDP traffic from any source to the destination address range 171.69.0.0 through 179.69.255.255 with a destination port less than 1024, denies any other IP traffic, and provides a log of the result.

```
Switch(config)# ip access-list extended marketing_group
Switch(config-ext-nacl)# permit tcp any 171.69.0.0 0.0.255.255 eq telnet
Switch(config-ext-nacl)# deny tcp any any
Switch(config-ext-nacl)# permit icmp any any
Switch(config-ext-nacl)# deny udp any 171.69.0.0 0.0.255.255 lt 1024
Switch(config-ext-nacl)# deny ip any any log
Switch(config-ext-nacl)# exit
```

The *Internet\_filter* ACL is applied to outgoing traffic and the *marketing\_group* ACL is applied to incoming traffic on a Layer 3 port.

```
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# no switchport
Switch(config-if)# ip address 2.0.5.1 255.255.255.0
Switch(config-if)# ip access-group Internet_filter out
Switch(config-if)# ip access-group marketing_group in
```

## Applying Time Range to an IP ACL: Example

This example denies HTTP traffic on IP on Monday through Friday between the hours of 8:00 a.m. and 6:00 p.m (18:00). The example allows UDP traffic only on Saturday and Sunday from noon to 8:00 p.m. (20:00).

```
Switch(config)# time-range no-http
Switch(config)# periodic weekdays 8:00 to 18:00
!
Switch(config)# time-range udp-yes
Switch(config)# periodic weekend 12:00 to 20:00
!
Switch(config)# ip access-list extended strict
Switch(config-ext-nacl)# deny tcp any any eq www time-range no-http
Switch(config-ext-nacl)# permit udp any any time-range udp-yes
!
Switch(config-ext-nacl)# exit
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# ip access-group strict in
```

## Creating Commented IP ACL Entries: Examples

In this example of a numbered ACL, the workstation that belongs to Jones is allowed access, and the workstation that belongs to Smith is not allowed access:

```
Switch(config)# access-list 1 remark Permit only Jones workstation through
Switch(config)# access-list 1 permit 171.69.2.88
Switch(config)# access-list 1 remark Do not allow Smith workstation through
Switch(config)# access-list 1 deny 171.69.3.13
```

In this example of a numbered ACL, the Winter and Smith workstations are not allowed to browse the web:

```
Switch(config)# access-list 100 remark Do not allow Winter to browse the web
Switch(config)# access-list 100 deny host 171.69.3.85 any eq www
Switch(config)# access-list 100 remark Do not allow Smith to browse the web
Switch(config)# access-list 100 deny host 171.69.3.13 any eq www
```

In this example of a named ACL, the Jones subnet is not allowed access:

```
Switch(config)# ip access-list standard prevention
```

## Configuration Examples for Network Security with ACLs

```
Switch(config-std-nacl)# remark Do not allow Jones subnet through
Switch(config-std-nacl)# deny 171.69.0.0 0.0.255.255
```

In this example of a named ACL, the Jones subnet is not allowed to use outbound Telnet:

```
Switch(config)# ip access-list extended telnetting
Switch(config-ext-nacl)# remark Do not allow Jones subnet to telnet out
Switch(config-ext-nacl)# deny tcp 171.69.0.0 0.0.255.255 any eq telnet
```

## Configuring ACL Logging: Examples

Two variations of logging are supported on router ACLs. The **log** keyword sends an informational logging message to the console about the packet that matches the entry; the **log-input** keyword includes the input interface in the log entry.

In this example, standard named access list *stan1* denies traffic from 10.1.1.0 0.0.0.255, allows traffic from all other sources, and includes the **log** keyword.

```
Switch(config)# ip access-list standard stan1
Switch(config-std-nacl)# deny 10.1.1.0 0.0.0.255 log
Switch(config-std-nacl)# permit any log
Switch(config-std-nacl)# exit
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# ip access-group stan1 in
Switch(config-if)# end
Switch# show logging
Syslog logging: enabled (0 messages dropped, 0 flushes, 0 overruns)
  Console logging: level debugging, 37 messages logged
  Monitor logging: level debugging, 0 messages logged
  Buffer logging: level debugging, 37 messages logged
  File logging: disabled
  Trap logging: level debugging, 39 message lines logged
```

Log Buffer (4096 bytes):

```
00:00:48: NTP: authentication delay calculation problems
```

<output truncated>

```
00:09:34:%SEC-6-IPACCESSLOGS:list stan1 permitted 0.0.0.0 1 packet
00:09:59:%SEC-6-IPACCESSLOGS:list stan1 denied 10.1.1.15 1 packet
00:10:11:%SEC-6-IPACCESSLOGS:list stan1 permitted 0.0.0.0 1 packet
```

This example is a named extended access list *ext1* that permits ICMP packets from any source to 10.1.1.0 0.0.0.255 and denies all UDP packets.

```
Switch(config)# ip access-list extended ext1
Switch(config-ext-nacl)# permit icmp any 10.1.1.0 0.0.0.255 log
Switch(config-ext-nacl)# deny udp any any log
Switch(config-ext-nacl)# exit
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# ip access-group ext1 in
```

## Applying a MAC ACL to a Layer 2 Interface: Examples

This example shows how to create and display an access list named *mac1*, denying only EtherType DECnet Phase IV traffic, but permitting all other types of traffic.

```
Switch(config)# mac access-list extended mac1
Switch(config-ext-macl)# deny any any decnet-iv
Switch(config-ext-macl)# permit any any
Switch(config-ext-macl)# end
```

## Configuring VLAN Maps with ACLs

```
Switch # show access-lists
Extended MAC access list mac1
 10 deny any any deernet-iv
 20 permit any any
```

This example shows how to apply MAC access list *mac1* to a port to filter packets entering the port:

```
Switch(config)# interface GigabitEthernet1/17
Switch(config-if)# mac access-group mac1 in
```

**Note:** The **mac access-group** interface configuration command is only valid when applied to a physical Layer 2 interface. You cannot use the command on EtherChannel port channels.

After receiving a packet, the switch checks it against the inbound ACL. If the ACL permits it, the switch continues to process the packet. If the ACL rejects the packet, the switch discards it. When you apply an undefined ACL to an interface, the switch acts as if the ACL has not been applied and permits all packets. Remember this behavior if you use undefined ACLs for network security.

## Configuring VLAN Maps with ACLs

This section describes how to configure VLAN maps, which is the only way to control filtering within a VLAN. VLAN maps have no direction.

To filter traffic in a specific direction by using a VLAN map, you need to include an ACL with specific source or destination addresses. If there is a match clause for that type of packet (IP or MAC) in the VLAN map, the default action is to drop the packet if the packet does not match any of the entries within the map. If there is no match clause for that type of packet, the default is to forward the packet.

For complete syntax and usage information for the commands used in this section, see the command reference for this release.

To create a VLAN map and apply it to one or more VLANs, perform these steps:

1. Create the standard or extended IPv4 ACLs or named MAC extended ACLs that you want to apply to the VLAN. See the "Creating Standard and Extended IPv4 ACLs" section and the "Creating a VLAN Map" section.
2. Enter the `vlan access-map` global configuration command to create a VLAN ACL map entry.
3. In `access-map` configuration mode, optionally enter an **action-forward** (the default) or **drop**—and enter the **match** command to specify an IP packet or a non-IP packet (with only a known MAC address) and to match the packet against one or more ACLs (standard or extended).

**Note:** If the VLAN map is configured with a match clause for a type of packet (IP or MAC) and the map action is drop, all packets that match the type are dropped. If the VLAN map has no match clause, and the configured action is drop, all IP and Layer 2 packets are dropped.

4. Use the `vlan filter` global configuration command to apply a VLAN map to one or more VLANs.

## VLAN Map Configuration Guidelines

Follow these guidelines when configuring VLAN maps:

- If there is no ACL configured to deny traffic on an interface and no VLAN map is configured, all traffic is permitted.
- Each VLAN map consists of a series of entries. The order of entries in a VLAN map is important. A packet that comes into the switch is tested against the first entry in the VLAN map. If it matches, the action specified for that part of the VLAN map is taken. If there is no match, the packet is tested against the next entry in the map.

- If the VLAN map has at least one match clause for the type of packet (IP or MAC) and the packet does not match any of these match clauses, the default is to drop the packet. If there is no match clause for that type of packet in the VLAN map, the default is to forward the packet.
- The system might take longer to boot up if you have configured a very large number of ACLs.
- Logging is not supported for VLAN maps.
- When a switch has an IP access list or MAC access list applied to a Layer 2 interface, and you apply a VLAN map to a VLAN that the port belongs to, the port ACL takes precedence over the VLAN map.
- If VLAN map configuration cannot be applied in hardware, all packets in that VLAN must be bridged and routed by software.
- You can configure VLAN maps on primary and secondary VLANs. However, we recommend that you configure the same VLAN maps on private-VLAN primary and secondary VLANs.
- When a frame is Layer-2 forwarded within a private VLAN, the same VLAN map is applied at the ingress side and at the egress side. When a frame is routed from inside a private VLAN to an external port, the private-VLAN map is applied at the ingress side.
  - For frames going upstream from a host port to a promiscuous port, the VLAN map configured on the secondary VLAN is applied.
  - For frames going downstream from a promiscuous port to a host port, the VLAN map configured on the primary VLAN is applied.

To filter out specific IP traffic for a private VLAN, you should apply the VLAN map to both the primary and secondary VLANs. For more information about private VLANs, see Chapter 19 "Configuring Private VLANs."

For configuration examples, see the "Using VLAN Maps in Your Network" section.

For information about using both router ACLs and VLAN maps, see the "VLAN Maps and Router ACL Configuration Guidelines" section.

## Creating a VLAN Map

Each VLAN map consists of an ordered series of entries. Beginning in privileged EXEC mode, follow these steps to create, add to, or delete a VLAN map entry:

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>vlan access-map</b> name [number]	Create a VLAN map, and give it a name and (optionally) a number. The number is the sequence number of the entry within the map.  When you create VLAN maps with the same name, numbers are assigned sequentially in increments of 10. When modifying or deleting maps, you can enter the number of the map entry that you want to modify or delete.  Entering this command changes to access-map configuration mode.
Step 3	<b>action {drop   forward}</b>	(Optional) Set the action for the map entry. The default is to forward.
Step 4	<b>match {ip   mac} address</b> {name   number} [name   number]	Match the packet (using either the IP or MAC address) against one or more standard or extended access lists. Note that packets are only matched against access lists of the correct protocol type. IP packets are matched against standard or extended IP access lists. Non-IP packets are only matched against named MAC extended access lists.



Step 5	<b>end</b>	Return to global configuration mode.
Step 6	<b>show running-config</b>	Display the access list configuration
Step 7	<b>copy running-config startup-config</b>	(Optional) Save your entries in the configuration file.

Use the `no vlan access-map name` global configuration command to delete a map. Use the `no vlan access-map name number` global configuration command to delete a single sequence entry from within the map.

Use the `no action access-map` configuration command to enforce the default action, which is to forward.

VLAN maps do not use the specific `permit` or `deny` keywords. To deny a packet by using VLAN maps, create an ACL that would match the packet, and set the action to drop. A permit in the ACL counts as a match. A deny in the ACL means no match.

## Examples of ACLs and VLAN Maps

These examples show how to create ACLs and VLAN maps for specific purposes.

### Example 1

This example shows how to create an ACL and a VLAN map to deny a packet. In the first map, any packets that match the `ip1` ACL (TCP packets) would be dropped. You first create the `ip1` ACL to permit any TCP packet and no other packets. Because there is a match clause for IP packets in the VLAN map, the default action is to drop any IP packet that does not match any of the match clauses.

```
Switch(config)# ip access-list extended ip1
Switch(config-ext-nacl)# permit tcp any any
Switch(config-ext-nacl)# exit
Switch(config)# vlan access-map map_1 10
Switch(config-access-map)# match ip address ip1
Switch(config-access-map)# action drop
```

This example shows how to create a VLAN map to permit a packet. ACL `ip2` permits UDP packets and any packets that match the `ip2` ACL are forwarded. In this map, any IP packets that did not match any of the previous ACLs (that is, packets that are not TCP packets or UDP packets) would get dropped.

```
Switch(config)# ip access-list extended ip2
Switch(config-ext-nacl)# permit udp any any
Switch(config-ext-nacl)# exit
Switch(config)# vlan access-map map_1 20
Switch(config-access-map)# match ip address ip2
Switch(config-access-map)# action forward
```

### Example 2

In this example, the VLAN map has a default action of drop for IP packets and a default action of forward for MAC packets. Used with standard ACL 101 and extended named access lists `igmp-match` and `tcp-match`, the map will have the following results:

- Forward all UDP packets
- Drop all IGMP packets
- Forward all TCP packets
- Drop all other IP packets

- Forward all non-IP packets

```
Switch(config)# access-list 101 permit udp any any
Switch(config)# ip access-list extended igmp-match
Switch(config-ext-nacl)# permit igmp any any
Switch(config)# ip access-list extended tcp-match
Switch(config-ext-nacl)# permit tcp any any
Switch(config-ext-nacl)# exit
Switch(config)# vlan access-map drop-ip-default 10
Switch(config-access-map)# match ip address 101
Switch(config-access-map)# action forward
Switch(config-access-map)# exit
Switch(config)# vlan access-map drop-ip-default 20
Switch(config-access-map)# match ip address igmp-match
Switch(config-access-map)# action drop
Switch(config-access-map)# exit
Switch(config)# vlan access-map drop-ip-default 30
Switch(config-access-map)# match ip address tcp-match
Switch(config-access-map)# action forward
```

### Example 3

In this example, the VLAN map has a default action of drop for MAC packets and a default action of forward for IP packets. Used with MAC extended access lists good-hosts and good-protocols, the map will have the following results:

- Forward MAC packets from hosts 0000.0c00.0111 and 0000.0c00.0211
- Forward MAC packets with decnet-iv or vines-ip protocols
- Drop all other non-IP packets
- Forward all IP packets

```
Switch(config)# mac access-list extended good-hosts
Switch(config-ext-macl)# permit host 000.0c00.0111 any
Switch(config-ext-macl)# permit host 000.0c00.0211 any
Switch(config-ext-nacl)# exit
Switch(config)# mac access-list extended good-protocols
Switch(config-ext-macl)# permit any any decnet-ip
Switch(config-ext-macl)# permit any any vines-ip
Switch(config-ext-nacl)# exit
Switch(config)# vlan access-map drop-mac-default 10
Switch(config-access-map)# match mac address good-hosts
Switch(config-access-map)# action forward
Switch(config-access-map)# exit
Switch(config)# vlan access-map drop-mac-default 20
Switch(config-access-map)# match mac address good-protocols
Switch(config-access-map)# action forward
```

### Example 4

In this example, the VLAN map has a default action of drop for all packets (IP and non-IP). Used with access lists tcp-match and good-hosts from Examples 2 and 3, the map will have the following results:

- Forward all TCP packets
- Forward MAC packets from hosts 0000.0c00.0111 and 0000.0c00.0211
- Drop all other IP packets
- Drop all other MAC packets

## Configuring VLAN Maps with ACLs

```
Switch(config)# vlan access-map drop-all-default 10
Switch(config-access-map)# match ip address tcp-match
Switch(config-access-map)# action forward
Switch(config-access-map)# exit
Switch(config)# vlan access-map drop-all-default 20
Switch(config-access-map)# match mac address good-hosts
Switch(config-access-map)# action forward
```

## Applying a VLAN Map to a VLAN

Beginning in privileged EXEC mode, follow these steps to apply a VLAN map to one or more VLANs:

	Command	Purpose
Step 1	<b>configure terminal</b>	Enter global configuration mode.
Step 2	<b>vlan filter mapname vlan-list list</b>	Apply the VLAN map to one or more VLAN IDs.  The list can be a single VLAN ID (22), a consecutive list (10-22), or a string of VLAN IDs (12, 22, 30).  <b>Note:</b> Spaces around the comma and hyphen are optional.
Step 3	<b>show running-config</b>	Display the access list.
Step 4	<b>copy running-config startup config</b>	(Optional) Save your entries in the configuration file.

To remove the VLAN map, use the **no vlan filter mapname vlan-list list** global configuration command.

Example below shows how to apply VLAN map 1 to VLANs 20 thru 22:

```
Switch(config)# vlan filter map 1 vlan-list 20-22
```

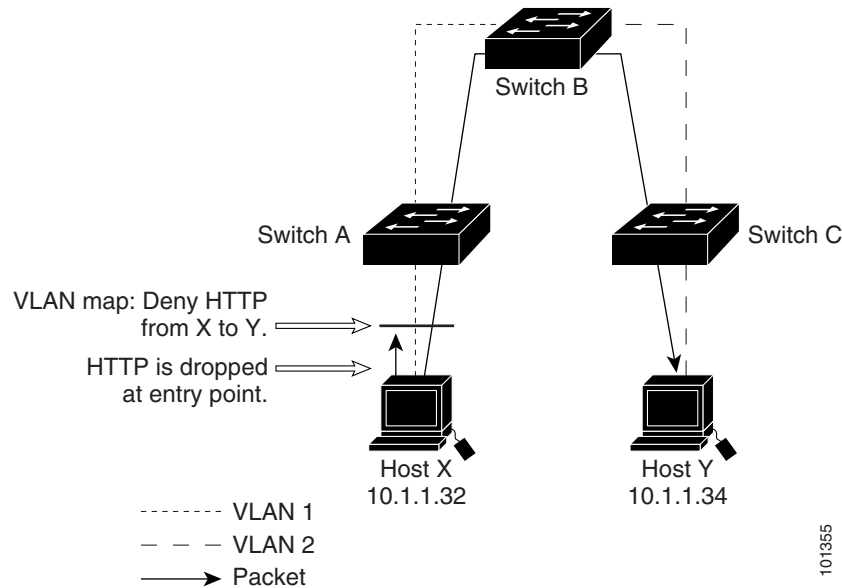
## Using VLAN Maps in Your Network

These sections describe some typical uses for VLAN maps:

- Wiring Closet Configuration
- Denying Access to a Server on Another

### Wiring Closet Configuration

In a wiring closet configuration, routing might not be enabled on the switch. In this configuration, the switch can still support a VLAN map and a QoS classification ACL. In Figure 37-4, assume that Host X and Host Y are in different VLANs and are connected to wiring closet switches A and C. Traffic from Host X to Host Y is eventually being routed by Switch B, a Layer 3 switch with routing enabled. Traffic from Host X to Host Y can be access-controlled at the traffic entry point, Switch A.

**Figure 77 Wiring Closet Configuration**

If you do not want HTTP traffic switched from Host X to Host Y, you can configure a VLAN map on Switch A to drop all HTTP traffic from Host X (IP address 10.1.1.32) to Host Y (IP address 10.1.1.34) at Switch A and not bridge it to Switch B.

First, define the IP access list `http` that permits (matches) any TCP traffic on the HTTP port.

```
Switch(config)# ip access-list extended http
Switch(config-ext-nacl)# permit tcp host 10.1.1.32 host 10.1.1.34 eq www
Switch(config-ext-nacl)# exit
```

Next, create VLAN access map 'map2' so that traffic that matches the `http` access list is dropped and all other IP traffic is forwarded.

```
Switch(config)# vlan access-map map2 10
Switch(config-access-map)# match ip address http
Switch(config-access-map)# action drop
Switch(config-access-map)# exit
Switch(config)# ip access-list extended match_all
Switch(config-ext-nacl)# permit ip any any
Switch(config-ext-nacl)# exit
Switch(config)# vlan access-map map2 20
Switch(config-access-map)# match ip address match_all
Switch(config-access-map)# action forward
```

Then, apply VLAN access map `map2` to VLAN 1.

```
Switch(config)# vlan filter map2 vlan 1
```

## Additional References

The following sections provide references related to switch administration:

## Additional References

## Related Documents

Related Topic	Document Title
Cisco IOS basic commands	<i>Cisco IOS Configuration Fundamentals Command Reference</i>
Cisco IOS multicast commands	<i>Cisco IOS IP Command Reference, Volume 3 of 3:Multicast</i>
Cisco IOS IP Addressing and Services configuration	<i>Cisco IOS IP Configuration Guide</i>
Cisco IOS ACL configuration	<i>Cisco IOS IP Command Reference, Volume 1 of 3: Addressing and Services</i>  <i>Cisco IOS Security Configuration Guide</i>

## Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	–

## MIBs

MIBs	MIBs Link
–	To locate and download MIBs using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL and choose a platform under the Cisco Access Products menu: <a href="http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml">http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml</a>

## RFCs

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	–

## Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	<a href="http://www.cisco.com/techsupport">http://www.cisco.com/techsupport</a>

