Configuring IPv4 Access Control Lists

Access control lists (ACLs) perform packet filtering to control which packets move through the network and where. Such control provides security by helping to limit network traffic, restrict the access of users and devices to the network, and prevent traffic from leaving a network. IP access lists can reduce the chance of spoofing and denial-of-service attacks and allow dynamic, temporary user access through a firewall.

IP access lists can also be used for purposes other than security, such as bandwidth control, limiting debug output, and identifying or classifying traffic for quality of service (QoS) features. This module provides an overview of IP access lists.

Finding Feature Information

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

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

Restrictions for Configuring IPv4 Access Control Lists

General Network Security

The following are restrictions for configuring network security with ACLs:

- Router ACL and VLAN ACLs are not supported.

- 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.
- 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.
- ACL wild card is not supported in downstream client policy.

IPv4 ACL Network Interfaces

The following restrictions apply to IPv4 ACLs to network interfaces:

- When controlling access to an interface, you can use a named or numbered ACL.
- If you apply an ACL to a Layer 3 interface and routing is not enabled on the switch, 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.
- On Layer 3 ports and SVIs, ACLs are not supported.
- ACL does not filter traffic when more than one VLAN Identifier Q-in-Q (VIDQ) tag is encapsulated.

MAC ACLs on 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:

- 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.

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.

IP Access List Entry Sequence Numbering

- This feature does not support dynamic, reflexive, or firewall access lists.

Information About Configuring IPv4 Access Control Lists

ACL Overview

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 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.

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.

IPv4 ACL Switch Unsupported Features

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

The following ACL-related features are not supported:

- Non-IP protocol ACLs or bridge-group ACLs
- IP accounting
- Inbound and outbound rate limiting (except with QoS ACLs)
- Reflexive ACLs, URL Redirect ACLs, and Dynamic ACLs are not supported (except for some specialized dynamic ACLs used by the switch clustering feature)
- ACL logging for VLAN maps

Access List Numbers

The number you use to denote your ACL shows the type of access list that you are creating.

This 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 1: Access List Numbers

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

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.

Numbered Standard IPv4 ACLs

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.

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.

Numbered Extended IPv4 ACLs

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.

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.

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

You can define an extended TCP, UDP, ICMP, IGMP, or other IP ACL. The switch also supports these IP protocols:

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

These IP protocols are supported:

- Authentication Header Protocol (**ahp**)
- Encapsulation Security Payload (**esp**)
- Enhanced Interior Gateway Routing Protocol (**eigrp**)
- 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**)

Named IPv4 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 and . The advantage of using named ACLs instead of numbered lists is that you can delete individual entries from a named list.

Consider these guidelines before configuring named ACLs:

- Numbered ACLs are also available.
- A standard ACL and an extended ACL cannot have the same name.
- You can use standard or extended ACLs (named or numbered) in VLAN maps.

Benefits of Using the Named ACL Support for Noncontiguous Ports on an Access Control Entry Feature

The Named ACL Support for Noncontiguous Ports on an Access Control Entry feature allows you to specify noncontiguous ports in a single access control entry, which greatly reduces the number of entries required in an access control list when several entries have the same source address, destination address, and protocol, but differ only in the ports.

This feature greatly reduces the number of access control entries (ACEs) required in an access control list to handle multiple entries for the same source address, destination address, and protocol. If you maintain large numbers of ACEs, use this feature to consolidate existing groups of access list entries wherever it is possible and when you create new access list entries. When you configure access list entries with noncontiguous ports, you will have fewer access list entries to maintain.

Benefits of IP Access List Entry Sequence Numbering

The ability to apply sequence numbers to IP access list entries simplifies access list changes. Prior to the IP Access List Entry Sequence Numbering feature, there was no way to specify the position of an entry within an access list. If a user wanted to insert an entry (statement) in the middle of an existing list, all of the entries after the desired position had to be removed, then the new entry was added, and then all the removed entries had to be reentered. This method was cumbersome and error prone.

This feature allows users to add sequence numbers to access list entries and resequence them. When a user adds a new entry, the user chooses the sequence number so that it is in a desired position in the access list. If necessary, entries currently in the access list can be resequenced to create room to insert the new entry.

Sequence Numbering Behavior

- For backward compatibility with previous releases, if entries with no sequence numbers are applied, the first entry is assigned a sequence number of 10, and successive entries are incremented by 10. The maximum sequence number is 2147483647. If the generated sequence number exceeds this maximum number, the following message is displayed:

```
Exceeded maximum sequence number.
```

- If the user enters an entry without a sequence number, it is assigned a sequence number that is 10 greater than the last sequence number in that access list and is placed at the end of the list.
- If the user enters an entry that matches an already existing entry (except for the sequence number), then no changes are made.

- If the user enters a sequence number that is already present, the following error message is generated:

```
Duplicate sequence number.
```

- If a new access list is entered from global configuration mode, then sequence numbers for that access list are generated automatically.
- Distributed support is provided so that the sequence numbers of entries in the Route Processor (RP) and line card are in synchronization at all times.
- Sequence numbers are not nvgened. That is, the sequence numbers themselves are not saved. In the event that the system is reloaded, the configured sequence numbers revert to the default sequence starting number and increment. The function is provided for backward compatibility with software releases that do not support sequence numbering.
- This feature works with named and numbered, standard and extended IP access lists.

Including 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.

The following is an example of a remark that describes function of the subsequent deny statement:

```
ip access-list extended telnetting
  remark Do not allow host1 subnet to telnet out
  deny tcp host 172.16.2.88 any eq telnet
```

Hardware and Software Treatment of IP ACLs

ACL processing is performed at the hardware side. If the hardware reaches its capacity to store ACL configurations, the packets are sent to the CPU, where ACL is processed at the software side. When sent for software ACL, the data packets are not sent at the line rate; instead, they are sent at a very low rate via rate limiting.

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. Software forwarding of packets might adversely impact the performance of the switch, depending on the number of CPU cycles that this consumes.

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 great enough bandwidth, not all of the packets that are forwarded can be logged.

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. 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 unreachables* is disabled. The flows matching a *permit* statement are switched in hardware.
- Adding the **log** keyword to an ACE in an 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 in hardware.

Time Ranges for 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. The **time-range** keyword and argument are referenced in the named and numbered extended ACL task tables.

These are some 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).
- 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 hardware memory. For this reason, you should be careful not to have several access lists configured to take affect 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.

IPv4 ACL Interface Considerations

When you apply the **ip access-group** interface configuration command to a Layer 3 interface (an SVI, a Layer 3 EtherChannel, or a routed port), the interface must have been configured with an IP address. Layer 3 access groups filter packets that are routed or are received by Layer 3 processes on the CPU. They do not affect packets bridged within a VLAN.

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 routing 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.

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.

Apply an Access Control List to an Interface

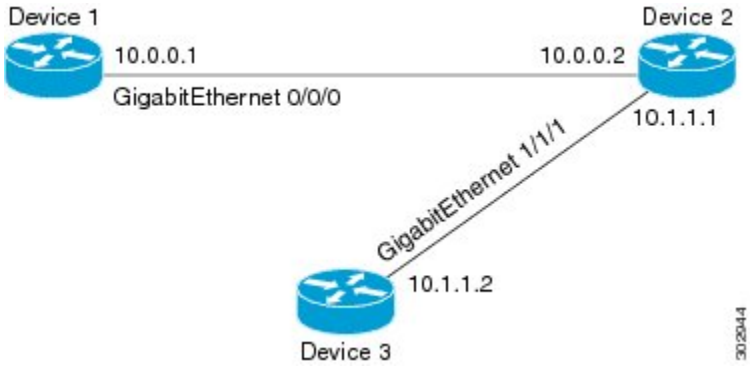
With some protocols, you can apply up to two access lists to an interface: one inbound access list and one outbound access list. With other protocols, you apply only one access list that checks both inbound and outbound packets.

If the access list is inbound, when a device receives a packet, Cisco software checks the access list's criteria statements for a match. If the packet is permitted, the software continues to process the packet. If the packet is denied, the software discards the packet.

If the access list is outbound, after receiving and routing a packet to the outbound interface, Cisco software checks the access list's criteria statements for a match. If the packet is permitted, the software transmits the packet. If the packet is denied, the software discards the packet.

Note Access lists that are applied to interfaces on a device do not filter traffic that originates from that device.

Figure 1: Topology for Applying Access Control Lists



The figure above shows that Device 2 is a bypass device that is connected to Device 1 and Device 3. An outbound access list is applied to Gigabit Ethernet interface 0/0/0 on Device 1. When you ping Device 3 from Device 1, the access list does not check for packets going outbound because the traffic is locally generated.

The access list check is bypassed for locally generated packets, which are always outbound.

By default, an access list that is applied to an outbound interface for matching locally generated traffic will bypass the outbound access list check; but transit traffic is subjected to the outbound access list check.

Note The behavior described above applies to all single-CPU platforms that run Cisco software.

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 ACL logging is only supported for RACL.

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.

Note The logging facility might drop some logging message packets if there are too many to be handled or if there is more than one logging message to be handled in 1 second. This behavior prevents the router from crashing due to too many logging packets. Therefore, the logging facility should not be used as a billing tool or an accurate source of the number of matches to an access list.

How to Configure ACLs

Configuring IPv4 ACLs

Follow the procedure given below to use IP ACLs on the switch:

SUMMARY STEPS

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

DETAILED STEPS

Step 1 Create an ACL by specifying an access list number or name and the access conditions.

Step 2 Apply the ACL to interfaces.

Creating a Numbered Standard ACL

Beginning in privileged EXEC mode, follow these steps to create a numbered standard ACL:

SUMMARY STEPS

1. **configure terminal**
2. **access-list** *access-list-number* {**deny** | **permit**} *source source-wildcard* [**log**]
3. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**access-list** *access-list-number* {**deny**	**permit**} *source source-wildcard* [**log**] **Example:** `Device(config)# access-list 2 deny your_host`	Defines a standard IPv4 access list by using a source address and wildcard. The *access-list-number* is a decimal number from 1 to 99 or 1300 to 1999. Enter **deny** or **permit** to specify whether to deny or permit access if conditions are matched. The *source* is the source address of the network or host from which the packet is being sent specified as: • The 32-bit quantity in dotted-decimal format. • The keyword **any** 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. • The keyword **host** as an abbreviation for source and *source-wildcard* of *source* 0.0.0.0. (Optional) The *source-wildcard* applies wildcard bits to the source. (Optional) Enter **log** to cause an informational logging message about the packet that matches the entry to be sent to the console. (Optional) Enter **smartlog** to send copies of denied or permitted packets to a NetFlow collector. **Note** Logging is supported only on ACLs attached to Layer 3 interfaces.

	Command or Action	Purpose
Step 3	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Creating a Numbered Extended ACL (CLI)

Follow the procedure given below to create a numbered extended ACL:

SUMMARY STEPS

1. **configure terminal**
2. **access-list** *access-list-number* {**deny** | **permit**} *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*] [**tos** tos] [**fragments**] [**log** [**log-input**] [**time-range** *time-range-name*] [**dscp** *dscp*]
3. **access-list** *access-list-number* {**deny** | **permit**} **tcp** *source source-wildcard* [*operator port*] *destination destination-wildcard* [*operator port*] **[established]** [**precedence** *precedence*] [**tos** *tos*] [**fragments**] [**log** [**log-input**] [**time-range** *time-range-name*] [**dscp** *dscp*] [*flag*]
4. **access-list** *access-list-number* {**deny** | **permit**} **udp** *source source-wildcard* [*operator port*] *destination destination-wildcard* [*operator port*] [**precedence** *precedence*] [**tos** *tos*] [**fragments**] [**log** [**log-input**] [**time-range** *time-range-name*] [**dscp** *dscp*]
5. **access-list** *access-list-number* {**deny** | **permit**} **icmp** *source source-wildcard destination destination-wildcard* [*icmp-type* | [[*icmp-type icmp-code*] | [*icmp-message*]] [**precedence** *precedence*] [**tos** *tos*] [**fragments**] [**time-range** *time-range-name*] [**dscp** *dscp*]
6. **access-list** *access-list-number* {**deny** | **permit**} **igmp** *source source-wildcard destination destination-wildcard* [*igmp-type*] [**precedence** *precedence*] [**tos** *tos*] [**fragments**] [**log** [**log-input**] [**time-range** *time-range-name*] [**dscp** *dscp*]
7. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**access-list** *access-list-number* {**deny**	**permit**} *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*] [**tos** tos] [**fragments**] [**log** [**log-input**] [**time-range** *time-range-name*] [**dscp** *dscp*] **Example:** `Device(config)# access-list 101 permit ip host`	Defines an extended IPv4 access list and the access conditions. The *access-list-number* is a decimal number from 100 to 199 or 2000 to 2699. Enter **deny** or **permit** to specify whether to deny or permit the packet if conditions are matched.

	Command or Action	Purpose
	`10.1.1.2 any precedence 0 tos 0 log`	For *protocol*, enter the name or number of an P 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**. **Note** This step includes options for most IP protocols. For additional specific parameters for TCP, UDP, ICMP, and IGMP, see the following steps. The *source* is the number of the network or host from which the packet is sent. The *source-wildcard* applies wildcard bits to the source. The *destination* is the network or host number to which the packet is sent. The *destination-wildcard* applies wildcard bits to the destination. Source, source-wildcard, destination, and destination-wildcard can be specified as: • The 32-bit quantity in dotted-decimal format. • The keyword **any** for 0.0.0.0 255.255.255.255 (any host). • The keyword **host** for a single host 0.0.0.0. The other keywords are optional and have these meanings: • **precedence**—Enter to match 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). • **fragments**—Enter to check non-initial fragments. • **tos**—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). • **log**—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. • **time-range**—Specify the time-range name.

	Command or Action	Purpose
		• **dscp**—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. **Note** Your controller must support the ability to: • Mark DCSP • Mark UP • Map DSCP and UP For more information on **DSCP-to-UP Mapping**, see: https://tools.ietf.org/html/draft-ietf-tsvwg-ieee-802-11-01 **Note** 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**.
Step 3	**access-list** *access-list-number* {**deny** | **permit**} **tcp** *source source-wildcard* [*operator port*] *destination destination-wildcard* [*operator port*] **[established]** [**precedence** *precedence*] [**tos** *tos*] [**fragments**] [**log** [**log-input**] [**time-range** *time-range-name*] [**dscp** *dscp*] [*flag*] **Example:** `Device(config)# access-list 101 permit tcp any any eq 500`	Defines an extended TCP access list and the access conditions. The parameters are the same as those described for an extended IPv4 ACL, with these exceptions: (Optional) Enter an *operator* and *port* to compare source (if positioned after *source source-wildcard*) or destination (if positioned after *destination destination-wildcard*) port. Possible operators include **eq** (equal), **gt** (greater than), **lt** (less than), **neq** (not equal), and **range** (inclusive range). Operators require a port number (range requires two port numbers separated by a space). Enter the *port* number as a decimal number (from 0 to 65535) or the name of a TCP port. Use only TCP port numbers or names when filtering TCP. The other optional keywords have these meanings: • **established**—Enter to match an established connection. This has the same function as matching on the **ack** or **rst** flag. • *flag*—Enter one of these flags to match by the specified TCP header bits: **ack** (acknowledge), **fin** (finish), **psh** (push), **rst** (reset), **syn** (synchronize), or **urg** (urgent).
Step 4	**access-list** *access-list-number* {**deny** | **permit**} **udp** *source source-wildcard* [*operator port*] *destination destination-wildcard* [*operator port*] [**precedence**	(Optional) Defines an extended UDP access list and the access conditions.

	Command or Action	Purpose
	precedence] [**tos** *tos*] [**fragments**] [**log** [**log-input**] [**time-range** *time-range-name*] [**dscp** *dscp*] **Example:** `Device(config)# access-list 101 permit udp any any eq 100`	The UDP parameters are the same as those described for TCP except that the [operator [port]] port number or name must be a UDP port number or name, and the **flag** keyword is and **established** keywords are not valid for UDP.
Step 5	**access-list** *access-list-number* {**deny** | **permit**} **icmp** *source source-wildcard destination destination-wildcard* [*icmp-type* | [[*icmp-type icmp-code*] | [*icmp-message*]] [**precedence** *precedence*] [**tos** *tos*] [**fragments**] [**time-range** *time-range-name*] [**dscp** *dscp*] **Example:** `Device(config)# access-list 101 permit icmp any any 200`	Defines an extended ICMP access list and the access conditions. The ICMP parameters are the same as those described for most IP protocols in an extended IPv4 ACL, with the addition of the ICMP message type and code parameters. These optional keywords have these meanings: • *icmp-type*—Enter to filter by ICMP message type, a number from 0 to 255. • *icmp-code*—Enter to filter ICMP packets that are filtered by the ICMP message code type, a number from 0 to 255. • *icmp-message*—Enter to filter ICMP packets by the ICMP message type name or the ICMP message type and code name.
Step 6	**access-list** *access-list-number* {**deny** | **permit**} **igmp** *source source-wildcard destination destination-wildcard* [*igmp-type*] [**precedence** *precedence*] [**tos** *tos*] [**fragments**] [**log** [**log-input**] [**time-range** *time-range-name*] [**dscp** *dscp*] **Example:** `Device(config)# access-list 101 permit igmp any any 14`	(Optional) Defines an extended IGMP access list and the access conditions. The IGMP parameters are the same as those described for most IP protocols in an extended IPv4 ACL, with this optional parameter. *igmp-type*—To match IGMP message type, enter a number from 0 to 15, or enter the message name: **dvmrp**, **host-query**, **host-report**, **pim**, or **trace**.
Step 7	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Creating Named Standard ACLs

Follow the procedure given below to create a standard ACL using names:

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **ip access-list standard** *name*
4. Use one of the following:
   - **deny** {*source* [*source-wildcard*] | **host** *source* | **any**} [**log**]
   - **permit** {*source* [*source-wildcard*] | **host** *source* | **any**} [**log**]
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip access-list standard** *name* **Example:** `Device(config)# ip access-list standard 20`	Defines a standard IPv4 access list using a name, and enter access-list configuration mode. The name can be a number from 1 to 99.

Step 4	Use one of the following:
	• **deny** {*source* [*source-wildcard*] | **host** *source* | **any**} [**log**]
	• **permit** {*source* [*source-wildcard*] | **host** *source* | **any**} [**log**]
	Example:
	`Device(config-std-nacl)# deny 192.168.0.0 0.0.255.255 255.255.0.0 0.0.255.255`
	or
	`Device(config-std-nacl)# permit 10.108.0.0 0.0.0.0 255.255.255.0 0.0.0.0`
		In access-list configuration mode, specify one or more conditions denied or permitted to decide if the packet is forwarded or dropped.
		• **host** *source*—A source and source wildcard of *source* 0.0.0.0.
		• **any**—A source and source wildcard of 0.0.0.0 255.255.255.255.

	Command or Action	Purpose
Step 5	**end** **Example:** `Device(config-std-nacl)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Creating Extended Named ACLs

Follow the procedure given below to create an extended ACL using names:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list extended** *name*
4. {**deny** | **permit**} *protocol* {*source* [*source-wildcard*] | **host** *source* | **any**} {*destination* [*destination-wildcard*] | host *destination* | **any**} [**precedence** *precedence*] [**tos** *tos*] **[established]** [**log**] [**time-range** *time-range-name*]
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Device# configure terminal`	
Step 3	**ip access-list extended** *name* **Example:** `Device(config)# ip access-list extended 150`	Defines an extended IPv4 access list using a name, and enter access-list configuration mode. The name can be a number from 100 to 199.
Step 4	{**deny** | **permit**} *protocol* {*source* [*source-wildcard*] | **host** *source* | **any**} {*destination* [*destination-wildcard*] | host *destination* | **any**} [**precedence** *precedence*] [**tos** *tos*] **[established]** [**log**] [**time-range** *time-range-name*] **Example:** `Device(config-ext-nacl)# permit 0 any any`	In access-list configuration mode, specify the conditions allowed or denied. Use the **log** keyword to get access list logging messages, including violations. • **host** *source*—A source and source wildcard of *source* 0.0.0.0. • **host** *destintation*—A destination and destination wildcard of *destination* 0.0.0.0. • **any**—A source and source wildcard or destination and destination wildcard of 0.0.0.0 255.255.255.255.
Step 5	**end** **Example:** `Device(config-ext-nacl)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

When you are creating 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.

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

What to do next

After creating a named ACL, you can apply it to interfaces.

Sequencing Access-List Entries and Revising the Access List

This task shows how to assign sequence numbers to entries in a named IP access list and how to add or delete an entry to or from an access list. When completing this task, keep the following points in mind:

- Resequencing the access list entries is optional. The resequencing step in this task is shown as required because that is one purpose of this feature and this task demonstrates that functionality.
- In the following procedure, the **permit** command is shown in Step 5 and the **deny** command is shown in Step 6. However, that order can be reversed. Use the order that suits the need of your configuration.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list resequence** *access-list-name starting-sequence-number increment*
4. **ip access-list** {**standard**| **extended**} *access-list-name*
5. Do one of the following:
   - *sequence-number* **permit** *source source-wildcard*
   - *sequence-number* **permit** *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*][**tos** *tos*] [**log**] [**time-range** *time-range-name*] [**fragments**]
6. Do one of the following:
   - *sequence-number* **deny** *source source-wildcard*
   - *sequence-number* **deny** *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*][**tos** *tos*] [**log**] [**time-range** *time-range-name*] [**fragments**]
7. Do one of the following:
   - *sequence-number* **permit** *source source-wildcard*
   - *sequence-number* **permit** *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*][**tos** *tos*] [**log**] [**time-range** *time-range-name*] [**fragments**]
8. Do one of the following:
   - *sequence-number* **deny** *source source-wildcard*
   - *sequence-number* **deny** *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*][**tos** *tos*] [**log**] [**time-range** *time-range-name*] [**fragments**]
9. Repeat Step 5 and/or Step 6 to add sequence number statements, as applicable.
10. **end**
11. **show ip access-lists** *access-list-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip access-list resequence** *access-list-name starting-sequence-number increment* **Example:** `Device(config)# ip access-list resequence kmd1 100 15`	Resequences the specified IP access list using the starting sequence number and the increment of sequence numbers.
Step 4	**ip access-list** {**standard**| **extended**} *access-list-name* **Example:** `Device(config)# ip access-list standard kmd1`	Specifies the IP access list by name and enters named access list configuration mode. • If you specify **standard**, make sure you subsequently specify **permit** and/or **deny** statements using the standard access list syntax. • If you specify **extended**, make sure you subsequently specify **permit** and/or **deny** statements using the extended access list syntax.
Step 5	Do one of the following: • *sequence-number* **permit** *source source-wildcard* • *sequence-number* **permit** *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*][**tos** *tos*] [**log**] [**time-range** *time-range-name*] [**fragments**] **Example:** `Device(config-std-nacl)# 105 permit 10.5.5.5 0.0.0 255`	Specifies a permit statement in named IP access list mode. • This access list happens to use a **permit** statement first, but a **deny** statement could appear first, depending on the order of statements you need. • As the prompt indicates, this access list was a standard access list. If you had specified **extended** in Step 4, the prompt for this step would be Device(config-ext-nacl) and you would use the extended **permit** command syntax.
Step 6	Do one of the following: • *sequence-number* **deny** *source source-wildcard* • *sequence-number* **deny** *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*][**tos** *tos*] [**log**] [**time-range** *time-range-name*] [**fragments**] **Example:**	(Optional) Specifies a deny statement in named IP access list mode. • This access list uses a **permit** statement first, but a **deny** statement could appear first, depending on the order of statements you need. • As the prompt indicates, this access list was a standard access list. If you had specified **extended** in Step 4,

	Command or Action	Purpose
	`Device(config-std-nacl)# 105 deny 10.6.6.7 0.0.0 255`	the prompt for this step would be Device(config-ext-nacl) and you would use the extended **deny** command syntax.
Step 7	Do one of the following: • *sequence-number* **permit** *source source-wildcard* • *sequence-number* **permit** *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*][**tos** *tos*] [**log**] [**time-range** *time-range-name*] [**fragments**] **Example:** `Device(config-ext-nacl)# 150 permit tcp any any log`	Specifies a permit statement in named IP access list mode. • This access list happens to use a **permit**statement first, but a **deny** statement could appear first, depending on the order of statements you need. • See the permit (IP) command for additional command syntax to permit upper layer protocols (ICMP, IGMP, TCP, and UDP). • Use the **no** *sequence-number* command to delete an entry.
Step 8	Do one of the following: • *sequence-number* **deny** *source source-wildcard* • *sequence-number* **deny** *protocol source source-wildcard destination destination-wildcard* [**precedence** *precedence*][**tos** *tos*] [**log**] [**time-range** *time-range-name*] [**fragments**] **Example:** `Device(config-ext-nacl)# 150 deny tcp any any log`	(Optional) Specifies a deny statement in named IP access list mode. • This access list happens to use a **permit**statement first, but a **deny** statement could appear first, depending on the order of statements you need. • See the deny (IP) command for additional command syntax to permit upper layer protocols (ICMP, IGMP, TCP, and UDP). • Use the **no** *sequence-number* command to delete an entry.
Step 9	Repeat Step 5 and/or Step 6 to add sequence number statements, as applicable.	Allows you to revise the access list.
Step 10	**end** **Example:** `Device(config-std-nacl)# end`	(Optional) Exits the configuration mode and returns to privileged EXEC mode.
Step 11	**show ip access-lists** *access-list-name* **Example:** `Device# show ip access-lists kmd1`	(Optional) Displays the contents of the IP access list.

Examples

Review the output of the **show ip access-lists** command to see that the access list includes the new entries:

```
Device# show ip access-lists kmd1
```

```
Standard IP access list kmd1
100 permit 10.4.4.0, wildcard bits 0.0.0.255
105 permit 10.5.5.0, wildcard bits 0.0.0.255
115 permit 10.0.0.0, wildcard bits 0.0.0.255
130 permit 10.5.5.0, wildcard bits 0.0.0.255
145 permit 10.0.0.0, wildcard bits 0.0.0.255
```

Configuring Commented IP ACL Entries

Either use a named or numbered access list configuration. You must apply the access list to an interface or terminal line after the access list is created for the configuration to work.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip access-list** {**standard** | **extended**} {*name* | *number*}
4. **remark** *remark*
5. **deny** *protocol* **host** *host-address* **any eq** *port*
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip access-list** {**standard**	**extended**} {*name*	*number*} **Example:** `Device(config)# ip access-list extended telnetting`	Identifies the access list by a name or number and enters extended named access list configuration mode.
Step 4	**remark** *remark* **Example:** `Device(config-ext-nacl)# remark Do not allow host1 subnet to telnet out`	Adds a remark for an entry in a named IP access list. • The remark indicates the purpose of the **permit** or **deny** statement.
Step 5	**deny** *protocol* **host** *host-address* **any eq** *port* **Example:** `Device(config-ext-nacl)# deny tcp host 172.16.2.88 any eq telnet`	Sets conditions in a named IP access list that denies packets.

	Command or Action	Purpose
Step 6	**end** **Example:** `Device(config-ext-nacl)# end`	Exits extended named access list configuration mode and enters privileged EXEC mode.

Configuring Time Ranges for ACLs

Follow these steps to configure a time-range parameter for an ACL:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **time-range** *time-range-name*
4. Use one of the following:
   - **absolute** [**start** *time date*] [**end** *time date*]
   - **periodic** *day-of-the-week hh:mm to* [*day-of-the-week*] *hh:mm*
   - **periodic** {**weekdays** | **weekend** | **daily**} *hh:mm to hh:mm*
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device(config)# enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**time-range** *time-range-name* **Example:** `Device(config)# time-range workhours`	Assigns a meaningful name (for example, *workhours*) to the time range to be created, and enter time-range configuration mode. The name cannot contain a space or quotation mark and must begin with a letter.
Step 4	Use one of the following: • **absolute** [**start** *time date*] [**end** *time date*]	Specifies when the function it will be applied to is operational.

	Command or Action	Purpose

	• **periodic** *day-of-the-week hh:mm to* [*day-of-the-week*] *hh:mm*
	• **periodic** {**weekdays** | **weekend** | **daily**} *hh:mm to hh:mm*
	Example:
	`Device(config-time-range)# absolute start 00:00 1 Jan 2006 end 23:59 1 Jan 2006`
	or
	`Device(config-time-range)# periodic weekdays 8:00 to 12:00`
		• You can use only one **absolute** statement in the time range. If you configure more than one absolute statement, only the one configured last is executed.
		• You can enter multiple **periodic** statements. For example, you could configure different hours for weekdays and weekends.
		See the example configurations.

Step 5	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:** `Device# show running-config`	Verifies your entries.
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

What to do next

Repeat the steps if you have multiple items that you want in effect at different times.

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.

Follow these steps to restrict incoming and outgoing connections between a virtual terminal line and the addresses in an ACL:

SUMMARY STEPS

1. **enable**

2. **configure terminal**
3. **line** [**console** | **vty**] *line-number*
4. **access-class** *access-list-number* {**in | out**}
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device(config)# enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**line** [**console**	**vty**] *line-number* **Example:** `Device(config)# line console 0`	Identifies a specific line to configure, and enter in-line configuration mode. • **console**—Specifies the console terminal line. The console port is DCE. • **vty**—Specifies a virtual terminal for remote console access. The *line-number* 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.
Step 4	**access-class** *access-list-number* {**in	out**} **Example:** `Device(config-line)# access-class 10 in`	Restricts incoming and outgoing connections between a particular virtual terminal line (into a device) and the addresses in an access list.
Step 5	**end** **Example:** `Device(config-line)# end`	Returns to privileged EXEC mode.
Step 6	**show running-config** **Example:**	Verifies your entries.

	Command or Action	Purpose
	`Device# show running-config`	
Step 7	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Applying an IPv4 ACL to an Interface (CLI)

This section describes how to apply IPv4 ACLs to network interfaces.

Beginning in privileged EXEC mode, follow the procedure given below to control access to an interface:

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip access-group** {*access-list-number* | *name*} {**in**}
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet 0/1interface gigabitethernet1/0/1`	Identifies a specific interface for configuration, and enter interface configuration mode. The interface can be a Layer 2 interface (port ACL).
Step 3	**ip access-group** {*access-list-number* | *name*} {**in**} **Example:** `Device(config-if)# ip access-group 2 in`	Controls access to the specified interface.

	Command or Action	Purpose
Step 4	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.
Step 5	**show running-config** **Example:** `Device# show running-config`	Displays the access list configuration.
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Monitoring IPv4 ACLs

You can monitor IPv4 ACLs by displaying the ACLs that are configured on the switch, and displaying the ACLs that have been applied to interfaces.

When you use the **ip access-group** interface configuration command to apply ACLs to a Layer 2 or 3 interface, you can display the access groups on the interface. You can also display the MAC ACLs applied to a Layer 2 interface. You can use the privileged EXEC commands as described in this table to display this information.

Table 2: Commands for Displaying Access Lists and Access Groups

Command	Purpose
show access-lists [*number* | *name*]	Displays the contents of one or all current IP and MAC address a specific access list (numbered or named).
show ip access-lists [*number* | *name*]	Displays the contents of all current IP access lists or a specific I (numbered or named).
show ip interface *interface-id*	Displays detailed configuration and status of an interface. If IP the interface and ACLs have been applied by using the **ip access-g** configuration command, the access groups are included in the d
show running-config [**interface** *interface-id*]	Displays the contents of the configuration file for the switch or interface, including all configured MAC and IP access lists and groups are applied to an interface.
show mac access-group [**interface** *interface-id*]	Displays MAC access lists applied to all Layer 2 interfaces or th Layer 2 interface.

Configuration Examples for ACLs

Example: Numbered ACLs

In this example, network 10.0.0.0 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 10.0.0.0 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 10.0.0.0 subnets. The ACL is applied to packets entering a port.

```
Device(config)# access-list 2 permit 10.48.0.3
Device(config)# access-list 2 deny 10.48.0.0 0.0.255.255
Device(config)# access-list 2 permit 10.0.0.0 0.255.255.255
Device(config)# interface gigabitethernet 0/1interface gigabitethernet2/0/1
Device(config-if)# ip access-group 2 in
```

Examples: Extended ACLs

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.

```
Device(config)# access-list 102 permit tcp any 128.88.0.0 0.0.255.255 gt 1023
Device(config)# access-list 102 permit tcp any host 128.88.1.2 eq 25
Device(config)# access-list 102 permit icmp any any
Device(config)# interface gigabitethernet 0/1interface gigabitethernet2/0/1
Device(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.

```
Device(config)# access-list 102 permit tcp any 128.88.0.0 0.0.255.255 eq 23
Device(config)# access-list 102 permit tcp any 128.88.0.0 0.0.255.255 eq 25
Device(config)# interface gigabitethernet 0/1interface gigabitethernet1/0/1
Device(config-if)# ip access-group 102 in
```

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 **ACK** or **RST** keywords are used to match ACK or RST bits set, which show that the packet belongs to an existing connection.

```
Device(config)# access-list 102 permit tcp any 128.88.0.0 0.0.255.255 RST
Device(config)# access-list 102 permit tcp any host 128.88.1.2 eq 25
Device(config)# interface gigabitethernet 0/1
Device(config-if)# ip access-group 102 in
```

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 on stack member 1 is the interface that connects the router to the Internet.

Examples: Named ACLs

Creating named standard and extended ACLs

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.

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

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.

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

Deleting individual ACEs from named ACLs

This example shows how you can delete individual ACEs from the named access list *border-list*:

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

Example Resequencing Entries in an Access List

The following example shows an access list before and after resequencing. The starting value is 1, and increment value is 2. The subsequent entries are ordered based on the increment values that users provide, and the range is from 1 to 2147483647.

When an entry with no sequence number is entered, by default it has a sequence number of 10 more than the last entry in the access list.

```
Router# show access-list carls
Extended IP access list carls
    10 permit ip host 10.3.3.3 host 172.16.5.34
    20 permit icmp any any
    30 permit tcp any host 10.3.3.3
    40 permit ip host 10.4.4.4 any
    50 Dynamic test permit ip any any
    60 permit ip host 172.16.2.2 host 10.3.3.12
    70 permit ip host 10.3.3.3 any log
    80 permit tcp host 10.3.3.3 host 10.1.2.2
    90 permit ip host 10.3.3.3 any
    100 permit ip any any
Router(config)# ip access-list extended carls
Router(config)# ip access-list resequence carls 1 2
Router(config)# end
Router# show access-list carls
Extended IP access list carls
    1 permit ip host 10.3.3.3 host 172.16.5.34
    3 permit icmp any any
    5 permit tcp any host 10.3.3.3
    7 permit ip host 10.4.4.4 any
    9 Dynamic test permit ip any any
    11 permit ip host 172.16.2.2 host 10.3.3.12
    13 permit ip host 10.3.3.3 any log
    15 permit tcp host 10.3.3.3 host 10.1.2.2
    17 permit ip host 10.3.3.3 any
    19 permit ip any any
```

Example Adding an Entry with a Sequence Number

In the following example, an new entry (sequence number 15) is added to an access list:

```
Router# show ip access-list
Standard IP access list tryon
2 permit 10.4.4.2, wildcard bits 0.0.255.255
5 permit 10.0.0.44, wildcard bits 0.0.0.255
10 permit 10.0.0.1, wildcard bits 0.0.0.255
20 permit 10.0.0.2, wildcard bits 0.0.0.255
Router(config)# ip access-list standard tryon
Router(config-std-nacl)# 15 permit 10.5.5.5 0.0.0.255
Router# show ip access-list
Standard IP access list tryon
2 permit 10.4.0.0, wildcard bits 0.0.255.255
5 permit 10.0.0.0, wildcard bits 0.0.0.255
10 permit 10.0.0.0, wildcard bits 0.0.0.255
15 permit 10.5.5.0, wildcard bits 0.0.0.255
20 permit 10.0.0.0, wildcard bits 0.0.0.255
```

Example Adding an Entry with No Sequence Number

The following example shows how an entry with no specified sequence number is added to the end of an access list. When an entry is added without a sequence number, it is automatically given a sequence number that puts it at the end of the access list. Because the default increment is 10, the entry will have a sequence number 10 higher than the last entry in the existing access list.

```
Router(config)# ip access-list standard resources
Router(config-std-nacl)# permit 10.1.1.1 0.0.0.255
Router(config-std-nacl)# permit 10.2.2.2 0.0.0.255
Router(config-std-nacl)# permit 10.3.3.3 0.0.0.255
Router# show access-list
Standard IP access list resources
10 permit 10.1.1.1, wildcard bits 0.0.0.255
20 permit 10.2.2.2, wildcard bits 0.0.0.255
30 permit 10.3.3.3, wildcard bits 0.0.0.255
Router(config)# ip access-list standard resources
Router(config-std-nacl)# permit 10.4.4.4 0.0.0.255
Router(config-std-nacl)# end
Router# show access-list
Standard IP access list resources
10 permit 10.1.1.1, wildcard bits 0.0.0.255
20 permit 10.2.2.2, wildcard bits 0.0.0.255
30 permit 10.3.3.3, wildcard bits 0.0.0.255
40 permit 10.4.4.4, wildcard bits 0.0.0.255
```

Examples: Configuring Commented IP ACL Entries

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:

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

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

```
Device(config)# ip access-list standard prevention
Device(config-std-nacl)# remark Do not allow Jones subnet through
Device(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:

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

Examples: Using Time Ranges with ACLs

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

```
Device# show time-range
time-range entry: new_year_day_2003 (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.

```
Device(config)# access-list 188 deny tcp any any time-range new_year_day_2006
Device(config)# access-list 188 permit tcp any any time-range workhours
Device(config)# end
Device# 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)
```

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

```
Device(config)# ip access-list extended deny_access
Device(config-ext-nacl)# deny tcp any any time-range new_year_day_2006
Device(config-ext-nacl)# exit
Device(config)# ip access-list extended may_access
Device(config-ext-nacl)# permit tcp any any time-range workhours
Device(config-ext-nacl)# end
Device# 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)
```

Examples: Time Range Applied to an IP ACL

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).

```
Device(config)# time-range no-http
Device(config)# periodic weekdays 8:00 to 18:00
!
Device(config)# time-range udp-yes
Device(config)# periodic weekend 12:00 to 20:00
!
Device(config)# ip access-list extended strict
Device(config-ext-nacl)# deny tcp any any eq www time-range no-http
Device(config-ext-nacl)# permit udp any any time-range udp-yes
!
Device(config-ext-nacl)# exit
Device(config)# interface gigabitethernet 0/1interface gigabitethernet2/0/1
Device(config-if)# ip access-group strict in
```

Examples: ACL Logging

Two variations of logging are supported on 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.

```
Device(config)# ip access-list standard stan1
Device(config-std-nacl)# deny 10.1.1.0 0.0.0.255 log
Device(config-std-nacl)# permit any log
Device(config-std-nacl)# exit
Device(config)# interface gigabitethernet 0/1interface gigabitethernet1/0/1
Device(config-if)# ip access-group stan1 in
Device(config-if)# end
Device# 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.

```
Device(config)# ip access-list extended ext1
Device(config-ext-nacl)# permit icmp any 10.1.1.0 0.0.0.255 log
Device(config-ext-nacl)# deny udp any any log
Device(config-std-nacl)# exit
Device(config)# interface gigabitethernet 0/2interface gigabitethernet1/0/2
Device(config-if)# ip access-group ext1 in
```

This is a an example of a log for an extended ACL:

```
01:24:23:%SEC-6-IPACCESSLOGDP:list ext1 permitted icmp 10.1.1.15 -> 10.1.1.61 (0/0), 1
packet
01:25:14:%SEC-6-IPACCESSLOGDP:list ext1 permitted icmp 10.1.1.15 -> 10.1.1.61 (0/0), 7
packets
01:26:12:%SEC-6-IPACCESSLOGP:list ext1 denied udp 0.0.0.0(0) -> 255.255.255.255(0), 1 packet
01:31:33:%SEC-6-IPACCESSLOGP:list ext1 denied udp 0.0.0.0(0) -> 255.255.255.255(0), 8 packets
```

Note that all logging entries for IP ACLs start with %SEC-6-IPACCESSLOG with minor variations in format depending on the kind of ACL and the access entry that has been matched.

This is an example of an output message when the **log-input** keyword is entered:

```
00:04:21:%SEC-6-IPACCESSLOGDP:list inputlog permitted icmp 10.1.1.10 (Vlan1 0001.42ef.a400)
 ->
10.1.1.61 (0/0), 1 packet
```

A log message for the same sort of packet using the **log** keyword does not include the input interface information:

```
00:05:47:%SEC-6-IPACCESSLOGDP:list inputlog permitted icmp 10.1.1.10 -> 10.1.1.61 (0/0), 1
 packet
```

Examples: Troubleshooting ACLs

If this ACL manager message appears and [chars] is the access-list name,

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

The switch has insufficient resources to create a hardware representation of the ACL. 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:

- 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.

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 hardware memory.

Additional References

Related Documents

MIBs

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

Technical Assistance

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

Feature Information for IPv4 Access Control Lists

Release	Feature Information
Cisco IOS 15.0(2)EX	IPv4 Access Control Lists perform packet filtering to control which packets move through the network and where. Such control provides security by helping to limit network traffic, restrict the access of users and devices to the network, and prevent traffic from leaving a network. This feature was introduced.
Cisco IOS 15.2(2)E	The Named ACL Support for Noncontiguous Ports on an Access Control Entry feature allows you to specify noncontiguous ports in a single access control entry, which greatly reduces the number of entries required in an access control list when several entries have the same source address, destination address, and protocol, but differ only in the ports.
Cisco IOS 15.2(2)E	The IP Access List Entry Sequence Numbering feature helps users to apply sequence numbers to permit or deny statements and also reorder, add, or remove such statements from a named IP access list. This feature makes revising IP access lists much easier. Prior to this feature, users could add access list entries to the end of an access list only; therefore needing to add statements anywhere except the end required reconfiguring the access list entirely. The following commands were introduced or modified: **deny (IP)**, **ip access-list resequence deny (IP)**, **permit (IP)**.