



ACL Support for Filtering IP Options

The ACL Support for Filtering IP Options feature describes how to use an IP access list to filter IP packets that contain IP options to prevent devices from becoming saturated with spurious packets.

This module also describes the ACL TCP Flags Filtering feature and how to use an IP access list to filter IP packets that contain TCP flags. The ACL TCP Flags Filtering feature allows you to select any combination of flags on which to filter. The ability to match on a flag set and on a flag not set gives you a greater degree of control for filtering on TCP flags, thus enhancing security.

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Prerequisites for ACL Support for Filtering IP Options

Before you configure the ACL Support for Filtering IP Options feature, you must understand the concepts of the IP access lists.

Information About ACL Support for Filtering IP Options

IP Options

IP uses four key mechanisms in providing its service: Type of Service, Time to Live, Options, and Header Checksum.

The Options, commonly referred to as IP Options, provide for control functions that are required in some situations but unnecessary for the most common communications. IP Options include provisions for time stamps, security, and special routing.

IP Options may or may not appear in datagrams. They must be implemented by all IP modules (host and gateways). What is optional is their transmission in any particular datagram, not their implementation. In some environments the security option may be required in all datagrams.

The option field is variable in length. There may be zero or more options. IP Options can have one of two formats:

- Format 1: A single octet of option-type.
- Format 2: An option-type octet, an option-length octet, and the actual option-data octets.

The option-length octet counts the option-type octet, the option-length octet, and the option-data octets.

The option-type octet is viewed as having three fields: a 1-bit copied flag, a 2-bit option class, and a 5-bit option number. These fields form an 8-bit value for the option type field. IP Options are commonly referred to by their 8-bit value.

For a complete list and description of IP Options, refer to RFC 791, *Internet Protocol* at the following URL: <http://www.faqs.org/rfcs/rfc791.html>

Benefits of Filtering IP Options

- Filtering of packets that contain IP Options from the network relieves downstream devices and hosts of the load from options packets.
- This feature also minimizes load to the Route Processor (RP) for packets with IP Options that require RP processing on distributed systems. Previously, the packets were always routed to or processed by the RP CPU. Filtering the packets prevents them from impacting the RP.

Benefits of Filtering on TCP Flags

The ACL TCP Flags Filtering feature provides a flexible mechanism for filtering on TCP flags. Previously, an incoming packet was matched as long as any TCP flag in the packet matched a flag specified in the access control entry (ACE). This behavior allows for a security loophole, because packets with all flags set could get past the access control list (ACL). The ACL TCP Flags Filtering feature allows you to select any combination of flags on which to filter. The ability to match on a flag set and on a flag not set gives you a greater degree of control for filtering on TCP flags, thus enhancing security.

Because TCP packets can be sent as false synchronization packets that can be accepted by a listening port, it is recommended that administrators of firewall devices set up some filtering rules to drop false TCP packets.

The ACEs that make up an access list can be configured to detect and drop unauthorized TCP packets by allowing only the packets that have a very specific group of TCP flags set or not set. The ACL TCP Flags Filtering feature provides a greater degree of packet-filtering control in the following ways:

- You can select any desired combination of TCP flags on which to filter TCP packets.
- You can configure ACEs to allow matching on a flag that is set, as well as on a flag that is not set.

TCP Flags

The table below lists the TCP flags, which are further described in RFC 793, *Transmission Control Protocol*.

Table 1: TCP Flags

TCP Flag	Purpose
ACK	Acknowledge flag—Indicates that the acknowledgment field of a segment specifies the next sequence number the sender of this segment is expecting to receive.
FIN	Finish flag—Used to clear connections.
PSH	Push flag—Indicates the data in the call should be immediately pushed through to the receiving user.
RST	Reset flag—Indicates that the receiver should delete the connection without further interaction.
SYN	Synchronize flag—Used to establish connections.
URG	Urgent flag—Indicates that the urgent field is meaningful and must be added to the segment sequence number.

How to Configure ACL Support for Filtering IP Options

Filtering Packets That Contain IP Options

Complete these steps to configure an access list to filter packets that contain IP options and to verify that the access list has been configured correctly.



Note

- The ACL Support for Filtering IP Options feature can be used only with named, extended ACLs.
- Resource Reservation Protocol (RSVP) Multiprotocol Label Switching Traffic Engineering (MPLS TE), Internet Group Management Protocol Version 2 (IGMPV2), and other protocols that use IP options packets may not function in drop or ignore mode if this feature is configured.
- On most Cisco devices, a packet with IP options is not switched in hardware, but requires control plane software processing (primarily because there is a need to process the options and rewrite the IP header), so all IP packets with IP options will be filtered and switched in software.

Procedure

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

	Command or Action	Purpose
	Device# configure terminal	
Step 3	ip access-list extended <i>access-list-name</i> Example: Device(config)# ip access-list extended mylist1	Specifies the IP access list by name and enters named access list configuration mode.
Step 4	[<i>sequence-number</i>] deny <i>protocol source source-wildcard destination destination-wildcard</i> [option <i>option-value</i>] [precedence <i>precedence</i>] [tos <i>tos</i>] [log] [time-range <i>time-range-name</i>] [fragments] Example: Device(config-ext-nacl)# deny ip any any option traceroute	(Optional) Specifies a deny statement in named IP access list mode. <ul style="list-style-type: none"> • This access list happens to use a deny statement first, but a permit statement could appear first, depending on the order of statements you need. • Use the option keyword and <i>option-value</i> argument to filter packets that contain a particular IP Option. • In this example, any packet that contains the traceroute IP option will be filtered out. • Use the no <i>sequence-number</i> form of this command to delete an entry.
Step 5	[<i>sequence-number</i>] permit <i>protocol source source-wildcard destination destination-wildcard</i> [option <i>option-value</i>] [precedence <i>precedence</i>] [tos <i>tos</i>] [log] [time-range <i>time-range-name</i>] [fragments] Example: Device(config-ext-nacl)# permit ip any any option security	Specifies a permit statement in named IP access list mode. <ul style="list-style-type: none"> • In this example, any packet (not already filtered) that contains the security IP option will be permitted. • Use the no <i>sequence-number</i> form of this command to delete an entry.
Step 6	Repeat Step 4 or Step 5 as necessary.	Allows you to revise the access list.
Step 7	end Example: Device(config-ext-nacl)# end	(Optional) Exits named access list configuration mode and returns to privileged EXEC mode.
Step 8	show ip access-lists <i>access-list-name</i> Example: Device# show ip access-lists mylist1	(Optional) Displays the contents of the IP access list.

Filtering Packets That Contain TCP Flags

This task configures an access list to filter packets that contain TCP flags and verifies that the access list has been configured correctly.



Note

- TCP flag filtering can be used only with named, extended ACLs.
- The ACL TCP Flags Filtering feature is supported only for Cisco ACLs.
- Previously, the following command-line interface (CLI) format could be used to configure a TCP flag-checking mechanism:

permit tcp any any rst The following format that represents the same access control entry (ACE) can now be used: **permit tcp any any match-any +rst** Both the CLI formats are accepted; however, if the new keywords **match-all** or **match-any** are chosen, they must be followed by the new flags that are prefixed with “+” or “-”. It is advisable to use only the old format or the new format in a single ACL. You cannot mix and match the old and new CLI formats.



Caution

If a device having ACEs with the new syntax format is reloaded with a previous version of the Cisco software that does not support the ACL TCP Flags Filtering feature, the ACEs will not be applied, leading to possible security loopholes.

Procedure

	Command or Action	Purpose
Step 1	<p>enable</p> <p>Example:</p> <pre>Device> enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	<p>configure terminal</p> <p>Example:</p> <pre>Device# configure terminal</pre>	<p>Enters global configuration mode.</p>
Step 3	<p>ip access-list extended <i>access-list-name</i></p> <p>Example:</p> <pre>Device(config)# ip access-list extended kmdl</pre>	<p>Specifies the IP access list by name and enters named access list configuration mode.</p>
Step 4	<p><i>[sequence-number]</i> permit tcp source source-wildcard [operator [port]] destination destination-wildcard [operator [port]] [established] {match-any match-all} {+ -} flag-name [precedence precedence] [tos tos] [log] [time-range time-range-name] [fragments]</p> <p>Example:</p> <pre>Device(config-ext-nacl)# permit tcp any any match-any +rst</pre>	<p>Specifies a permit statement in named IP access list mode.</p> <ul style="list-style-type: none"> • 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. • Use the TCP command syntax of the permit command.

	Command or Action	Purpose
		<ul style="list-style-type: none"> Any packet with the RST TCP header flag set will be matched and allowed to pass the named access list kmd1 in Step 3.
Step 5	<pre>[sequence-number] deny tcp source source-wildcard [operator [port]] destination destination-wildcard [operator [port]] [established]{match-any match-all} {+ -} flag-name] [precedence precedence] [tos tos] [log] [time-range time-range-name] [fragments]</pre> <p>Example:</p> <pre>Device(config-ext-nacl)# deny tcp any any match-all -ack -fin</pre>	<p>(Optional) Specifies a deny statement in named IP access list mode.</p> <ul style="list-style-type: none"> 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. Use the TCP command syntax of the deny command. Any packet that does not have the ACK flag set, and also does not have the FIN flag set, will not be allowed to pass the named access list kmd1 in Step 3. See the deny(IP) command for additional command syntax to permit upper-layer protocols (ICMP, IGMP, TCP, and UDP).
Step 6	Repeat Step 4 or Step 5 as necessary, adding statements by sequence number where you planned. Use the no sequence-number command to delete an entry.	Allows you to revise the access list.
Step 7	<p>end</p> <p>Example:</p> <pre>Device(config-ext-nacl)# end</pre>	(Optional) Exits the configuration mode and returns to privileged EXEC mode.
Step 8	<p>show ip access-lists access-list-name</p> <p>Example:</p> <pre>Device# show ip access-lists kmd1</pre>	<p>(Optional) Displays the contents of the IP access list.</p> <ul style="list-style-type: none"> Review the output to confirm that the access list includes the new entry.

Configuration Examples for ACL Support for Filtering IP Options

Example: Filtering Packets That Contain IP Options

The following example shows an extended access list named mylist2 that contains access list entries (ACEs) that are configured to permit TCP packets only if they contain the IP Options that are specified in the ACEs:

```
ip access-list extended mylist2
```

```

10 permit ip any any option eool
20 permit ip any any option record-route
30 permit ip any any option zsu
40 permit ip any any option mtup

```

The **show access-list** command has been entered to show how many packets were matched and therefore permitted:

```

Device# show ip access-list mylist2
Extended IP access list test
10 permit ip any any option eool (1 match)
20 permit ip any any option record-route (1 match)
30 permit ip any any option zsu (1 match)
40 permit ip any any option mtup (1 match)

```

Example: Filtering Packets That Contain TCP Flags

The following access list allows TCP packets only if the TCP flags ACK and SYN are set and the FIN flag is not set:

```

ip access-list extended aaa
 permit tcp any any match-all +ack +syn -fin
end

```

The **show access-list** command has been entered to display the ACL:

```

Device# show access-list aaa

Extended IP access list aaa
 10 permit tcp any any match-all +ack +syn -fin

```

Additional References for ACL Support for Filtering IP Options

Related Documents

Related Topic	Document Title
Cisco security commands	<ul style="list-style-type: none"> • Cisco IOS Security Command Reference: Commands A to C • Cisco IOS Security Command Reference: Commands D to L • Cisco IOS Security Command Reference: Commands M to R • Cisco IOS Security Command Reference: Commands S to Z

RFCs

RFC	Title
RFC 791	<i>Internet Protocol</i> http://www.faqs.org/rfcs/rfc791.html
RFC 793	<i>Transmission Control Protocol</i>
RFC 1393	<i>Traceroute Using an IP Option</i>

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Creating an IP Access List to Filter

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

Table 2: Feature Information for Creating an IP Access List to Filter

Feature Name	Releases	Feature Configuration Information
ACL Support for Filtering IP Options	Cisco IOS 15.2(2)E	This feature allows you to filter packets having IP Options, in order to prevent routers from becoming saturated with spurious packets.
ACL TCP Flags Filtering	Cisco IOS 15.2(2)E	This feature provides a flexible mechanism for filtering on TCP flags. The ACL TCP Flags Filtering feature allows you to select any combination of flags on which to filter. The ability to match on a flag set and on a flag not set gives you a greater degree of control for filtering on TCP flags, thus enhancing security.