



## **Cisco IOS Security Command Reference: Commands M to R, Cisco IOS XE Release 3SE (Catalyst 3650 Switches)**

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## mab through mime-type

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# mab

To enable MAC-based authentication on a port, use the **mab** command in interface configuration mode. To disable MAC-based authentication, use the **no** form of this command.

**mab [eap]**

**no mab**

## Syntax Description

<b>eap</b>	(Optional) Configures the port to use Extensible Authentication Protocol (EAP).
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## Command Default

MAC-based authentication is not enabled.

## Command Modes

Interface configuration (config-if)

## Command History

Release	Modification
12.2(33)SXI	This command was introduced.
15.2(2)T	This command was integrated into Cisco IOS Release 15.2(2)T.

## Usage Guidelines

Use the **mab** command to enable MAC-based authentication on a port. To enable EAP on the port, use the **mab eap** command.



### Note

If you are unsure whether MAB or MAB EAP is enabled or disabled on the switched port, use the **default mab** or **default mab eap** commands in interface configuration mode to configure MAB or MAB EAP to its default.

## Examples

The following example shows how to configure MAC-based authorization on a Gigabit Ethernet port:

```
Switch(config)# interface GigabitEthernet6/2
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config-if)# mab
Switch(config-if)# end
```

**Related Commands**

Command	Description
show mab	Displays information about MAB.

## mac access-group

To use a MAC access control list (ACL) to control the reception of incoming traffic on a Gigabit Ethernet interface, an 802.1Q VLAN subinterface, an 802.1Q-in-Q stacked VLAN subinterface, use the **macaccess-group** command in interface or subinterface configuration mode. To remove a MAC ACL, use the **no** form of this command.

**mac access-group** *access-list-number* **in**

**no mac access-group** *access-list-number* **in**

### Syntax Description

<i>access-list-number</i>	Number of a MAC ACL to apply to an interface or subinterface (as specified by a <b>access-list(MAC)</b> command). This is a decimal number from 700 to 799.
<b>in</b>	Filters on inbound packets.

### Command Default

No access list is applied to the interface or subinterface.

### Command Modes

Interface configuration (config-if) Subinterface configuration (config-subif)

### Command History

Release	Modification
12.0(32)S	This command was introduced on the Cisco 12000 series Internet router.
12.2(33)SXH	This command was integrated into Cisco IOS Release 12.2(33)SXH.

### Usage Guidelines

MAC ACLs are applied on incoming traffic on Gigabit Ethernet interfaces and VLAN subinterfaces. After a networking device receives a packet, the Cisco IOS software checks the source MAC address of the Gigabit Ethernet, 802.1Q VLAN, or 802.1Q-in-Q packet against the access list. If the MAC access list permits the address, the software continues to process the packet. If the access list denies the address, the software discards the packet and returns an Internet Control Message Protocol (ICMP) host unreachable message.

If the specified MAC ACL does not exist on the interface or subinterface, all packets are passed.

On Catalyst 6500 series switches, this command is supported on Layer 2 ports only.



#### Note

The **macaccess-group** command is supported on a VLAN subinterface only if a VLAN is already configured on the subinterface.

**Examples**

The following example applies MAC ACL 101 on incoming traffic received on Gigabit Ethernet interface 0:

```
Router> enable
Router# configure terminal
Router(config)# interface gigabitethernet 0
Router(config-if)# mac access-group 101 in
```

**Related Commands**

Command	Description
<b>access-list (MAC)</b>	Defines a MAC ACL.
<b>clear mac access-list counters</b>	Clears the counters of a MAC ACL.
<b>ip access-group</b>	Configures an IP access list to be used for packets transmitted from the asynchronous host.
<b>show access-group mode interface</b>	Displays the ACL configuration on a Layer 2 interface.
<b>show mac access-list</b>	Displays the contents of one or all MAC ACLs.

## mac-address (RITE)

To specify the Ethernet address of the destination host, use the **mac-address** command in router IP traffic export (RITE) configuration mode. To change the MAC address of the destination host, use the **no** form of this command.

**mac-address** *H.H.H*

**no mac-address** *H.H.H*

### Syntax Description

<i>H.H.H</i>	48-bit MAC address.
--------------	---------------------

### Command Default

A destination host is not known.

### Command Modes

RITE configuration

### Command History

Release	Modification
12.3(4)T	This command was introduced.
12.2(25)S	This command was integrated into Cisco IOS Release 12.2(25)S.

### Usage Guidelines

The **mac-address** command, which is used to specify the destination host that is receiving the exported traffic, is part of suite of RITE configuration mode commands that are used to control various attributes for both incoming and outgoing IP traffic export.

The **ip traffic-export profile** command allows you to begin a profile that can be configured to export IP packets as they arrive or leave a selected router ingress interface. A designated egress interface exports the captured IP packets out of the router. Thus, the router can export unaltered IP packets to a directly connected device.

### Examples

The following example shows how to configure the profile “corp1,” which will send captured IP traffic to host “00a.8aab.90a0” at the interface “FastEthernet 0/1.” This profile is also configured to export one in every 50 packets and to allow incoming traffic only from the access control lists (ACL) “ham\_ACL.”

```
Router(config)# ip traffic-export profile corp1
Router(config-rite)# interface FastEthernet 0/1
Router(config-rite)# bidirectional
Router(config-rite)# mac-address 00a.8aab.90a0
Router(config-rite)# outgoing sample one-in-every 50
Router(config-rite)# incoming access-list ham_acl
Router(config-rite)# exit
```

```
Router(config)# interface FastEthernet 0/0  
Router(config-if)# ip traffic-export apply corp1
```

**Related Commands**

Command	Description
<b>ip traffic-export profile</b>	Creates or edits an IP traffic export profile and enables the profile on an ingress interface.

## match class-map

To use a traffic class as a classification policy, use the **match class-map** command in class-map or policy inline configuration mode. To remove a specific traffic class as a match criterion, use the **no** form of this command.

**match class-map** *class-map-name*

**no match class-map** *class-map-name*

### Syntax Description

<i>class-map-name</i>	Name of the traffic class to use as a match criterion.
-----------------------	--

### Command Default

No match criteria are specified.

### Command Modes

Class-map configuration (config-cmap)

### Command History

Release	Modification
12.0(5)XE	This command was introduced.
12.1(1)E	This command was integrated into Cisco IOS Release 12.1(1)E.
12.1(5)T	This command was integrated into Cisco IOS Release 12.1(5)T.
12.4(6)T	This command was enhanced to support Zone-Based Policy Firewall.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(31)SB	This command was implemented on the Cisco 10000 series.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
Cisco IOS XE Release 3.2S	This command was integrated into Cisco IOS XE Release 3.2S.

### Usage Guidelines

The only method of including both match-any and match-all characteristics in a single traffic class is to use the **match class-map** command. To combine match-any and match-all characteristics into a single class, do one of the following:

- Create a traffic class with the match-any instruction and use a class configured with the match-all instruction as a match criterion (using the **match class-map** command).

- Create a traffic class with the match-all instruction and use a class configured with the match-any instruction as a match criterion (using the **match class-map** command).

You can also use the **match class-map** command to nest traffic classes within one another, saving users the overhead of re-creating a new traffic class when most of the information exists in a previously configured traffic class.

When packets are matched to a class map, a traffic rate is generated for these packets. In a zone-based firewall policy, only the first packet that creates a session matches the policy. Subsequent packets in this flow do not match the filters in the configured policy, but instead match the session directly. The statistics related to subsequent packets are shown as part of the 'inspect' action.

## Examples

### Examples

In the following example, the traffic class called class1 has the same characteristics as traffic class called class2, with the exception that traffic class class1 has added a destination address as a match criterion. Rather than configuring traffic class class1 line by line, you can enter the **match class-map class2** command. This command allows all of the characteristics in the traffic class called class2 to be included in the traffic class called class1, and you can simply add the new destination address match criterion without reconfiguring the entire traffic class.

```
Router(config)# class-map match-any class2
Router(config-cmap)# match protocol ip
Router(config-cmap)# match qos-group 3
Router(config-cmap)# match access-group 2
Router(config-cmap)# exit
Router(config)# class-map match-all class1
Router(config-cmap)# match class-map class2
Router(config-cmap)# match destination-address mac 1.1.1
Router(config-cmap)# exit
```

The following example shows how to combine the characteristics of two traffic classes, one with match-any and one with match-all characteristics, into one traffic class with the **match class-map** command. The result of traffic class called class4 requires a packet to match one of the following three match criteria to be considered a member of traffic class called class 4: IP protocol *and* QoS group 4, destination MAC address 1.1.1, or access group 2. Match criteria IP protocol *and* QoS group 4 are required in the definition of the traffic class named class3 and included as a possible match in the definition of the traffic class named class4 with the **match class-map class3** command.

In this example, only the traffic class called class4 is used with the service policy called policy1.

```
Router(config)# class-map match-all class3
Router(config-cmap)# match protocol ip
Router(config-cmap)# match qos-group 4
Router(config-cmap)# exit
Router(config)# class-map match-any class4
Router(config-cmap)# match class-map class3
Router(config-cmap)# match destination-address mac 1.1.1
Router(config-cmap)# match access-group 2
Router(config-cmap)# exit
Router(config)# policy-map policy1
Router(config-pmap)# class class4
Router(config-pmap-c)# police 8100 1500 2504 conform-action transmit exceed-action
set-qos-transmit 4
Router(config-pmap-c)# exit
```

**Related Commands**

Command	Description
class-map	Creates a class map to be used for matching packets to a specified class.



## pac key through port-misuse

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- [permit](#), page 12
- [permit \(IP\)](#), page 23
- [port](#), page 38
- [port \(TACACS+\)](#), page 39

## permit

To set conditions in named IP access list or object group access control list (OGACL) that will permit packets, use the **permit** command in the appropriate configuration mode. To remove a condition from an IP access list or an OGACL, use the **no** form of this command.

```
permit protocol [source-addr source-wildcard] {any|host {address|name}}| object-group object-group-name
{destination-addr destination-wildcard} any|host {address|name}}| object-group object-group-name } [dscp
dscp-value| precedence precedence-value| fragments fragment-value| option option-value| reflect
access-list-name| time-range time-range-value| ttl match-value ttl-value [ttl-value]| tos tos-value| timeout
max-time| log [ log-value ]| log-input [ log-input-value ]]
```

```
no permit protocol [source-addr source-wildcard] {any|host {address|name}}| object-group
object-group-name; {destination-addr destination-wildcard} any|host {address|name}}| object-group
object-group-name;
```

```
permit {tcp|udp} {source-addr source-wildcard} any|host source-addr| object-group source-obj-group
{destination-addr destination-wildcard} any|host dest-addr| object-group dest-obj-group| port-match-criteria
{destination-addr destination-wildcard} any|host dest-addr| object-group dest-obj-group } }
[port-match-criteria port-number| fragments| ack| established| fin| psh| rst| syn| urg| match-all match-value|
match-any match-value| dscp dscp-value| precedence precedence-value| option option-value| time-range
time-range-value| ttl match-value ttl-value [ ttl-value ]| tos tos-value| log [ log-value ]| log-input
[ log-input-value ]]
```

```
no permit {tcp|udp} {source-addr source-wildcard} any|host source-addr| object-group source-obj-group
{destination-addr destination-wild-card} any|host dest-addr| object-group dest-obj-group| port-match-criteria
{destination-addr destination-wild-card} any|host dest-addr| object-group dest-obj-group }
```

### Syntax Description

<i>protocol</i>	Name or number of a protocol; valid values are; valid values are <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>object-group</b> , <b>tcp</b> , <b>pcp</b> , <b>pim</b> , <b>udp</b> , or an integer in the range 0 to 255 representing an IP protocol number. To match any Internet protocol (including Internet Control Message Protocol (ICMP), TCP, and User Datagram Protocol (UDP), use the keyword <b>ip</b> . See the “Usage Guidelines” section for additional qualifiers.
<i>source-addr</i>	(Optional) Number of the network or host from which the packet is being sent in a 32-bit quantity in four-part, dotted-decimal format.
<i>source-wildcard</i>	(Optional) Wildcard bits to be applied to the source in four-part, dotted-decimal format. Place ones in the bit positions you want to ignore.

<b>any</b>	Specifies any source or any destination host as an abbreviation for the <i>source-addr</i> or <i>destination-addr</i> value and the <i>source-wildcard</i> or <i>destination-wildcard</i> value of 0.0.0.0 255.255.255.255.
<b>host</b> <i>address name</i>	Specifies the source or destination address and name of a single host.
<b>object-group</b> <i>object-group-name</i>	Specifies the source or destination name of the object group.
<i>destination-addr</i>	Number of the network or host to which the packet is being sent in a 32-bit quantity in four-part, dotted-decimal format.
<i>destination-wildcard</i>	Wildcard bits to be applied to the destination in a 32-bit quantity in four-part, dotted-decimal format. Place ones in the bit positions you want to ignore.
<b>object-group</b> <i>dest-addr-group-name</i>	Specifies the destination address group name.
<b>dscp</b> <i>dscp-value</i>	(Optional) Matches the packets with the given Differentiated Services Code Point (DSCP) value; see the “Usage Guidelines” section for valid values.
<b>precedence</b> <i>precedence-value</i>	(Optional) Specifies the precedence filtering level for packets; valid values are a number from 0 to 7 or by a name. See the “Usage Guidelines” section for a list of valid names.
<b>fragments</b> <i>fragment-value</i>	(Optional) Applies the access list entry to noninitial fragments of packets; the fragment is either permitted or denied accordingly. For more details about the <b>fragments</b> keyword, see the “Access List or OGACL Processing of Fragments” and “Fragments and Policy Routing” sections in the “Usage Guidelines” section.
<b>option</b> <i>option-value</i>	(Optional) Matches the packets with the given IP options value number; see the “Usage Guidelines” section for valid values.
<b>reflect</b> <i>access-list-name</i>	(Optional) Create reflexive access list entry.
<b>time-range</b> <i>time-range-value</i>	(Optional) Specifies a time-range entry name.
<b>ttl</b> <i>match-value ttl-value</i>	(Optional) Specifies the match packets with given TTL value; see the “Usage Guidelines” section for valid values.

<b>tos</b> <i>tos-value</i>	(Optional) Specifies the service filtering level for packets; valid values are a number from 0 to 15 or by a name as listed in the “Usage Guidelines” section of the <b>access-list</b> (IP extended) command.
<b>timeout</b> <i>max-time</i>	Specifies the maximum time for a reflexive ACL to live; the valid values are from 1 to 2147483 seconds.
<b>log</b>	<p>(Optional) Causes an informational logging message about the packet that matches the entry to be sent to the console. (The level of messages logged to the console is controlled by the <b>logging console</b> command.)</p> <p>The message for a standard list includes the access list number, whether the packet was permitted or denied, the source address, and the number of packets.</p> <p>The message for an extended list includes the access list number; whether the packet was permitted or denied; the protocol; whether the protocol was TCP, UDP, ICMP, or a number; and, if appropriate, the source and destination addresses and port numbers and the user-defined cookie or router-generated hash value.</p> <p>For both standard and extended lists, the message is generated for the first packet that matches, and then at 5-minute intervals, including the number of packets permitted or denied in the prior 5-minute interval.</p> <p>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 reloading because of 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.</p> <p>After you specify the <b>log</b> keyword (and the associated <i>word</i> argument), you cannot specify any other keywords or settings for this command.</p>

<i>log-value</i>	<p>(Optional) User-defined cookie appended to the log message. The cookie:</p> <ul style="list-style-type: none"> <li>• cannot be more than characters</li> <li>• cannot start with hexadecimal notation (such as 0x)</li> <li>• cannot be the same as, or a subset of, the following keywords: <b>reflect</b>, <b>fragment</b>, <b>time-range</b></li> <li>• must contain alphanumeric characters only</li> </ul> <p>The user-defined cookie is appended to the access control entry (ACE) syslog entry and uniquely identifies the ACE, within the access control list, that generated the syslog entry.</p>
<b>log-input</b> <i>log-input-value</i>	<p>(Optional) Matches the log against this entry, including the input interface.</p> <p>After you specify the <b>log-input</b> keyword (and the associated <i>log-input-value</i> argument), you cannot specify any other keywords or settings for this command.</p>
<b>tcp</b>	Specifies the TCP protocol.
<b>udp</b>	Specifies the UDP protocol.
<b>object-group</b> <i>source-obj-group</i>	Specifies the source address group name.
<i>port-match-criteria</i> <i>port-number</i>	Matches only packets on a given port number; see the “Usage Guidelines” section for valid values.

**Command Default**

There are no specific conditions under which a packet passes the access list.

**Command Modes**

Standard access-list configuration (config-std-nacl) Extended access-list configuration (config-ext-nacl)

**Command History**

Release	Modification
12.4(20)T	This command was introduced.
12.4(22)T	The <i>word</i> argument was added to the <b>log</b> and <b>log-input</b> keywords.

## Usage Guidelines

Use this command following the **ip access-list** command to define the conditions under which a packet passes the access list.

In Cisco IOS 15.0(1)M and later Releases, to remove the log entry from the **permit ip any any log** command, use the **permit ip any any** command.

In releases earlier than Cisco IOS Release 15.0(1)M, to remove the **log** option from the **permit ip any any log** command, use the **no permit ip any any log** and the **permit ip any any** commands.

In Cisco IOS 15.0(1)M and later releases, to remove the log entry and the user-defined cookie, use the **permit ip any any [log-value]** command.

In releases earlier than Cisco IOS Release 15.0(1)M, to remove the log entry and user-defined cookies, use the **no permit ip any any log [log-value]** and **permit ip any any** commands.

### Access List or OGACL Processing of Fragments

The behavior of access-list entries regarding the use or lack of the **fragments** keyword are summarized in the table below:

**Table 1: Access list or OGACL Processing of Fragments**

If the Access-List Entry Has...	Then...
<p>...no <b>fragments</b> keyword (the default behavior), and assuming all of the access-list entry information matches,</p>	<p>For an access-list entry containing only Layer 3 information:</p> <ul style="list-style-type: none"> <li>• The entry is applied to nonfragmented packets, initial fragments, and noninitial fragments.</li> </ul> <p>For an access list entry containing Layer 3 and Layer 4 information:</p> <ul style="list-style-type: none"> <li>• The entry is applied to nonfragmented packets and initial fragments:               <ul style="list-style-type: none"> <li>• If the entry is a <b>permit</b> statement, the packet or fragment is permitted.</li> <li>• If the entry is a <b>deny</b> statement, the packet or fragment is denied.</li> </ul> </li> <li>• The entry is also applied to noninitial fragments in the following manner. Because noninitial fragments contain only Layer 3 information, only the Layer 3 portion of an access-list entry can be applied. If the Layer 3 portion of the access-list entry matches, and               <ul style="list-style-type: none"> <li>• If the entry is a <b>permit</b> statement, the noninitial fragment is permitted.</li> <li>• If the entry is a <b>deny</b> statement, the next access-list entry is processed.</li> </ul> </li> </ul> <p><b>Note</b> The <b>deny</b> statements are handled differently for noninitial fragments versus nonfragmented or initial fragments.</p>
<p>...the <b>fragments</b> keyword, and assuming all of the access-list entry information matches,</p>	<p><b>Note</b> The access-list entry is applied only to noninitial fragments. The <b>fragments</b> keyword cannot be configured for an access-list entry that contains any Layer 4 information.</p>

Ensure that you do not add the **fragments** keyword to every access list entry because the first fragment of the IP packet is considered a nonfragment and is treated independently of the subsequent fragments. An initial fragment will not match an access list **permit** or **deny** entry that contains the **fragments** keyword, the packet is compared to the next access list entry, and so on, until it is either permitted or denied by an access list entry that does not contain the **fragments** keyword. Therefore, you may need two access list entries for every **deny** entry. The first **deny** entry of the pair will not include the **fragments** keyword, and applies to the initial fragment. The second **deny** entry of the pair will include the **fragments** keyword and applies to the subsequent

fragments. In the cases where there are multiple **deny** access list entries for the same host but with different Layer 4 ports, a single **deny** access-list entry with the **fragments** keyword for that host is all that needs to be added. Thus all the fragments of a packet are handled in the same manner by the access list.

Packet fragments of IP datagrams are considered individual packets and each counts individually as a packet in access list accounting and access list violation counts.

**Note**

The **fragments** keyword cannot solve all cases involving access lists and IP fragments.

---

### Fragments and Policy Routing

Fragmentation and the fragment control feature affect policy routing if the policy routing is based on the **match ip address** command and the access list had entries that match on Layer 4 through 7 information. It is possible that noninitial fragments pass the access list and are policy routed, even if the first fragment was not policy routed or the reverse.

By using the **fragments** keyword in access list entries as described earlier, a better match between the action taken for initial and noninitial fragments can be made and it is more likely policy routing will occur as intended.

The *source-addr* and *destination-addr* arguments allow you to create an object group based on a source or destination group. The following keywords and arguments are available:

- **dscp** *dscp-value* --(Optional) Matches the packets with the given DSCP value; the valid values are as follows:
  - **0** to **63**--Differentiated services codepoint value
  - **af11**--Matches the packets with AF11 dscp (001010)
  - **af12**--Matches the packets with AF12 dscp (001100)
  - **af13**--Matches the packets with AF13 dscp (001110)
  - **af21**--Matches the packets with AF21 dscp (010010)
  - **af22**--Matches the packets with AF22 dscp (010100)
  - **af23**--Matches the packets with AF23 dscp (010110)
  - **af31**--Matches the packets with AF31 dscp (011010)
  - **af32**--Matches the packets with AF32 dscp (011100)
  - **af33**--Matches the packets with AF33 dscp (011110)
  - **af41**--Matches the packets with AF41 dscp (100010)
  - **af42**--Matches the packets with AF42 dscp (100100)
  - **af43**--Matches the packets with AF43 dscp (100110)
  - **cs1**--Matches the packets with CS1 (precedence 1) dscp (001000)
  - **cs2**--Matches the packets with CS2 (precedence 2) dscp (010000)
  - **cs3**--Matches the packets with CS3 (precedence 3) dscp (011000)
  - **cs4**--Matches the packets with CS4 (precedence 4) dscp (100000)
  - **cs5**--Matches the packets with CS5 (precedence 5) dscp (101000)

- **cs6**--Matches the packets with CS6 (precedence 6) dscp (110000)
- **cs7**--Matches the packets with CS7 (precedence 7) dscp (111000)
- **default**--Matches the packets with default dscp (000000)
- **ef**--Matches the packets with EF dscp (101110)
  
- **fragments** --(Optional) Checks for noninitial fragments. See the table above.
- **log** --(Optional) Logs the matches against this entry.
- **log-input** --(Optional) Logs the matches against this entry, including the input interface.
- **option** *option-value* --(Optional) Matches the packets with given IP Options value. The valid values are as follows:
  - 0 to 255--IP Options value.
  - **add-ext**--Matches the packets with Address Extension Option (147).
  - **any-options**--Matches the packets with ANY Option.
  - **com-security**--Matches the packets with Commercial Security Option (134).
  - **dps**--Matches the packets with Dynamic Packet State Option (151).
  - **encode**--Matches the packets with Encode Option (15).
  - **cool**--Matches the packets with End of Options (0).
  - **ext-ip**--Matches the packets with Extended IP Option (145).
  - **ext-security**--Matches the packets with Extended Security Option (133).
  - **finn**--Matches the packets with Experimental Flow Control Option (205).
  - **imitd**--Matches the packets with IMI Traffic Descriptor Option (144).
  - **lsr**--Matches the packets with Loose Source Route Option (131).
  - **match-all**--Matches the packets if all specified flags are present.
  - **match-any**--Matches the packets if any specified flag is present.
  - **mtup**--Matches the packets with MTU Probe Option (11).
  - **mtur**--Matches the packets with MTU Reply Option (12).
  - **no-op**--Matches the packets with No Operation Option (1).
  - **psh**--Match the packets on the PSH bit.
  - **nsapa**--Matches the packets with NSAP Addresses Option (150).
  - **reflect**--Creates reflexive access list entry.
  - **record-route**--Matches the packets with Record Route Option (7).
  - **rst**--Matches the packets on the RST bit.
  - **router-alert**--Matches the packets with Router Alert Option (148).
  - **sdb**--Matches the packets with Selective Directed Broadcast Option (149).

- **security**--Matches the packets with Basic Security Option (130).
  - **ssr**--Matches the packets with Strict Source Routing Option (137).
  - **stream-id**--Matches the packets with Stream ID Option (136).
  - **syn**--Matches the packets on the SYN bit.
  - **timestamp**--Matches the packets with Time Stamp Option (68).
  - **traceroute**--Matches the packets with Trace Route Option (82).
  - **ump**--Matches the packets with Upstream Multicast Packet Option (152).
  - **visa**--Matches the packets with Experimental Access Control Option (142).
  - **zsu**--Matches the packets with Experimental Measurement Option (10).
- **precedence** *precedence-value* --(Optional) Matches the packets with given precedence value; the valid values are as follows:
    - 0 to 7--Precedence value.
    - **critical**--Matches the packets with critical precedence (5).
    - **flash**--Matches the packets with flash precedence (3).
    - **flash-override**--Matches the packets with flash override precedence (4).
    - **immediate**--Matches the packets with immediate precedence (2).
    - **internet**--Matches the packets with internetwork control precedence (6).
    - **network**--Matches the packets with network control precedence (7).
    - **priority**--Matches the packets with priority precedence (1).
    - **routine**--Matches the packets with routine precedence (0).
  - **reflect acl-name** -- (Optional) Creates reflexive access list entry.
  - **ttl** *match-value ttl-value* -- (Optional) Specifies the match packets with given TTL value; the valid values are as follows:
    - **eq**--Matches packets on a given TTL number.
    - **gt**--Matches packets with a greater TTL number.
    - **lt**--Matches packets with a lower TTL number.
    - **neq**--Matches packets not on a given TTL number.
    - **range**--Matches packets in the range of TTLs.
  - **time-range** *time-range-value* --(Optional) Specifies a time-range entry name.
  - **tos** --(Optional) Matches the packets with given ToS value; the valid values are as follows:
    - 0 to 15--Type of service value.
    - **max-reliability**--Matches the packets with the maximum reliable ToS (2).
    - **max-throughput**--Matches the packets with the maximum throughput ToS (4).

- **min-delay**--Matches the packets with the minimum delay ToS (8).
  - **min-monetary-cost**--Matches the packets with the minimum monetary cost ToS (1).
  - **normal**--Matches the packets with the normal ToS (0).
- **timeout** *max-time* -- (Optional) Specifies the maximum time for a reflexive ACL to live; the valid values are from 1 to 2147483 seconds.

## Examples

The following example shows how to create an access list that permits packets from the users in my\_network\_object\_group if the protocol ports match the ports specified in my\_network\_object\_group:

```
Router> enable
Router# configure terminal
Router(config)# ip access-list extended my_ogacl_policy
Router(config-ext-nacl)# permit tcp object-group my_network_object_group portgroup
my_service_object_group any
```

The following example shows how to create an access list that permits packets from the users in my\_network\_object\_group if the protocol ports match the ports specified in my\_network\_object\_group. In addition, logging is enabled for the access list, and all syslog entries for this ACE include the word MyServiceCookieValue:

```
Router> enable
Router# configure terminal
Router(config)# ip access-list extended my_ogacl_policy
Router(config-ext-nacl)# permit tcp object-group my_network_object_group portgroup
my_service_object_group any log MyServiceCookieValue
```

## Related Commands

Command	Description
<b>deny</b>	Sets conditions in a named IP access list or OGACL that will deny packets.
<b>ip access-group</b>	Applies an ACL or OGACL to an interface or a service policy map.
<b>ip access-list</b>	Defines an IP access list or OGACL by name or number.
<b>ip access-list logging hash-generation</b>	Enables hash value generation for ACE syslog entries.
<b>object-group network</b>	Defines network object groups for use in OGACLs.
<b>object-group service</b>	Defines service object groups for use in OGACLs.
<b>show ip access-list</b>	Displays the contents of IP access lists or OGACLs.
<b>show object-group</b>	Displays information about object groups that are configured.



## permit (IP)

To set conditions to allow a packet to pass a named IP access list, use the permit command in access list configuration mode. To remove a permit condition from an access list, use the **no** form of this command.

[ *sequence-number* ] **permit** *source* [ *source-wildcard* ]

[ *sequence-number* ] **permit** *protocol source source-wildcard destination destination-wildcard* [ **option** *option-name* ] [ **precedence** *precedence* ] [ **tos** *tos* ] [ **ttl** *operator value* ] [ **time-range** *time-range-name* ] [ **fragments** ] [ **log** [ *user-defined-cookie* ] ]

**no** *sequence-number*

**no permit** *source* [ *source-wildcard* ]

**no permit** *protocol source source-wildcard destination destination-wildcard* [ **option** *option-name* ] [ **precedence** *precedence* ] [ **tos** *tos* ] [ **ttl** *operator value* ] [ **time-range** *time-range-name* ] [ **fragments** ] [ **log** [ *user-defined-cookie* ] ]

### Internet Control Message Protocol (ICMP)

[ *sequence-number* ] **permit icmp** *source source-wildcard destination destination-wildcard* [ *icmp-type* [ *icmp-code* ] ] *icmp-message* [ **precedence** *precedence* ] [ **tos** *tos* ] [ **ttl** *operator value* ] [ **time-range** *time-range-name* ] [ **fragments** ] [ **log** [ *user-defined-cookie* ] ]

### Internet Group Management Protocol (IGMP)

[ *sequence-number* ] **permit igmp** *source source-wildcard destination destination-wildcard* [ *igmp-type* ] [ **precedence** *precedence* ] [ **tos** *tos* ] [ **ttl** *operator value* ] [ **time-range** *time-range-name* ] [ **fragments** ] [ **log** [ *user-defined-cookie* ] ]

### Transmission Control Protocol (TCP)

[ **sequence-number** ] **permit tcp** *source source-wildcard* [ *operator* [ *port* ] ] *destination destination-wildcard* [ *operator* [ *port* ] ] [ **established** { **match-any** | **match-all** } { + - } *flag-name* | **precedence** *precedence* | **tos** *tos* | **ttl** *operator value* | **log** | **time-range** *time-range-name* | **fragments** | **log** | [ *user-defined-cookie* ] ]

### User Datagram Protocol (UDP)

[ *sequence-number* ] **permit udp** *source source-wildcard* [ *operator* [ *port* ] ] *destination destination-wildcard* [ *operator* [ *port* ] ] [ **precedence** *precedence* ] [ **tos** *tos* ] [ **ttl** *operator value* ] [ **time-range** *time-range-name* ] [ **fragments** ] [ **log** [ *user-defined-cookie* ] ]

### Syntax Description

<i>sequence-number</i>	(Optional) Sequence number assigned to the permit statement. The sequence number causes the system to insert the statement in that numbered position in the access list.
------------------------	--

<i>source</i>	<p>Number of the network or host from which the packet is being sent. There are three alternative ways to specify the source:</p> <ul style="list-style-type: none"> <li>• Use a 32-bit quantity in four-part dotted-decimal format.</li> <li>• Use the <b>any</b> keyword as an abbreviation for a <i>source</i> and <i>source-wildcard</i> of 0.0.0.0 255.255.255.255.</li> <li>• Use <b>host source</b> as an abbreviation for a <i>source</i> and <i>source-wildcard</i> of <i>source</i>0.0.0.0.</li> </ul>
<i>source-wildcard</i>	<p>(Optional) Wildcard bits to be applied to the source. There are three alternative ways to specify the source wildcard:</p> <ul style="list-style-type: none"> <li>• Use a 32-bit quantity in four-part dotted-decimal format. Place 1s in the bit positions that you want to ignore.</li> <li>• Use the <b>any</b> keyword as an abbreviation for a <i>source</i> and <i>source-wildcard</i> of 0.0.0.0 255.255.255.255.</li> <li>• Use <b>host source</b> as an abbreviation for a <i>source</i> and <i>source-wildcard</i> of <i>source</i>0.0.0.0.</li> </ul>
<i>protocol</i>	<p>Name or number of an Internet protocol. The <i>protocol</i> argument can be one of the keywords <b>eigrp</b>, <b>gre</b>, <b>icmp</b>, <b>igmp</b>, <b>ip</b>, <b>ipinip</b>, <b>nos</b>, <b>ospf</b>, <b>tcp</b>, or <b>udp</b>, or an integer in the range from 0 to 255 representing an Internet protocol number. To match any Internet protocol (including ICMP, TCP, and UDP), use the <b>ip</b> keyword.</p> <p><b>Note</b> When the <b>icmp</b>, <b>igmp</b>, <b>tcp</b>, and <b>udp</b> keywords are entered, they must be followed with the specific command syntax that is shown for the ICMP, IGMP, TCP, and UDP forms of the <b>permit</b> command.</p> <p><b>Note</b> To configure a packet filter to allow BGP traffic, use protocol <b>tcp</b> and specify the port number as 179 or <b>bgp</b></p>

<i>destination</i>	<p>Number of the network or host to which the packet is being sent. There are three alternative ways to specify the destination:</p> <ul style="list-style-type: none"> <li>• Use a 32-bit quantity in four-part dotted-decimal format.</li> <li>• Use the <b>any</b> keyword as an abbreviation for the <i>destination</i> and <i>destination-wildcard</i> of 0.0.0.0 255.255.255.255.</li> <li>• Use <b>host destination</b> as an abbreviation for a <i>destination</i> and <i>destination-wildcard</i> of <i>destination</i> 0.0.0.0.</li> </ul>
<i>destination-wildcard</i>	<p>Wildcard bits to be applied to the destination. There are three alternative ways to specify the destination wildcard:</p> <ul style="list-style-type: none"> <li>• Use a 32-bit quantity in four-part dotted-decimal format. Place 1s in the bit positions that you want to ignore.</li> <li>• Use the <b>any</b> keyword as an abbreviation for a <i>destination</i> and <i>destination-wildcard</i> of 0.0.0.0 255.255.255.255.</li> <li>• Use <b>host destination</b> as an abbreviation for a <i>destination</i> and <i>destination-wildcard</i> of <i>destination</i> 0.0.0.0.</li> </ul>
<b>option</b> <i>option-name</i>	<p>(Optional) Packets can be filtered by IP Options, as specified by a number from 0 to 255, or by the corresponding IP Option name, as listed in the table in the “Usage Guidelines” section.</p>
<b>precedence</b> <i>precedence</i>	<p>(Optional) Packets can be filtered by precedence level, as specified by a number from 0 to 7 or by a name.</p>
<b>tos</b> <i>tos</i>	<p>(Optional) Packets can be filtered by type of service (ToS) level, as specified by a number from 0 to 15, or by a name as listed in the “Usage Guidelines” section of the <b>access-list</b>(IP extended) command.</p>

<b>ttl</b> <i>operator-value</i>	<p>(Optional) Compares the TTL value in the packet to the TTL value specified in this <b>permit</b> statement.</p> <ul style="list-style-type: none"> <li>• The <i>operator</i> can be <b>lt</b> (less than), <b>gt</b> (greater than), <b>eq</b> (equal), <b>neq</b> (not equal), or <b>range</b> (inclusive range).</li> <li>• The <i>value</i> can range from 0 to 255.</li> <li>• If the operator is <b>range</b>, specify two values separated by a space.</li> <li>• For Release 12.0S, if the operator is <b>eq</b> or <b>neq</b>, only one TTL value can be specified.</li> <li>• For all other releases, if the operator is <b>eq</b> or <b>neq</b>, as many as 10 TTL values can be specified, separated by a space.</li> </ul>
<b>time-range</b> <i>time-range-name</i>	<p>(Optional) Name of the time range that applies to this <b>permit</b> statement. The name of the time range and its restrictions are specified by the <b>time-range</b> and <b>absolute</b> or <b>periodic</b> commands, respectively.</p>
<b>fragments</b>	<p>(Optional) The access list entry applies to noninitial fragments of packets; the fragment is either permitted or denied accordingly. For more details about the <b>fragments</b> keyword, see the "Access List Processing of Fragments" and "Fragments and Policy Routing" sections in the "Usage Guidelines" section.</p>
<b>log</b>	<p>(Optional) Causes an informational logging message about the packet that matches the entry to be sent to the console. (The level of messages logged to the console is controlled by the <b>logging console</b> command.)</p> <p>After you specify the <b>log</b> keyword (and the associated <i>word</i> argument), you cannot specify any other keywords or settings for this command.</p>

<i>user-defined-cookie</i>	<p>(Optional) User-defined cookie appended to the log message. The cookie:</p> <ul style="list-style-type: none"> <li>• Cannot be more than 64 characters.</li> <li>• Cannot start with hexadecimal notation (such as 0x).</li> <li>• Cannot be the same as, or a subset of, the following keywords: <b>fragment</b>, <b>reflect</b>, <b>time-range</b>.</li> <li>• Must contain alphanumeric characters only.</li> </ul> <p>The user-defined cookie is appended to the Allegro Crypto Engine (ACE) syslog entry and uniquely identifies the ACE, within the access control list, that generated the syslog entry.</p>
<b>icmp</b>	Permits only ICMP packets. When you enter the <b>icmp</b> keyword, you must use the specific command syntax shown for the ICMP form of the <b>permit</b> command.
<i>icmp-type</i>	(Optional) ICMP packets can be filtered by ICMP message type. The type is a number from 0 to 255.
<i>icmp-code</i>	(Optional) ICMP packets that are filtered by ICMP message type can also be filtered by the ICMP message code. The code is a number from 0 to 255.
<i>icmp-message</i>	(Optional) ICMP packets can be filtered by an ICMP message type name or an ICMP message type and code name. The possible names are listed in the “Usage Guidelines” section of the <b>access-list</b> (IP extended) command.
<b>igmp</b>	Permits only IGMP packets. When you enter the <b>igmp</b> keyword, you must use the specific command syntax shown for the IGMP form of the <b>permit</b> command.
<i>igmp-type</i>	(Optional) IGMP packets can be filtered by IGMP message type or message name. A message type is a number from 0 to 15. IGMP message names are listed in the “Usage Guidelines” section of the <b>access-list</b> (IP extended) command.
<b>tcp</b>	Permits only TCP packets. When you enter the <b>tcp</b> keyword, you must use the specific command syntax shown for the TCP form of the <b>permit</b> command.

<i>operator</i>	<p>(Optional) Compares source or destination ports. Operators are <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).</p> <p>If the operator is positioned after the source and source-wildcard arguments, it must match the source port. If the operator is positioned after the destination and destination-wildcard arguments, it must match the destination port.</p> <p>The range operator requires two port numbers. Up to ten port numbers can be entered for the <b>eq</b> (equal) and <b>neq</b> (not equal) operators. All other operators require one port number.</p>
<i>port</i>	<p>(Optional) The decimal number or name of a TCP or UDP port. A port number is a number from 0 to 65535. TCP and UDP port names are listed in the “Usage Guidelines” section of the <b>access-list (IP extended)</b> command.</p> <p>TCP port names can be used only when filtering TCP. UDP port names can be used only when filtering UDP.</p>
<b>established</b>	<p>(Optional) For the TCP protocol only: Indicates an established connection. A match occurs if the TCP datagram has the ACK or RST bit set. The nonmatching case is that of the initial TCP datagram to form a connection.</p>
<b>match-any   match-all</b>	<p>(Optional) For the TCP protocol only: A match occurs if the TCP datagram has certain TCP flags set or not set. You use the <b>match-any</b> keyword to allow a match to occur if any of the specified TCP flags are present, or you can use the <b>match-all</b> keyword to allow a match to occur only if all of the specified TCP flags are present. You must follow the <b>match-any</b> and <b>match-all</b> keywords with the + or - keyword and the <i>flag-name</i> argument to match on one or more TCP flags.</p>
+   - <i>flag-name</i>	<p>(Optional) For the TCP protocol only: The + keyword matches IP packets if their TCP headers contain the TCP flags that are specified by the <i>flag-name</i> argument. The - keyword matches IP packets that do not contain the TCP flags specified by the <i>flag-name</i> argument. You must follow the + and - keywords with the <i>flag-name</i> argument. TCP flag names can be used only when filtering TCP. Flag names for the TCP flags are as follows: <b>ack</b>, <b>fin</b>, <b>psh</b>, <b>rst</b>, <b>syn</b>, and <b>urg</b>.</p>

<b>udp</b>	Permits only UDP packets. When you enter the <b>udp</b> keyword, you must use the specific command syntax shown for the UDP form of the <b>permit</b> command.
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**Command Default**

There are no specific conditions under which a packet passes the named access list.

**Command Modes**

Access list configuration (config-ext-nacl)

**Command History**

Release	Modification
11.2	This command was introduced.
12.0(1)T	The <b>time-range</b> <i>time-range-name</i> keyword and argument were added.
12.0(11)	The <b>fragments</b> keyword was added.
12.2(13)T	The <b>igrp</b> keyword was removed because the IGRP protocol was no longer available in Cisco IOS software.
12.2(14)S	The <i>sequence-number</i> argument was added.
12.2(15)T	The <i>sequence-number</i> argument was added.
12.3(4)T	The <b>option</b> <i>option-name</i> keyword and argument were added. The <b>match-any</b> , <b>match-all</b> , +, and - keywords and the <i>flag-name</i> argument were added.
12.3(7)T	Command functionality was modified to allow up to ten port numbers to be added after the <b>eq</b> and <b>neq</b> operators so that an access list entry can be created with noncontiguous ports.
12.4	The <b>drip</b> keyword was added to specify the TCP port number used for Optimized Edge Routing (OER) communication.
12.4(2)T	The <b>tll</b> <i>operator value</i> keyword and arguments were added.
12.2(27)SBC	This command was integrated into Cisco IOS Release 12.2(27)SBC.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
12.4(22)T	The <i>word</i> argument was added to the <b>log</b> keyword.
Cisco IOS XE Release 3.2	This command was implemented on Cisco ASR 1000 Series Aggregation Services Routers.

**Usage Guidelines**

Use the **permit** command following the **ip access-list** command to define the conditions under which a packet passes the named access list.



**Note**

In Cisco IOS XE, an inclusive port range for users to access a network cannot be matched in the extended ACL using the **permit** command.

The **time-range** keyword allows you to identify a time range by name. The **time-range**, **absolute**, and **periodic** commands specify when this **permit** statement is in effect.

**log Keyword**

A log message includes the access list number or access list name, and whether the packet was permitted or denied; the protocol, whether it was TCP, UDP, ICMP, or a number; and, if appropriate, the source and destination addresses and port numbers, and the user-defined cookie or router-generated hash value. The message is generated for the first packet that matches, and then at 5-minute intervals, including the number of packets permitted or denied in the prior 5-minute interval.

Use the **ip access-list log-update** command to generate logging messages when the number of matches reaches a configurable threshold (rather than waiting for a 5-minute-interval). See the **ip access-list log-update** command for more information.

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 reloading because of 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.

If you enable Cisco Express Forwarding and then create an access list that uses the **log** keyword, the packets that match the access list are not Cisco Express Forwarding switched. They are fast-switched. Logging disables Cisco Express Forwarding .

**Access List Filtering of IP Options**

Access control lists can be used to filter packets with IP Options to prevent routers from being saturated with spurious packets containing IP Options. To see a complete table of all IP Options, including ones currently not in use, refer to the latest Internet Assigned Numbers Authority (IANA) information that is available from its URL: [www.iana.org](http://www.iana.org).

Cisco IOS software allows you to filter packets according to whether they contain one or more of the legitimate IP Options by entering either the IP Option value or the corresponding name for the *option-name* argument as shown in the table below.

**Table 2: IP Option Values and Names**

IP Option Value or Name	Description
0 to 255	IP Options values.
add-ext	Match packets with Address Extension Option (147).
any-options	Match packets with any IP Option.

IP Option Value or Name	Description
com-security	Match packets with Commercial Security Option (134).
dps	Match packets with Dynamic Packet State Option (151).
encode	Match packets with Encode Option (15).
eool	Match packets with End of Options (0).
ext-ip	Match packets with Extended IP Options (145).
ext-security	Match packets with Extended Security Option (133).
finn	Match packets with Experimental Flow Control Option (205).
imitd	Match packets with IMI Traffic Descriptor Option (144).
lsr	Match packets with Loose Source Route Option (131).
mtup	Match packets with MTU Probe Option (11).
mtur	Match packets with MTU Reply Option (12).
no-op	Match packets with No Operation Option (1).
nsapa	Match packets with NSAP Addresses Option (150).
psh	Match the packets on the PSH bit.
record-route	Match packets with Router Record Route Option (7).
reflect	Create reflexive access list entry.
router-alert	Match packets with Router Alert Option (148).
rst	Matche the packets on the RST bit.
sdb	Match packets with Selective Directed Broadcast Option (149).
security	Match packets with Base Security Option (130).
ssr	Match packets with Strict Source Routing Option (137).
stream-id	Match packets with Stream ID Option (136).

IP Option Value or Name	Description
syn	Matches the packets on the SYN bit.
timestamp	Match packets with Time Stamp Option (68).
traceroute	Match packets with Trace Route Option (82).
ump	Match packets with Upstream Multicast Packet Option (152).
visa	Match packets with Experimental Access Control Option (142).
zsu	Match packets with Experimental Measurement Option (10).

### Filtering IP Packets Based on TCP Flags

The access list entries that make up an access list can be configured to detect and drop unauthorized TCP packets by allowing only the packets that have very specific groups of TCP flags set or not set. Users can select any desired combination of TCP flags with which to filter TCP packets. Users can configure access list entries in order to allow matching on a flag that is set and on a flag that is not set. Use the + and - keywords with a flag name to specify that a match is made based on whether a TCP header flag has been set. Use the **match-any** and **match-all** keywords to allow the packet if any or all, respectively, of the flags specified by the + or - keyword and *flag-name* argument have been set or not set.

### Permitting Optimized Edge Routing (OER) Communication

The **drip** keyword was introduced under the **tcp** keyword to support packet filtering in a network where OER is configured. The **drip** keyword specifies port 3949 that OER uses for internal communication. This option allows you to build a packet filter that permits communication between an OER master controller and border routers. The **drip** keyword is entered following the TCP source, destination addresses, and the **eq** operator. See the example in the “Examples” section.

### Access List Processing of Fragments

The behavior of access list entries regarding the use or lack of use of the **fragments** keyword can be summarized as follows:

If the Access-List Entry Has ...	Then ...
<p>... no <b>fragments</b> keyword (the default behavior), and assuming all of the access list entry information matches,</p>	<p>For an access list entry that contains only Layer 3 information, the entry is applied to nonfragmented packets, initial fragments, and noninitial fragments.</p> <p>For an access list entry that contains Layer 3 and Layer 4 information:</p> <ul style="list-style-type: none"> <li>• The entry is applied to nonfragmented packets and initial fragments. <ul style="list-style-type: none"> <li>• If the entry is a <b>permit</b> statement, then the packet or fragment is permitted.</li> <li>• If the entry is a <b>deny</b> statement, then the packet or fragment is denied.</li> </ul> </li> <li>• The entry is also applied to noninitial fragments in the following manner. Because noninitial fragments contain only Layer 3 information, only the Layer 3 portion of an access list entry can be applied. If the Layer 3 portion of the access list entry matches, and <ul style="list-style-type: none"> <li>• If the entry is a <b>permit</b> statement, then the noninitial fragment is permitted.</li> <li>• If the entry is a <b>deny</b> statement, then the next access list entry is processed.</li> </ul> </li> </ul> <p><b>Note</b> The <b>deny</b> statements are handled differently for noninitial fragments versus nonfragmented or initial fragments.</p>
<p>... the <b>fragments</b> keyword, and assuming all of the access list entry information matches,</p>	<p>The access list entry is applied only to noninitial fragments. The <b>fragments</b> keyword cannot be configured for an access list entry that contains any Layer 4 information.</p>

Be aware that you should not add the **fragments** keyword to every access list entry because the first fragment of the IP packet is considered a nonfragment and is treated independently of the subsequent fragments. An initial fragment will not match an access list **permit** or **deny** entry that contains the **fragments** keyword. The packet is compared to the next access list entry, and so on, until it is either permitted or denied by an access list entry that does not contain the **fragments** keyword. Therefore, you may need two access list entries for every **deny** entry. The first **deny** entry of the pair will not include the **fragments** keyword and applies to the initial fragment. The second **deny** entry of the pair will include the **fragments** keyword and applies to the subsequent fragments. In the cases in which there are multiple **deny** access list entries for the same host but with different Layer 4 ports, a single **deny** access list entry with the **fragments** keyword for that host is all that needs to be added. Thus all the fragments of a packet are handled in the same manner by the access list.

Packet fragments of IP datagrams are considered individual packets, and each counts individually as a packet in access list accounting and access list violation counts.

**Note**

The **fragments** keyword cannot solve all cases that involve access lists and IP fragments.

**Fragments and Policy Routing**

Fragmentation and the fragment control feature affect policy routing if the policy routing is based on the **match ip address** command and the access list has entries that match on Layer 4 through 7 information. It is possible that noninitial fragments pass the access list and are policy-routed, even if the first fragment is not policy-routed.

If you specify the **fragments** keyword in access list entries, a better match between the action taken for initial and noninitial fragments can be made, and it is more likely that policy routing will occur as intended.

**Creating an Access List Entry with Noncontiguous Ports**

For Cisco IOS Release 12.3(7)T and later releases, you can specify noncontiguous ports on the same access control entry, which greatly reduces the number of access list entries required for the same source address, destination address, and protocol. If you maintain large numbers of access list entries, we recommend that you consolidate them when possible by using noncontiguous ports. You can specify up to ten port numbers following the **eq** and **neq** operators.

**Examples**

The following example shows how to set conditions for a standard access list named Internetfilter:

```
ip access-list standard Internetfilter
 deny 192.168.34.0 0.0.0.255
 permit 172.16.0.0 0.0.255.255
 permit 10.0.0.0 0.255.255.255
! (Note: all other access implicitly denied).
```

The following example shows how to permit Telnet traffic on Mondays, Tuesdays, and Fridays from 9:00 a.m. to 5:00 p.m.:

```
time-range testing
 periodic Monday Tuesday Friday 9:00 to 17:00
!
ip access-list extended legal
 permit tcp any any eq telnet time-range testing
!
interface ethernet0
 ip access-group legal in
```

The following example shows how to set a permit condition for an extended access list named filter2. The access list entry specifies that a packet may pass the named access list only if it contains the NSAP Addresses IP Option, which is represented by the IP Option value nsapa.

```
ip access-list extended filter2
 permit ip any any option nsapa
```

The following example shows how to set a permit condition for an extended access list named kmdfilter1. The access list entry specifies that a packet can pass the named access list only if the RST IP flag has been set for that packet:

```
ip access-list extended kmdfilter1
 permit tcp any any match-any +rst
```

The following example shows how to set a permit condition for an extended access list named kmdfilter1. The access list entry specifies that a packet can pass the named access list if the RST TCP flag or the FIN TCP flag has been set for that packet:

```
ip access-list extended kmdfilter1
 permit tcp any any match-any +rst +fin
```

The following example shows how to verify the access list by using the **show access-lists** command and then to add an entry to an existing access list:

```
Router# show access-lists
Standard IP access list 1
 2 permit 10.0.0.0, wildcard bits 0.0.255.255
 5 permit 10.0.0.0, wildcard bits 0.0.255.255
10 permit 10.0.0.0, wildcard bits 0.0.255.255
20 permit 10.0.0.0, wildcard bits 0.0.255.255
ip access-list standard 1
 15 permit 10.0.0.0 0.0.255.255
```

The following examples shows how to remove the entry with the sequence number of 20 from the access list:

```
ip access-list standard 1
 no 20
!Verify that the list has been removed.
Router# show access-lists
Standard IP access list 1
10 permit 0.0.0.0, wildcard bits 0.0.0.255
30 permit 0.0.0.0, wildcard bits 0.0.0.255
40 permit 0.4.0.0, wildcard bits 0.0.0.255
```

The following example shows how, if a user tries to enter an entry that is a duplicate of an entry already on the list, no changes occur. The entry that the user is trying to add is a duplicate of the entry already in the access list with a sequence number of 20.

```
Router# show access-lists 101
Extended IP access list 101
 10 permit ip host 10.0.0.0 host 10.5.5.34
 20 permit icmp any any
 30 permit ip host 10.0.0.0 host 10.2.54.2
 40 permit ip host 10.0.0.0 host 10.3.32.3 log
ip access-list extended 101
 100 permit icmp any any
Router# show access-lists 101
Extended IP access list 101
 10 permit ip host 10.3.3.3 host 10.5.5.34
 20 permit icmp any any
 30 permit ip host 10.34.2.2 host 10.2.54.2
 40 permit ip host 10.3.4.31 host 10.3.32.3 log
```

The following example shows what occurs if a user tries to enter a new entry with a sequence number of 20 when an entry with a sequence number of 20 is already in the list. An error message appears, and no change is made to the access list.

```
Router# show access-lists 101
Extended IP access lists 101
 10 permit ip host 10.3.3.3 host 10.5.5.34
 20 permit icmp any any
 30 permit ip host 10.34.2.2 host 10.2.54.2
 40 permit ip host 10.3.4.31 host 10.3.32.3 log
ip access-lists extended 101
 20 permit udp host 10.1.1.1 host 10.2.2.2
%Duplicate sequence number.
Router# show access-lists 101
Extended IP access lists 101
 10 permit ip host 10.3.3.3 host 10.5.5.34
 20 permit icmp any any
 30 permit ip host 10.34.2.2 host 10.2.54.2
 40 permit ip host 10.3.4.31 host 10.3.32.3 log
```

The following example shows several **permit** statements that can be consolidated into one access list entry with noncontiguous ports. The **show access-lists** command is entered to display a group of access list entries for the access list named aaa.

```
Router# show access-lists aaa
Extended IP access lists aaa
 10 permit tcp any eq telnet any eq 450
```

```

20 permit tcp any eq telnet any eq 679
30 permit tcp any eq ftp any eq 450
40 permit tcp any eq ftp any eq 679

```

Because the entries are all for the same **permit** statement and simply show different ports, they can be consolidated into one new access list entry. The following example shows the removal of the redundant access list entries and the creation of a new access list entry that consolidates the previously displayed group of access list entries:

```

ip access-list extended aaa
no 10
no 20
no 30
no 40
permit tcp any eq telnet ftp any eq 450 679

```

The following example shows the creation of the consolidated access list entry:

```

Router# show access-lists aaa
Extended IP access list aaa
 10 permit tcp any eq telnet ftp any eq 450 679

```

The following access list filters IP packets containing Type of Service (ToS) level 3 with TTL values 10 and 20. It also filters IP packets with a TTL greater than 154 and applies that rule to noninitial fragments. It permits IP packets with a precedence level of flash and a TTL not equal to 1, and sends log messages about such packets to the console. All other packets are denied.

```

ip access-list extended canton
deny ip any any tos 3 ttl eq 10 20
deny ip any any ttl gt 154 fragments
permit ip any any precedence flash ttl neq 1 log

```

The following example shows how to configure a packet filter, for any TCP source and destination, that permits communication between an OER master controller and border router:

```

ip access-list extended 100
permit any any tcp eq drip
exit

```

The following example shows how to set a permit condition for an extended access list named `filter_logging`. The access list entry specifies that a packet may pass the named access list only if it is of TCP protocol type and destined to host 10.5.5.5, all other packets are denied. In addition, the logging mechanism is enabled and one of the user defined cookies (`Permit_tcp_to_10.5.5.5` or `Deny_all`) is appended to the appropriate syslog entry.

```

ip access-list extended filter_logging
permit tcp any host 10.5.5.5 log Permit_tcp_to_10.5.5.5
deny ip any any log Deny_all

```

The following example shows how to configure a packet filter for any TCP source and destination that permits inbound and outbound BGP traffic:

```

ip access-list extended 100
permit tcp any eq bgp any eq bgp

```

## Related Commands

Command	Description
<b>absolute</b>	Specifies an absolute time when a time range is in effect.
<b>access-list (IP extended)</b>	Defines an extended IP access list.

<b>Command</b>	<b>Description</b>
<b>access-list (IP standard)</b>	Defines a standard IP access list.
<b>deny (IP)</b>	Sets conditions under which a packet does not pass a named IP access list.
<b>ip access-group</b>	Controls access to an interface.
<b>ip access-list log-update</b>	Sets the threshold number of packets that cause a logging message.
<b>ip access-list logging hash-generation</b>	Enables hash value generation for ACE syslog entries.
<b>ip access-list resequence</b>	Applies sequence numbers to the access list entries in an access list.
<b>ip options</b>	Drops or ignores IP Options packets that are sent to the router.
<b>logging console</b>	Sends system logging (syslog) messages to all available TTY lines and limits messages based on severity.
<b>match ip address</b>	Distributes any routes that have a destination network number address that is permitted by a standard or extended access list, or performs policy routing on packets.
<b>periodic</b>	Specifies a recurring (weekly) time range for functions that support the time-range feature.
<b>show access-lists</b>	Displays a group of access-list entries.
<b>show ip access-list</b>	Displays the contents of all current IP access lists.
<b>time-range</b>	Specifies when an access list or other feature is in effect.

# port

To specify the port on which a device listens for RADIUS requests from configured RADIUS clients, use the **port** command in dynamic authorization local server configuration mode. To restore the default, use the **no** form of this command.

**port** *port-number*

**no port** *port-number*

## Syntax Description

<i>port-number</i>	Port number. The default value is port 1700.
--------------------	--

## Command Default

The device listens for RADIUS requests on the default port (port 1700).

## Command Modes

Dynamic authorization local server configuration (config-locsvr-da-radius)

## Command History

Release	Modification
12.2(28)SB	This command was introduced.
Cisco IOS XE Release 2.6	This command was integrated into Cisco IOS XE Release 2.6.

## Usage Guidelines

A device (such as a router) can be configured to allow an external policy server to dynamically send updates to the router. This functionality is facilitated by the CoA RADIUS extension. CoA introduced peer-to-peer capability to RADIUS, enabling a router and external policy server each to act as a RADIUS client and server. Use the **port** command to specify the ports on which the router will listen for requests from RADIUS clients.

## Examples

The following example specifies port 1650 as the port on which the device listens for RADIUS requests:

```
aaa server radius dynamic-author
  client 10.0.0.1
  port 1650
```

## Related Commands

Command	Description
<b>aaa server radius dynamic-author</b>	Configures a device as a AAA server to facilitate interaction with an external policy server.

## port (TACACS+)

To specify the TCP port to be used for TACACS+ connections, use the **port** command in TACACS+ server configuration mode. To remove the TCP port, use the **no** form of this command.

**port** [ *number* ]

**no port** [ *number* ]

### Syntax Description

number	(Optional) Specifies the port where the TACACS+ server receives access-request packets. The range is from 1 to 65535.
--------	---

### Command Default

If no port is configured, port 49 is used.

### Command Modes

TACACS+ server configuration (config-server-tacacs)

### Command History

Release	Modification
Cisco IOS XE Release 3.2S	This command was introduced.

### Usage Guidelines

TCP port 49 is used if the *number* argument is not used when using the **port** command.

### Examples

The following example shows how to specify TCP port 12:

```
Router (config)# tacacs server server1
Router (config-server-tacacs)# port 12
```

### Related Commands

Command	Description
<b>tacacs server</b>	Configures the TACACS+ server for IPv6 or IPv4 and enters TACACS+ server configuration mode.





## ppp accounting through quit

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# primary

To assign a specified trustpoint as the primary trustpoint of the router, use the **primary** command in ca-trustpoint configuration mode.

**primary** *name*

## Syntax Description

<i>name</i>	Name of the primary trustpoint of the router.
-------------	---

## Command Default

No default behavior or values.

## Command Modes

Ca-trustpoint configuration

## Command History

Release	Modification
12.2(8)T	This command was introduced.
12.2(18)SXD	This command was integrated into Cisco IOS Release 12.2(18)SXD.
12.2(33)SRA	This command was integrated into Cisco IOS release 12.(33)SRA.

## Usage Guidelines

Use the primary command to specify a given trustpoint as primary.

Before you can configure this command, you must enable the **crypto ca trustpoint** command, which defines the trustpoint and enters ca-trustpoint configuration mode.

## Examples

The following example shows how to configure the trustpoint “ka” as the primary trustpoint:

```
cr
ypto ca trustpoint ka
  enrollment url http://xxx
  primary
  crl option
al
```

## Related Commands

Command	Description
<b>crypto ca trustpoint</b>	Declares the CA that your router should use.

# privilege level

To set the default privilege level for a line, use the **privilege level** command in line configuration mode. To restore the default user privilege level to the line, use the **no** form of this command.

**privilege level** *level*

**no privilege level**

## Syntax Description

<i>level</i>	Privilege level associated with the specified line.
--------------	---

## Command Default

Level 15 is the level of access permitted by the enable password.  
 Level 1 is normal EXEC-mode user privileges.

## Command Modes

Line configuration

## Command History

Release	Modification
10.3	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS release 12.(33)SRA.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

## Usage Guidelines

Users can override the privilege level you set using this command by logging in to the line and enabling a different privilege level. They can lower the privilege level by using the **disable** command. If users know the password to a higher privilege level, they can use that password to enable the higher privilege level.

You can use level 0 to specify a subset of commands for specific users or lines. For example, you can allow user “guest” to use only the **show users** and **exit** commands.

You might specify a high level of privilege for your console line to restrict line usage.



### Note

Before Cisco IOS Release 12.2SXI, it was mandatory that a privilege level of 15 needed to be configured in the Access Control System (ACS) for Webauth (web authentication) to succeed. After this release, privilege configurations in the ACS are no longer mandatory.

**Note**

Some CLI commands are not supported with the **privilege level** command. For example, commands such as **router bgp**, and **default interface**, etc cannot be associated with a privilege level. Though the global configuration CLI may accept the privilege-level assignment for these unsupported commands, they do not become part of the router's running-configuration.

**Examples**

The following example configures the auxiliary line for privilege level 5. Anyone using the auxiliary line has privilege level 5 by default:

```
line aux 0
  privilege level 5
```

The following example sets all **show ip** commands, which includes all **show** commands, to privilege level 7:

```
privilege exec level 7 show ip route
```

This is equivalent to the following command:

```
privilege exec level 7 show
```

The following example sets the **show ip route** command to level 7 and **show ip** commands to level 1:

```
privilege exec level 7 show ip route
privilege exec level 1 show ip
```

**Related Commands**

Command	Description
<b>enable password</b>	Sets a local password to control access to various privilege levels.



## radius attribute nas-port-type through rd

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## radius-server attribute nas-port format

To set the NAS-Port format used for RADIUS accounting features and restore the default NAS-port format, or to set the global attribute 61 session format e string or configure a specific service port type for attribute 61 support, use the **radius-server attribute nas-port format** command in global configuration mode. To stop sending attribute 61 to the RADIUS server, use the **no** form of this command.

### NAS-Port for RADIUS Accounting Features and Restoring Default NAS-Port Format

**radius-server attribute nas-port format** *format*

**no radius-server attribute nas-port format** *format*

### Extended NAS-Port Support

**radius-server attribute nas-port format** *format* [ *string* ] [**type** *nas-port-type*]

**no radius-server attribute nas-port format** *format* [ *string* ] [**type** *nas-port-type*]

### Syntax Description

<i>format</i>	NAS-Port format. Possible values for the format argument are as follows: <ul style="list-style-type: none"> <li>• a--Standard NAS-Port format</li> <li>• b--Extended NAS-Port format</li> <li>• c--Carrier-based format</li> <li>• d--PPPoX (PPP over Ethernet or PPP over ATM) extended NAS-Port format</li> <li>• e--C onfigurable NAS-Port format</li> </ul>
<i>string</i>	(Optional) Represents all of a specific port type for format e. It is possible to specify multiple values with this argument.
<b>type</b> <i>nas-port-type</i>	(Optional) Allows you to globally specify different format strings to represent specific physical port types. You may set one of the extended NAS-Port-Type attribute values: <ul style="list-style-type: none"> <li>• <b>type 30</b> --PPP over ATM (PPPoA)</li> <li>• <b>type 31</b> --PPP over Ethernet (PPPoE) over ATM (PPPoEoA)</li> <li>• <b>type 32</b> --PPPoE over Ethernet (PPPoEoE)</li> <li>• <b>type 33</b> --PPPoE over VLAN (PPPoEoVLAN)</li> <li>• <b>type 34</b> --PPPoE over Q-in-Q (PPPoEoQinQ)</li> </ul>

**Command Default** Standard NAS-Port format for NAS-Port for RADIUS accounting features and restoring default NAS-Port format or extended NAS-Port support.

**Command Modes** Global configuration

Command History	Release	Modification
	11.3(7)T	This command was introduced.
	11.3(9)DB	The PPP extended NAS-Port format was added.
	12.1(5)T	The PPP extended NAS-Port format was expanded to support PPPoE over ATM and PPPoE over IEEE 802.1Q VLANs.
	12.2(4)T	Format e was introduced.
	12.2(11)T	Format e was extended to support PPPoX information.
	12.3(3)	Format e was extended to support Session ID U.
	12.3(7)XI1	Format e was extended to allow the format string to be NAS-Port-Type attribute specific. The following keyword and arguments were added: <i>string</i> , <b>type</b> <i>nas-port-type</i> .
	12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
	12.2(33)SRA	This command was integrated into Cisco IOS Release 12.(33)SRA.
	12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
	12.2(33)SRC	This command was integrated into Cisco IOS Release 12.2(33)SRC.

**Usage Guidelines** The **radius-server attribute nas-port format** command configures RADIUS to change the size and format of the NAS-Port attribute field (RADIUS IETF attribute 5).

The following NAS-Port formats are supported:

- Standard NAS-Port format--This 16-bit NAS-Port format indicates the type, port, and channel of the controlling interface. This is the default format used by Cisco IOS software.
- Extended NAS-Port format--The standard NAS-Port attribute field is expanded to 32 bits. The upper 16 bits of the NAS-Port attribute display the type and number of the controlling interface; the lower 16 bits indicate the interface that is undergoing authentication.

- Shelf-slot NAS-Port format--This 16-bit NAS-Port format supports expanded hardware models requiring shelf and slot entries.
- PPP extended NAS-Port format--This NAS-Port format uses 32 bits to indicate the interface, virtual path identifier (VPI), and virtual channel indicator (VCI) for PPPoA and PPPoEoA, and the interface and VLAN ID for PPPoE over Institute of Electrical and Electronic Engineers (IEEE) standard 802.1Q VLANs.

### Format e

Before Cisco IOS Release 12.2(4)T formats a through c did not work with Cisco platforms such as the AS5400. For this reason, a configurable format e was developed. Format e requires you to explicitly define the usage of the 32 bits of attribute 25 (NAS-Port). The usage is defined with a given parser character for each NAS-Port field of interest for a given bit field. By configuring a single character in a row, such as x, only one bit is assigned to store that given value. Additional characters of the same type, such as x, will provide a larger available range of values to be stored. The table below shows how the ranges may be expanded:

**Table 3: Format e Ranges**

Character	Range
x	0-1
xx	0-3
xxx	0-7
xxxx	0-F
xxxxx	0-1F

It is imperative that you know what the valid range is for a given parameter on a platform that you want to support. The Cisco IOS RADIUS client will bitmask the determined value to the maximum permissible value on the basis of configuration. Therefore, if one has a parameter that turns out to have a value of 8, but only 3 bits (xxx) are configured, 8 and 0x7 will give a result of 0. Therefore, you must always configure a sufficient number of bits to capture the value required correctly. Care must be taken to ensure that format e is configured to properly work for all NAS port types within your network environment.

The table below shows the supported parameters and their characters:

**Table 4: Supported Parameters and Characters**

Supported Parameters	Characters
Zero	0 (always sets a 0 to that bit)
One	1 (always sets a 0 to that bit)
DS0 shelf	f
DS0 slot	s

Supported Parameters	Characters
DS0 adaptor	a
DS0 port	p (physical port)
DS0 subinterface	i
DS0 channel	c
Async shelf	F
Async slot	S
Async port	P
Async line	L (modern line number, that is, physical terminal [TTY] number)
PPPoX slot	S
PPPoX adaptor	A
PPPoX port	P
PPPoX VLAN ID	V
PPPoX VPI	I
PPPoX VCI	C
Session ID	U

All 32 bits that represent the NAS-Port must be set to one of the above characters because this format makes no assumptions for empty fields.

### Access Router

The DS0 port on a T1-based card and on a T3-based card will give different results. On T1-based cards, the physical port is equal to the virtual port (because these are the same). So, **p** and **d** will give the same information for a T1 card. However, on a T3 system, the port will give you the physical port number (because there can be more than one T3 card for a given platform). As such, **d** will give you the virtual T1 line (as per configuration on a T3 controller). On a T3 system, **p** and **d** will be different, and one should capture both to properly identify the physical device. As a working example for the Cisco AS5400, the following configuration is recommended:

```
Router (config)# radius-server attribute nas-port format e SSSSPPPPPPPPSSSSpppppccccc
This will give one an asynchronous slot (0-16), asynchronous port (0-512), DS0 slot (0-16), DS0 physical port (0-32), DS0 virtual port (0-32), and channel (0-32). The parser has been implemented to explicitly require 32-bit support, or it will fail.
```

Finally, format e is supported for channel-associated signaling (CAS), PRI, and BRI-based interfaces.



# radius-server configure-nas

To have the Cisco router or access server query the vendor-proprietary RADIUS server for the static routes and IP pool definitions used throughout its domain when the device starts up, use the **radius-server configure-nas** command in global configuration mode. To discontinue the query of the RADIUS server, use the no form of this command.

**radius-server configure-nas**

**no radius-server configure-nas**

**Syntax Description** This command has no arguments or keywords.

**Command Default** No default behavior or values.

**Command Modes** Global configuration

Command History	Release	Modification
	11.3	This command was introduced.
	12.2(33)SRA	This command was integrated into Cisco IOS release 12.(33)SRA.
	12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

**Usage Guidelines** Use the **radius-server configure-nas** command to have the Cisco router query the vendor-proprietary RADIUS server for static routes and IP pool definitions when the router first starts up. Some vendor-proprietary implementations of RADIUS let the user define static routes and IP pool definitions on the RADIUS server instead of on each individual network access server in the network. As each network access server starts up, it queries the RADIUS server for static route and IP pool information. This command enables the Cisco router to obtain static routes and IP pool definition information from the RADIUS server.



**Note** Because the **radius-server configure-nas** command is performed when the Cisco router starts up, it will not take effect until you issue a **copy system:running-config nvram:startup-config** command.

**Examples** The following example shows how to tell the Cisco router or access server to query the vendor-proprietary RADIUS server for already-defined static routes and IP pool definitions when the device first starts up:

```
radius-server configure-nas
```

**Related Commands**

Command	Description
<b>radius-server host non-standard</b>	Identifies that the security server is using a vendor-proprietary implementation of RADIUS.

## radius-server dead-criteria

To force one or both of the criteria--used to mark a RADIUS server as dead--to be the indicated constant, use the **radius-server dead-criteria** command in global configuration mode. To disable the criteria that were set, use the **no** form of this command.

**radius-server dead-criteria** [**time** *seconds*] [**tries** *number-of-tries*]

**no radius-server dead-criteria** [**time** *seconds*] [**tries** *number-of-tries*]

### Syntax Description

<p><b>time</b> <i>seconds</i></p>	<p>(Optional) Minimum amount of time, in seconds, that must elapse from the time that the router last received a valid packet from the RADIUS server to the time the server is marked as dead. If a packet has not been received since the router booted, and there is a timeout, the time criterion will be treated as though it has been met. You can configure the time to be from 1 through 120 seconds.</p> <ul style="list-style-type: none"> <li>If the <i>seconds</i> argument is not configured, the number of seconds will range from 10 to 60 seconds, depending on the transaction rate of the server.</li> </ul> <p><b>Note</b> Both the time criterion and the tries criterion must be met for the server to be marked as dead.</p>
<p><b>tries</b> <i>number-of-tries</i></p>	<p>(Optional) Number of consecutive timeouts that must occur on the router before the RADIUS server is marked as dead. If the server performs both authentication and accounting, both types of packets will be included in the number. Improperly constructed packets will be counted as though they were timeouts. All transmissions, including the initial transmit and all retransmits, will be counted. You can configure the number of timeouts to be from 1 through 100.</p> <ul style="list-style-type: none"> <li>If the <i>number-of-tries</i> argument is not configured, the number of consecutive timeouts will range from 10 to 100, depending on the transaction rate of the server and the number of configured retransmissions.</li> </ul> <p><b>Note</b> Both the time criterion and the tries criterion must be met for the server to be marked as dead.</p>

**Command Default**

The number of seconds and number of consecutive timeouts that occur before the RADIUS server is marked as dead will vary, depending on the transaction rate of the server and the number of configured retransmissions.

**Command Modes**

Global configuration (config)

**Command History**

Release	Modification
12.2(15)T	This command was introduced.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

**Usage Guidelines****Note**

Both the time criterion and the tries criterion must be met for the server to be marked as dead.

The **no** form of this command has the following cases:

- If neither the *seconds* nor the *number-of-tries* argument is specified with the **no radius-server dead-criteria** command, both time and tries will be reset to their defaults.
- If the *seconds* argument is specified using the originally set value, the time will be reset to the default value range (10 to 60).
- If the *number-of-tries* argument is specified using the originally set value, the number of tries will be reset to the default value range (10 to 100).

**Examples**

The following example shows how to configure the router so that it will be considered dead after 5 seconds and 4 tries:

```
Router (config)# radius-server dead-criteria time 5 tries 4
```

The following example shows how to disable the time and number-of-tries criteria that were set for the **radius-server dead-criteria** command.

```
Router (config)# no radius-server dead-criteria
```

The following example shows how to disable the time criterion that was set for the **radius-server dead-criteria** command.

```
Router (config)# no radius-server dead-criteria time 5
```

The following example shows how to disable the number-of-tries criterion that was set for the **radius-server dead-criteria** command.

```
Router (config)# no radius-server dead-criteria tries 4
```

**Related Commands**

Command	Description
<b>debug aaa dead-criteria transactions</b>	Displays AAA dead-criteria transaction values.
<b>show aaa dead-criteria</b>	Displays dead-criteria information for a AAA server.
show aaa server-private	Displays the status of all private RADIUS servers.
show aaa servers	Displays information about the number of packets sent to and received from AAA servers.

## radius-server deadline

To improve RADIUS response time when some servers might be unavailable and to skip unavailable servers immediately, use the **radius-server deadline** command in global configuration mode. To set deadline to 0, use the **no** form of this command.

**radius-server deadline** *minutes*

**no radius-server deadline**

### Syntax Description

<i>minutes</i>	Length of time, in minutes (up to a maximum of 1440 minutes or 24 hours), for which a RADIUS server is skipped over by transaction requests.
----------------	--

### Command Default

Dead time is set to 0.

### Command Modes

Global configuration (config)

### Command History

Release	Modification
11.1	This command was introduced.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

### Usage Guidelines

Use this command to enable the Cisco IOS software to mark as “dead” any RADIUS servers that fail to respond to authentication requests, thus avoiding the wait for the request to time out before trying the next configured server. A RADIUS server marked as “dead” is skipped by additional requests for the specified duration (in minutes) or unless there are no servers not marked as “dead.”



#### Note

If a RADIUS server that is marked as “dead” receives a directed-request, the directed-request is not omitted by the RADIUS server. The RADIUS server continues to process the directed-request because the request is directly sent to the RADIUS server.

#### When the RADIUS Server Is Marked As Dead

For Cisco IOS versions prior to 12.2(13.7)T, the RADIUS server will be marked as dead if a packet is transmitted for the configured number of retransmits and a valid response is not received from the server within the configured timeout for any of the RADIUS packet transmissions.

For Cisco IOS versions 12.2(13.7)T and later, the RADIUS server will be marked as dead if both of the following conditions are met:

- 1 A valid response has not been received from the RADIUS server for any outstanding transaction for at least the timeout period that is used to determine whether to retransmit to that server, and
- 2 At least the requisite number of retransmits plus one (for the initial transmission) have been sent consecutively across all transactions being sent to the RADIUS server without receiving a valid response from the server within the requisite timeout.

### Examples

The following example specifies five minutes of deadtime for RADIUS servers that fail to respond to authentication requests:

```
radius-server deadtime 5
```

### Related Commands

Command	Description
<b>deadtime (server-group configuration)</b>	Configures deadtime within the context of RADIUS server groups.
<b>radius-server host</b>	Specifies a RADIUS server host.
<b>radius-server retransmit</b>	Specifies the number of times that the Cisco IOS software searches the list of RADIUS server hosts before giving up.
<b>radius-server timeout</b>	Sets the interval for which a router waits for a server host to reply.

# radius-server host

To specify a RADIUS server host, use the **radius-server host** command in global configuration mode. To delete the specified RADIUS host, use the **no** form of this command.

## Cisco IOS Release 12.4T and Later Releases

**radius-server host** {*hostname*|*ip-address*} [**alias** {*hostname*|*ip-address*}] [**acct-port** *port-number*] [**auth-port** *port-number*] [**non-standard**] [**timeout** *seconds*] [**retransmit** *retries*] [**backoff exponential** [**max-delay** *minutes*] [**backoff-retry** *number-of-retransmits*] ] [**key** *encryption-key*]

**no radius-server host** {*hostname*|*ip-address*}

## All Other Releases

**radius-server host** {*hostname*|*ip-address*} [**alias** {*hostname*|*ip-address*}] [**acct-port** *port-number*] [**auth-port** *port-number*] [**non-standard**] [**timeout** *seconds*] [**retransmit** *retries*] [**test username** *user-name*] [**ignore-acct-port**] [**ignore-auth-port**] [**idle-time** *minutes*] [**backoff exponential** [**max-delay** *minutes*] [**backoff-retry** *number-of-retransmits*] ] [**key-wrap encryption-key** *encryption-key* **message-auth-code-key** *encryption-key*] [**format** {*ascii*|*hex*}] [**pac**] [**key** *encryption-key*]

**no radius-server host** {*hostname*|*ip-address*}

## Syntax Description

<i>hostname</i>	Domain Name System (DNS) name of the RADIUS server host.
<i>ip-address</i>	IP address of the RADIUS server host.
<b>alias</b>	(Optional) Allows up to eight aliases per line for any given RADIUS server.
<b>acct-port</b> <i>port-number</i>	(Optional) UDP destination port for accounting requests. <ul style="list-style-type: none"> <li>The host is not used for authentication if the port number is set to zero. If the port number is not specified, the default port number assigned is 1646.</li> </ul>
<b>auth-port</b> <i>port-number</i>	(Optional) UDP destination port for authentication requests. <ul style="list-style-type: none"> <li>The host is not used for authentication if the port number is set to zero. If the port number is not specified, the default port number assigned is 1645.</li> </ul>
<b>non-standard</b>	Parses attributes that violate the RADIUS standard.

<b>timeout</b> <i>seconds</i>	<p>(Optional) Time interval (in seconds) that the device waits for the RADIUS server to reply before retransmitting.</p> <ul style="list-style-type: none"> <li>• The timeout keyword overrides the global value of the <b>radius-server timeout</b> command.</li> <li>• If no timeout value is specified, a global value is used; the range is from 1 to 1000.</li> </ul>
<b>retransmit</b> <i>retries</i>	<p>(Optional) Number of times a RADIUS request is resent to a server, if that server is not responding or there is a delay in responding.</p> <ul style="list-style-type: none"> <li>• The retransmit keyword overrides the global setting of the <b>radius-server retransmit</b> command.</li> <li>• If no retransmit value is specified, a global value is used; the range is from 1 to 100.</li> </ul>
<b>test username</b> <i>user-name</i>	(Optional) Sets the test username for the automated testing feature for RADIUS server load balancing.
<b>ignore-acct-port</b>	(Optional) Disables the automated testing feature for RADIUS server load balancing on the accounting port.
<b>ignore-auth-port</b>	(Optional) Disables the automated testing feature for RADIUS server load balancing on the authentication port.
<b>idle-time</b> <i>minutes</i>	(Optional) Length of time (in minutes) the server remains idle before it is quarantined and test packets are sent out. The range is from 1 to 35791. The default is 60.
<b>backoff exponential</b>	(Optional) Sets the exponential retransmits backup mode.
<b>max-delay</b> <i>minutes</i>	<p>(Optional) Sets the maximum delay (in minutes) between retransmits.</p> <ul style="list-style-type: none"> <li>• <b>max-delay</b> <i>minutes</i> <i>minutes</i>—The range is from 1 to 120. The default value is 3.</li> </ul>
<b>key-wrap encryption-key</b>	(Optional) Specifies the key-wrap encryption key.

<b>message-auth-code-key</b>	Specifies the key-wrap message authentication code key.
<b>format</b>	(Optional) Specifies the format of the message authenticator code key. <ul style="list-style-type: none"> <li>• Valid values are: <ul style="list-style-type: none"> <li>◦ <b>ascii</b>—Configures the key in ASCII format.</li> <li>◦ <b>hex</b>—Configures the key in hexadecimal format.</li> </ul> </li> </ul>
<b>backoff-retry</b> <i>number-of-retransmits</i>	(Optional) Specifies the exponential backoff retry. <ul style="list-style-type: none"> <li>• <i>number-of-retransmits</i>—Number of backoff retries. The range is from 1 to 50. The default value is 8.</li> </ul>
<b>pac</b>	(Optional) Generates the per-server Protected Access Credential (PAC) key.
<b>key</b>	(Optional) Encryption key used between the device and the RADIUS daemon running on this RADIUS server. <ul style="list-style-type: none"> <li>• The <b>key</b> keyword overrides the global setting of the <b>radius-server key</b> command. If no key string is specified, a global value is used.</li> </ul> <p><b>Note</b> The <b>key</b> keyword is a text string that must match the encryption key used on the RADIUS server. Always configure the key as the last item in the <b>radius-server host</b> command syntax because the leading spaces are ignored, but spaces within and at the end of the key are used. If you use spaces in the key, do not enclose the key in quotation marks unless the quotation marks themselves are part of the key.</p>
<i>encryption-key</i>	Specifies the encryption key. <ul style="list-style-type: none"> <li>• Valid values for <i>encryption-key</i> are: <ul style="list-style-type: none"> <li>◦ <b>0</b>—Specifies that an unencrypted key follows.</li> <li>◦ <b>7</b>—Specifies that a hidden key follows.</li> <li>◦ String specifying the unencrypted (clear-text) server key.</li> </ul> </li> </ul>

**Command Default** No RADIUS host is specified and RADIUS server load balancing automated testing is disabled by default.

**Command Modes** Global configuration (config)

Release	Modification
11.1	This command was introduced.
12.0(5)T	This command was modified to add options for configuring timeout, retransmission, and key values per RADIUS server.
12.1(3)T	This command was modified. The <b>alias</b> keyword was added.
12.2(15)B	This command was integrated into Cisco IOS Release 12.2(15)B. The <b>backoff exponential</b> , <b>backoff-retry</b> , <b>key</b> , and <b>max-delay</b> keywords and <i>number-of-retransmits</i> , <i>encryption-key</i> , and <i>minutes</i> arguments were added.
12.2(28)SB	This command was integrated into Cisco release 12.2(28)SB. The <b>test username user-name</b> , <b>ignore-auth-port</b> , <b>ignore-acct-port</b> , and <b>idle-time seconds</b> keywords and arguments were added for configuring the RADIUS server load balancing automated testing functionality.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA. The keywords and arguments that were added in Cisco IOS Release 12.2(28)SB apply to Cisco IOS Release 12.2(33)SRA and subsequent 12.2SR releases.
12.4(11)T	This command was modified. <b>Note</b> The keywords and arguments that were added in Cisco IOS Release 12.2(28)SB do not apply to Cisco IOS Release 12.4(11)T or to subsequent 12.4T releases.
12.2 SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware. <b>Note</b> The keywords and arguments that were added in Cisco IOS Release 12.2(28)SB do not apply to Cisco IOS Release 12.2SX.
Cisco IOS XE Release 2.5	This command was integrated into Cisco IOS XE Release 2.5.
15.3(1)S	This command was modified. The <b>key-wrap encryption-key</b> , <b>message-auth-code-key</b> , <b>format</b> , <b>ascii</b> , and <b>hex</b> keywords were added.
Cisco IOS XE Release 3.2SE	This command was integrated into Cisco IOS XE Release 3.2SE.

**Usage Guidelines**

You can use multiple **radius-server host** commands to specify multiple hosts. The software searches for hosts in the order in which you specify them.

If no host-specific timeout, retransmit, or key values are specified, the global values apply to each host.

We recommend the use of a test user who is not defined on the RADIUS server for the automated testing of the RADIUS server. This is to protect against security issues that can arise if the test user is not configured correctly.

If you configure one RADIUS server with a nonstandard option and another RADIUS server without the nonstandard option, the RADIUS server host with the nonstandard option does not accept a predefined host. However, if you configure the same RADIUS server host IP address for different UDP destination ports, where one UDP destination port (for accounting requests) is configured using the **acct-port** keyword and another UDP destination port (for authentication requests) is configured using the **auth-port** keyword with and without the nonstandard option, the RADIUS server does not accept the nonstandard option. This results in resetting all the port numbers. You must specify a host and configure accounting and authentication ports on a single line.

To use separate servers for accounting and authentication, use the zero port value as appropriate.

**RADIUS Server Automated Testing**

When you use the **radius-server host** command to enable automated testing for RADIUS server load balancing:

- The authentication port is enabled by default. If the port number is not specified, the default port number (1645) is used. To disable the authentication port, specify the **ignore-auth-port** keyword.
- The accounting port is enabled by default. If the port number is not specified, the default port number (1645) is used. To disable the accounting port, specify the **ignore-acct-port** keyword.

**Examples**

The following example shows how to specify host1 as the RADIUS server and to use default ports for both accounting and authentication depending on the Cisco release that you are using:

```
radius-server host host1
```

The following example shows how to specify port 1612 as the destination port for authentication requests and port 1616 as the destination port for accounting requests on the RADIUS host named host1:

```
radius-server host host1 auth-port 1612 acct-port 1616
```

Because entering a line resets all the port numbers, you must specify a host and configure accounting and authentication ports on a single line.

The following example shows how to specify the host with IP address 192.0.2.46 as the RADIUS server, uses ports 1612 and 1616 as the authorization and accounting ports, sets the timeout value to six, sets the retransmit value to five, and sets "rad123" as the encryption key, thereby matching the key on the RADIUS server:

```
radius-server host 192.0.2.46 auth-port 1612 acct-port 1616 timeout 6 retransmit 5 key rad123
```

To use separate servers for accounting and authentication, use the zero port value as appropriate.

The following example shows how to specify the RADIUS server host1 for accounting but not for authentication, and the RADIUS server host2 for authentication but not for accounting:

```
radius-server host host1.example.com auth-port 0
radius-server host host2.example.com acct-port 0
```

The following example shows how to specify four aliases on the RADIUS server with IP address 192.0.2.1:

```
radius-server host 192.0.2.1 auth-port 1646 acct-port 1645
radius-server host 192.0.2.1 alias 192.0.2.2 192.0.2.3 192.0.2.4
```

The following example shows how to enable exponential backoff retransmits on a per-server basis. In this example, assume that the retransmit is configured for three retries and the timeout is configured for five seconds; that is, the RADIUS request will be transmitted three times with a delay of five seconds. Thereafter, the device will continue to retransmit RADIUS requests with a delayed interval that doubles each time until 32 retries have been achieved. The device will stop doubling the retransmit intervals after the interval surpasses the configured 60 minutes; it will transmit every 60 minutes.

The **pac** keyword allows the PAC-Opaque, which is a variable length field, to be sent to the server during the Transport Layer Security (TLS) tunnel establishment phase. The PAC-Opaque can be interpreted only by the server to recover the required information for the server to validate the peer's identity and authentication. For example, the PAC-Opaque may include the PAC-Key and the PAC's peer identity. The PAC-Opaque format and contents are specific to the issuing PAC server.

The following example shows how to configure automatic PAC provisioning on a device. In seed devices, the PAC-Opaque has to be provisioned so that all RADIUS exchanges can use this PAC-Opaque to enable automatic PAC provisioning for the server being used. All nonseed devices obtain the PAC-Opaque during the authentication phase of a link initialization.

```
enable
configure terminal
radius-server host 10.0.0.1 auth-port 1812 acct-port 1813 pac
```

## Examples

The following example shows how to enable RADIUS server automated testing for load balancing with the authorization and accounting ports specified depending on the Cisco release that you are using:

```
radius-server host 192.0.2.176 test username test1 auth-port 1645 acct-port 1646
```

## Related Commands

Command	Description
<b>aaa accounting</b>	Enables AAA accounting of requested services for billing or security purposes.
<b>aaa authentication ppp</b>	Specifies one or more AAA authentication method for use on serial interfaces that run PPP.
<b>aaa authorization</b>	Sets parameters that restrict network access to a user.
<b>debug aaa test</b>	Shows when the idle timer or dead timer has expired for RADIUS server load balancing.
<b>load-balance</b>	Enables RADIUS server load balancing for named RADIUS server groups.
<b>ppp</b>	Starts an asynchronous connection using PPP.
<b>ppp authentication</b>	Enables CHAP or PAP or both and specifies the order in which CHAP and PAP authentication are to be selected on the interface.

Command	Description
<b>radius-server key</b>	Sets the authentication and encryption key for all RADIUS communications between the device and the RADIUS daemon.
<b>radius-server load-balance</b>	Enables RADIUS server load balancing for the global RADIUS server group.
<b>radius-server retransmit</b>	Specifies the number of times Cisco software searches the list of RADIUS server hosts before giving up.
<b>radius-server timeout</b>	Sets the interval that a device waits for a server host to reply.
<b>test aaa group</b>	Tests the RADIUS load balancing server response manually.
<b>username</b>	Establishes a username-based authentication system, such as PPP CHAP and PAP.

## radius-server key

To set the authentication and encryption key for all RADIUS communications between the router and the RADIUS daemon, use the **radius-server key** command in global configuration mode. To disable the key, use the **no** form of this command.

**radius-server key** {**0** *string*| **7** *string*} *string*

**no radius-server key**

### Syntax Description

<b>0</b> <i>string</i>	Specifies that an unencrypted key will follow. The unencrypted (cleartext) shared key.
<b>7</b> <i>string</i>	Specifies that a hidden key will follow. The hidden shared key.
<i>string</i>	The unencrypted (cleartext) shared key.

### Command Default

The authentication and encryption key is disabled.

### Command Modes

Global configuration (config)

### Command History

Release	Modification
11.1	This command was introduced.
12.1(3)T	This command was modified. The <i>string</i> argument was modified as follows: <ul style="list-style-type: none"> <li>• <b>0</b> <i>string</i></li> <li>• <b>7</b> <i>string</i></li> <li>• <i>string</i></li> </ul>
12.2(33)SRA	This command was integrated into Cisco IOS release 12.(33)SRA.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
Cisco IOS XE Release 3.3S	This command was integrated into Cisco IOS XE Release 3.3S.

**Usage Guidelines**

After enabling authentication, authorization, and accounting (AAA) authentication with the **aaa new-model** command, you must set the authentication and encryption key using the **radius-server key** command.

**Note**

Specify a RADIUS key after you issue the **aaa new-model** command.

The key entered must match the key used on the RADIUS daemon. All leading spaces are ignored, but spaces within and at the end of the key are used. If you use spaces in your key, do not enclose the key in quotation marks unless the quotation marks themselves are part of the key.

**Examples**

The following example sets the authentication and encryption key to “key1”:

```
Router(config)# radius-server key key1
```

The following example sets the authentication and encryption key to “anykey.” The 7 specifies that a hidden key will follow.

```
service password-encryption
radius-server key 7 anykey
```

After you save your configuration and use the show-running config command, an encrypted key will be displayed as follows:

```
Router# show running-config
!
!
radius-server key 7 19283103834782sda
! The leading 7 indicates that the following text is encrypted.
```

**Related Commands**

Command	Description
<b>aaa accounting</b>	Enables AAA accounting of requested services for billing or security purposes.
<b>aaa authentication ppp</b>	Specifies one or more AAA authentication methods for use on serial interfaces running PPP.
<b>aaa authorization</b>	Sets parameters that restrict user access to a network.
aaa new-model	Enables AAA access control model.
<b>ppp</b>	Starts an asynchronous connection using PPP.
<b>ppp authentication</b>	Enables CHAP or PAP or both and specifies the order in which CHAP and PAP authentication are selected on the interface.
<b>radius-server host</b>	Specifies a RADIUS server host.
<b>service password-encryption</b>	Encrypt passwords.

Command	Description
<b>username</b>	Establishes a username-based authentication system, such as PPP CHAP and PAP.

## radius-server load-balance

To enable RADIUS server load balancing for the global RADIUS server group referred to as “radius” in the authentication, authorization and accounting (AAA) method lists, use the radius-server load-balance command in global configuration mode. To disable RADIUS server load balancing, use the **no** form of this command.

**radius-server load-balance method least-outstanding** [*batch-size number*] [**ignore-preferred-server**]  
**no radius-server load-balance**

### Syntax Description

<b>method least-outstanding</b>	Enables least outstanding mode for load balancing.
<b>batch-size</b>	(Optional) The number of transactions to be assigned per batch.
<i>number</i>	(Optional) The number of transactions in a batch. <ul style="list-style-type: none"> <li>• The default is 25.</li> <li>• The range is 1-2147483647.</li> </ul> <p><b>Note</b> Batch size may impact throughput and CPU load. It is recommended that the default batch size, 25, be used because it is optimal for high throughput, without adversely impacting CPU load.</p>
<b>ignore-preferred-server</b>	(Optional) Indicates if a transaction associated with a single AAA session should attempt to use the same server or not. <ul style="list-style-type: none"> <li>• If set, preferred server setting will not be used.</li> <li>• Default is to use the preferred server.</li> </ul>

### Command Default

If this command is not configured, global RADIUS server load balancing will not occur.

### Command Modes

Global configuration

### Command History

Release	Modification
12.2(28)SB	This command was introduced.
12.4(11)T	This command was integrated into Cisco IOS Release 12.4(11)T.
12.2(33)SRC	This command was integrated into Cisco IOS Release 12.2(33)SRC.

**Examples**

The following example shows how to enable load balancing for global RADIUS server groups. It is shown in three parts: the current configuration of RADIUS command output, debug output, and AAA server status information. You can use the delimiting characters to display only the relevant parts of the configuration.

**Examples**

The following shows the relevant RADIUS configuration:

```
Router# show running-config | inc radius
aaa authentication ppp default group radius
aaa accounting network default start-stop group radius
radius-server host 192.0.2.238 auth-port 2095 acct-port 2096 key cisco
radius-server host 192.0.2.238 auth-port 2015 acct-port 2016 key cisco
radius-server load-balance method least-outstanding batch-size 5
```

The lines in the current configuration of RADIUS command output above are defined as follows:

- The **aaa authentication ppp** command authenticates all PPP users using RADIUS.
- The **aaa accounting** command enables the sending of all accounting requests to the AAA server after the client is authenticated and after the disconnect using the keyword start-stop.
- The **radius-server host** command defines the IP address of the RADIUS server host with the authorization and accounting ports specified and the authentication and encryption key identified.
- The **radius-server load-balance** command enables load balancing for the global RADIUS server groups with the batch size specified.

**Examples**

The debug output below shows the selection of preferred server and processing of requests for the configuration above.

```
Router# show debug
General OS:
  AAA server group server selection debugging is on
Router#
<sending 10 pppoe requests>
Router#
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000014):No preferred server available.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:No more transactions in batch. Obtaining a new
server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Obtaining a new least loaded server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Server[0] load:0
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Server[1] load:0
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Selected Server[0] with load 0
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:[5] transactions remaining in batch.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000014):Server (192.0.2.238:2095,2096) now being
used as preferred server
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000015):No preferred server available.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:[4] transactions remaining in batch. Reusing
server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000015):Server (192.0.2.238:2095,2096) now being
used as preferred server
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000016):No preferred server available.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:[3] transactions remaining in batch. Reusing
server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000016):Server (192.0.2.238:2095,2096) now being
used as preferred server
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000017):No preferred server available.
```

```

*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:[2] transactions remaining in batch. Reusing
server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000017):Server (192.0.2.238:2095,2096) now being
used as preferred server
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000018):No preferred server available.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:[1] transactions remaining in batch. Reusing
server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000018):Server (192.0.2.238:2095,2096) now being
used as preferred server
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000019):No preferred server available.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:No more transactions in batch. Obtaining a new
server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Obtaining a new least loaded server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Server[1] load:0
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Server[0] load:5
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Selected Server[1] with load 0
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:[5] transactions remaining in batch.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(00000019):Server (192.0.2.238:2015,2016) now being
used as preferred server
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT(0000001A):No preferred server available.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.199:AAA/SG/SERVER_SELECT:[4] transactions remaining in batch. Reusing
server.
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT(0000001A):Server (192.0.2.238:2015,2016) now being
used as preferred server
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT(0000001B):No preferred server available.
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT:[3] transactions remaining in batch. Reusing
server.
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT(0000001B):Server (192.0.2.238:2015,2016) now being
used as preferred server
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT(0000001C):No preferred server available.
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT:[2] transactions remaining in batch. Reusing
server.
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT(0000001C):Server (192.0.2.238:2015,2016) now being
used as preferred server
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT(0000001D):No preferred server available.
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT:Obtaining least loaded server.
*Feb 28 13:40:32.203:AAA/SG/SERVER_SELECT:[1] transactions remaining in batch. Reusing
server
.
.
.

```

### Server Status Information for Global RADIUS Server Group Example

The output below shows the AAA server status for the global RADIUS server group configuration example.

```

Router# show aaa server
RADIUS:id 4, priority 1, host 192.0.2.238, auth-port 2095, acct-port 2096
  State:current UP, duration 3175s, previous duration 0s
  Dead:total time 0s, count 0
  Quarantined:No
  Authen:request 6, timeouts 1
    Response:unexpected 1, server error 0, incorrect 0, time 1841ms
    Transaction:success 5, failure 0
  Author:request 0, timeouts 0
    Response:unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction:success 0, failure 0
  Account:request 5, timeouts 0
    Response:unexpected 0, server error 0, incorrect 0, time 3303ms
    Transaction:success 5, failure 0
  Elapsed time since counters last cleared:2m
RADIUS:id 5, priority 2, host 192.0.2.238, auth-port 2015, acct-port 2016
  State:current UP, duration 3175s, previous duration 0s
  Dead:total time 0s, count 0
  Quarantined:No
  Authen:request 6, timeouts 1
    Response:unexpected 1, server error 0, incorrect 0, time 1955ms

```

```

Transaction:success 5, failure 0
Author:request 0, timeouts 0
Response:unexpected 0, server error 0, incorrect 0, time 0ms
Transaction:success 0, failure 0
Account:request 5, timeouts 0
Response:unexpected 0, server error 0, incorrect 0, time 3247ms
Transaction:success 5, failure 0
Elapsed time since counters last cleared:2m
Router#

```

The output shows the status of two RADIUS servers. Both servers are up and, in the last 2 minutes, have processed successfully:

- 5 out of 6 authentication requests
- 5 out of 5 accounting requests

### Related Commands

Command	Description
<b>debug aaa sg-server selection</b>	Shows why the RADIUS and TACACS+ server group system in a router is selecting a particular server.
<b>debug aaa test</b>	Shows when the idle timer or dead timer has expired for RADIUS server load balancing.
<b>load-balance</b>	Enables RADIUS server load balancing for named RADIUS server groups.
<b>radius-server host</b>	Enables RADIUS automated testing for load balancing.
<b>test aaa group</b>	Tests RADIUS load balancing server response manually.

## radius-server retransmit

To specify the number of times the Cisco IOS software searches the list of RADIUS server hosts before giving up, use the **radius-server retransmit** command in global configuration mode. To disable retransmission, use the **no** form of this command.

**radius-server retransmit** *retries*

**no radius-server retransmit**

### Syntax Description

<i>retries</i>	Maximum number of retransmission attempts. The range is 0 to 100.
----------------	---

### Command Default

The default number of retransmission attempts is 3.

### Command Modes

Global configuration (config)

### Command History

Release	Modification
11.1	This command was introduced.
12.2(31)SB	This command was integrated into Cisco IOS Release 12.2(31)SB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
Cisco IOS XE Release 3.3S	This command was integrated into Cisco IOS XE Release 3.3S.

### Usage Guidelines

The Cisco IOS software tries all servers, allowing each one to time out before increasing the retransmit count.

If the RADIUS server is only a few hops from the router, we recommend that you configure the RADIUS server retransmit rate to 5.

### Examples

The following example shows how to specify a retransmit counter value of five times:

```
Router(config)# radius-server retransmit 5
```

**Related Commands**

<b>Command</b>	<b>Description</b>
<b>aaa new-model</b>	Enables the AAA access control model.
<b>radius-server host</b>	Specifies a RADIUS server host.
<b>radius-server key</b>	Sets the authentication and encryption key for all RADIUS communications between the router and the RADIUS daemon.
<b>radius-server timeout</b>	Sets the interval for which a router waits for a server host to reply.
<b>show radius statistics</b>	Displays the RADIUS statistics for accounting and authentication packets.

## radius-server timeout

To set the interval for which a router waits for a server host to reply, use the **radius-server timeout** command in global configuration mode. To restore the default, use the **no** form of this command.

**radius-server timeout** *seconds*

**no radius-server timeout**

### Syntax Description

<i>seconds</i>	Number that specifies the timeout interval, in seconds. The range is 1 to 1000. The default is 5 seconds .
----------------	--

### Command Default

5 seconds

### Command Modes

Global configuration

### Command History

Release	Modification
11.1	This command was introduced.
12.2(31)SB	This command was integrated into Cisco IOS Release 12.2(31)SB.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

### Usage Guidelines

Use this command to set the number of seconds a router waits for a server host to reply before timing out. If the RADIUS server is only a few hops from the router, we recommend that you configure the RADIUS server timeout to 15 seconds.

### Examples

The following example shows how to set the interval timer to 10 seconds:

```
radius-server timeout 10
```

### Related Commands

Command	Description
<b>radius-server host</b>	Specifies a RADIUS server host.

<b>Command</b>	<b>Description</b>
<b>radius-server key</b>	Sets the authentication and encryption key for all RADIUS communications between the router and the RADIUS daemon.
<b>radius-server retransmit</b>	Specifies the number of times the Cisco IOS software searches the list of RADIUS server hosts before giving up.
<b>show radius statistics</b>	Displays the RADIUS statistics for accounting and authentication packets.

## radius-server vsa send

To configure the network access server (NAS) to recognize and use vendor-specific attributes (VSAs), use the **radius-server vsa send** command in global configuration mode. To disable the NAS from using VSAs, use the **no** form of this command.

**radius-server vsa send** [**accounting**| **authentication**| **cisco-nas-port**] [**3gpp2**]

**no radius-server vsa send** [**accounting**| **authentication**| **cisco-nas-port**] [**3gpp2**]

### Syntax Description

<b>accounting</b>	(Optional) Limits the set of recognized VSAs to only accounting attributes.
<b>authentication</b>	(Optional) Limits the set of recognized VSAs to only authentication attributes.
<b>cisco-nas-port</b>	(Optional) Returns the Cisco NAS port VSA. <b>Note</b> Due to the IETF requirement for including NAS port information in attribute 87 (Attr87), the Cisco NAS port is obsoleted by default.
<b>3gpp2</b>	(Optional) Adds Third Generation Partnership Project 2 (3GPP2) Cisco VSAs to the 3GPP2 packet type.

### Command Default

NAS is not configured to recognize and use VSAs.

### Command Modes

Global configuration (config)

### Command History

Release	Modification
11.3T	This command was introduced.
12.2(27)SBA	This command was integrated into Cisco IOS Release 12.2(27)SBA.
12.2(33)SRA	This command was modified. The <b>cisco-nas-port</b> and <b>3gpp2</b> keywords were added to provide backward compatibility for Cisco VSAs.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
Cisco IOS XE Release 3.3S	This command was integrated into Cisco IOS XE Release 3.3S.

Release	Modification
Cisco IOS XE Release 3.8S	This command was modified. The <b>accounting</b> and <b>authentication</b> keywords were enabled by default for NAS to use VSAs in accounting and authentication requests, respectively.

### Usage Guidelines

The IETF draft standard specifies a method for communicating vendor-specific information between the NAS and the RADIUS server by using the VSA (attribute 26). VSAs allow vendors to support their own extended attributes not suitable for general use. The **radius-server vsa send** command enables the NAS to recognize and use both accounting and authentication VSAs. Use the **accounting** keyword with the **radius-server vsa send** command to limit the set of recognized VSAs to accounting attributes only. Use the **authentication** keyword with the **radius-server vsa send** command to limit the set of recognized VSAs to authentication attributes only. Use the **show running-config all** command to see the default **radius-server vsa send accounting** and **radius-server vsa send authentication** commands.

The Cisco RADIUS implementation supports one vendor-specific option using the format recommended in the specification. The Cisco vendor ID is 9, and the supported option has vendor-type 1, which is named `cisco-avpair`. The value is a string with the following format:

```
"protocol : attribute separator value"
```

In the preceding example, *protocol* is a value of the Cisco protocol attribute for a particular type of authorization; *attribute* and *value* are an appropriate attribute-value (AV) pair defined in the Cisco TACACS+ specification; and *separator* is = for mandatory attributes. This solution allows the full set of features available for TACACS+ authorization to also be used for RADIUS.

For example, the following AV pair causes the Multiple Named IP Address Pools feature to be activated during IP authorization (that is, during the PPP Internet Protocol Control Protocol [IPCP] address assignment):

```
cisco-avpair= "ip:addr-pool=first"
```

The following example causes a NAS Prompt user to have immediate access to EXEC commands.

```
cisco-avpair= "shell:priv-lvl=15"
```

Other vendors have their own unique vendor IDs, options, and associated VSAs. For more information about vendor IDs and VSAs, see RFC 2138, *Remote Authentication Dial-In User Service (RADIUS)*.

### Examples

The following example shows how to configure the NAS to recognize and use vendor-specific accounting attributes:

```
Device(config)# radius-server vsa send accounting
```

### Related Commands

Command	Description
<b>aaa nas port extended</b>	Replaces the NAS-Port attribute with RADIUS IETF attribute 26 and displays extended field information.
<b>show running-config all</b>	Displays complete configuration information, including the default settings and values.

## rd

To specify a route distinguisher (RD) for a VPN routing and forwarding (VRF) instance, use the **rd** command in VRF configuration mode. To remove a route distinguisher, use the **no** form of this command.

**rd** *route-distinguisher*

**no rd** *route-distinguisher*

### Syntax Description

<i>route-distinguisher</i>	An 8-byte value to be added to an IPv4 prefix to create a VPN IPv4 prefix.
----------------------------	--

### Command Default

No RD is specified.

### Command Modes

VRF configuration (config-vrf)

### Command History

Release	Modification
12.0(5)T	This command was introduced.
12.0(21)ST	This command was integrated into Cisco IOS 12.0(21)ST.
12.0(22)S	This command was integrated into Cisco IOS 12.0(22)S.
12.2(13)T	This command was integrated into Cisco IOS 12.2(13)T.
12.2(14)S	This command was integrated into Cisco IOS 12.2(14)S.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2(33)SRB	Support for IPv6 was added.
12.2(33)SB	This command was integrated into Cisco IOS Release 12.2(33)SB.
12.2(33)SXI	This command was integrated into Cisco IOS Release 12.2(33)SXI.
12.2(54)SG	This command was integrated into Cisco IOS Release 12.2(54)SG.
Cisco IOS XE Release 3.1S	This command was integrated into Cisco IOS XE Release 3.1S.
15.1(2)SNG	This command was implemented on the Cisco ASR 901 Series Aggregation Services Routers.

**Usage Guidelines**

An RD creates routing and forwarding tables and specifies the default route distinguisher for a VPN. The RD is added to the beginning of the customer's IPv4 prefixes to change them into globally unique VPN-IPv4 prefixes.

An RD is either:

- ASN-related--Composed of an autonomous system number and an arbitrary number.
- IP-address-related--Composed of an IP address and an arbitrary number.

You can enter an RD in either of these formats:

*16-bit autonomous-system-number* : *your 32-bit number* For example, 101:3.

*32-bit IP address* : *your 16-bit number* For example, 192.168.122.15:1.

**Examples**

The following example shows how to configure a default RD for two VRFs. It illustrates the use of both autonomous-system-number-relative and IP-address-relative RDs:

```
Router(config)# ip vrf vrf1
Router(config-vrf)# rd 100:3
Router(config-vrf)# exit
Router(config)# ip vrf vrf2
Router(config-vrf)# rd 10.13.0.12:200
```

The following is an example of a VRF for IPv4 and IPv6 that has common policies defined in the global part of the VRF configuration:

```
vrf definition vrf2
 rd 200:1
 route-target both 200:2
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
 end
```

**Related Commands**

Command	Description
<b>ip vrf</b>	Configures a VRF routing table.
<b>show ip vrf</b>	Displays the set of defined VRFs and associated interfaces.
<b>vrf definition</b>	Configures a VRF routing table and enters VRF configuration mode.





## reauthentication time through rsa-pubkey

---

- [remark, page 82](#)

# remark

To write a helpful comment (remark) for an entry in a named IP access list, use the remark command in access list configuration mode. To remove the remark, use the **no** form of this command.

**remark** *remark*

**no remark** *remark*

## Syntax Description

<i>remark</i>	Comment that describes the access-list entry, up to 100 characters long.
---------------	--

## Command Default

The access-list entries have no remarks.

## Command Modes

Standard named or extended named access list configuration

## Command History

Release	Modification
12.0(2)T	This command was introduced.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.

## Usage Guidelines

The remark can be up to 100 characters long; anything longer is truncated.

If you want to write a comment about an entry in a numbered IP access list, use the **access-list remark** command.

## Examples

In the following example, the host1 subnet is not allowed to use outbound Telnet:

```
ip access-list extended telnetting
 remark Do not allow host1 subnet to telnet out
 deny tcp host 172.69.2.88 any eq telnet
```

## Related Commands

Command	Description
<b>access-list remark</b>	Specifies a helpful comment (remark) for an entry in a numbered IP access list.

<b>Command</b>	<b>Description</b>
<b>deny (IP)</b>	Sets conditions under which a packet does not pass a named IP access list.
<b>ip access-list</b>	Defines an IP access list by name.
<b>permit (IP)</b>	Sets conditions under which a packet passes a named IP access list.

remark