



# Configuring RADIUS

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## Finding Feature Information

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

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

## Prerequisites for Configuring RADIUS

This section lists the prerequisites for controlling Switch access with RADIUS.

General:

- RADIUS and Authentication, Authorization, and Accounting (AAA) must be enabled to use any of the configuration commands in this chapter.
- RADIUS is facilitated through AAA and can be enabled only through AAA commands.

- Use the **aaa new-model** global configuration command to enable AAA.
- Use the **aaa authentication** global configuration command to define method lists for RADIUS authentication.
- Use **line** and **interface** commands to enable the defined method lists to be used.
- At a minimum, you must identify the host or hosts that run the RADIUS server software and define the method lists for RADIUS authentication. You can optionally define method lists for RADIUS authorization and accounting.
- You should have access to and should configure a RADIUS server before configuring RADIUS features on your Switch.
- The RADIUS host is normally a multiuser system running RADIUS server software from Cisco (Cisco Secure Access Control Server Version 3.0), Livingston, Merit, Microsoft, or another software provider. For more information, see the RADIUS server documentation.
- To use the Change-of-Authorization (CoA) interface, a session must already exist on the switch. CoA can be used to identify a session and enforce a disconnect request. The update affects only the specified session.
- A redundant connection between a switch stack and the RADIUS server is recommended. This is to help ensure that the RADIUS server remains accessible in case one of the connected stack members is removed from the switch stack.

For RADIUS operation:

- Users must first successfully complete RADIUS authentication before proceeding to RADIUS authorization, if it is enabled.

### Related Topics

[RADIUS and Switch Access, on page 3](#)

[RADIUS Operation, on page 4](#)

## Restrictions for Configuring RADIUS

This topic covers restrictions for controlling Switch access with RADIUS.

General:

- To prevent a lapse in security, you cannot configure RADIUS through a network management application.

RADIUS is not suitable in the following network security situations:

- Multiprotocol access environments. RADIUS does not support AppleTalk Remote Access (ARA), NetBIOS Frame Control Protocol (NBFCP), NetWare Asynchronous Services Interface (NASI), or X.25 PAD connections.
- Switch-to-switch or router-to-router situations. RADIUS does not provide two-way authentication. RADIUS can be used to authenticate from one device to a non-Cisco device if the non-Cisco device requires authentication.
- Networks using a variety of services. RADIUS generally binds a user to one service model.

**Related Topics**

[RADIUS Overview, on page 3](#)

# Information about RADIUS

## RADIUS and Switch Access

This section describes how to enable and configure RADIUS. RADIUS provides detailed accounting information and flexible administrative control over the authentication and authorization processes.

**Related Topics**

[Prerequisites for Configuring RADIUS, on page 1](#)

[Configuring the Switch for Local Authentication and Authorization  
SSH Servers, Integrated Clients, and Supported Versions](#)

## RADIUS Overview

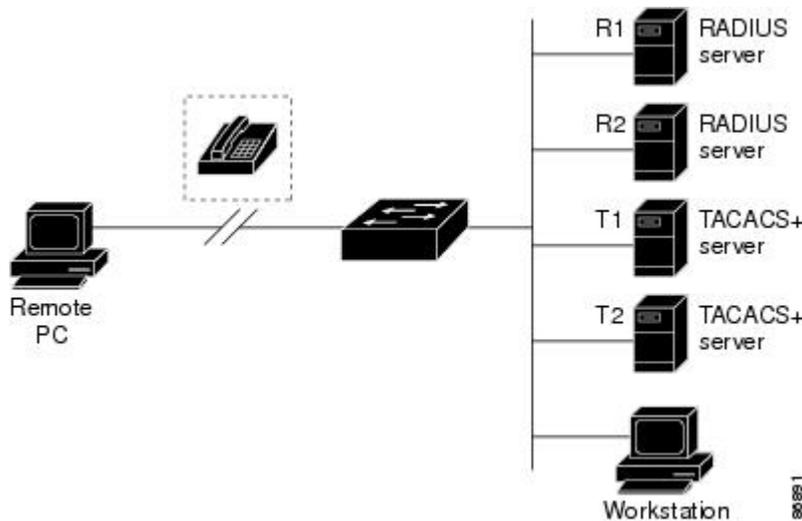
RADIUS is a distributed client/server system that secures networks against unauthorized access. RADIUS clients run on supported Cisco routers and switches. Clients send authentication requests to a central RADIUS server, which contains all user authentication and network service access information.

Use RADIUS in these network environments that require access security:

- Networks with multiple-vendor access servers, each supporting RADIUS. For example, access servers from several vendors use a single RADIUS server-based security database. In an IP-based network with multiple vendors' access servers, dial-in users are authenticated through a RADIUS server that has been customized to work with the Kerberos security system.
- Turnkey network security environments in which applications support the RADIUS protocol, such as in an access environment that uses a *smart card* access control system. In one case, RADIUS has been used with Enigma's security cards to validate users and to grant access to network resources.
- Networks already using RADIUS. You can add a Cisco Switch containing a RADIUS client to the network. This might be the first step when you make a transition to a TACACS+ server. See Figure 2: Transitioning from RADIUS to TACACS+ Services below.
- Network in which the user must only access a single service. Using RADIUS, you can control user access to a single host, to a single utility such as Telnet, or to the network through a protocol such as IEEE 802.1x. For more information about this protocol, see Chapter 11, "Configuring IEEE 802.1x Port-Based Authentication."
- Networks that require resource accounting. You can use RADIUS accounting independently of RADIUS authentication or authorization. The RADIUS accounting functions allow data to be sent at the start and end of services, showing the amount of resources (such as time, packets, bytes, and so forth) used during

the session. An Internet service provider might use a freeware-based version of RADIUS access control and accounting software to meet special security and billing needs.

**Figure 1: Transitioning from RADIUS to TACACS+ Services**



### Related Topics

[Restrictions for Configuring RADIUS, on page 2](#)

## RADIUS Operation

When a user attempts to log in and authenticate to a Switch that is access controlled by a RADIUS server, these events occur:

- 1 The user is prompted to enter a username and password.
- 2 The username and encrypted password are sent over the network to the RADIUS server.
- 3 The user receives one of the following responses from the RADIUS server:
  - ACCEPT—The user is authenticated.
  - REJECT—The user is either not authenticated and is prompted to re-enter the username and password, or access is denied.
  - CHALLENGE—A challenge requires additional data from the user.
  - CHALLENGE PASSWORD—A response requests the user to select a new password.

The ACCEPT or REJECT response is bundled with additional data that is used for privileged EXEC or network authorization. The additional data included with the ACCEPT or REJECT packets includes these items:

- Telnet, SSH, rlogin, or privileged EXEC services
- Connection parameters, including the host or client IP address, access list, and user timeouts

## Related Topics

[Prerequisites for Configuring RADIUS, on page 1](#)

# RADIUS Change of Authorization

The RADIUS Change of Authorization (CoA) provides a mechanism to change the attributes of an authentication, authorization, and accounting (AAA) session after it is authenticated. When a policy changes for a user or user group in AAA, administrators can send RADIUS CoA packets from the AAA server such as a Cisco Secure Access Control Server (ACS) to reinitialize authentication and apply the new policy. This section provides an overview of the RADIUS interface including available primitives and how they are used during a CoA.

- Change-of-Authorization Requests
- CoA Request Response Code
- CoA Request Commands
- Session Reauthentication
- Stacking Guidelines for Session Termination

A standard RADIUS interface is typically used in a pulled model where the request originates from a network attached device and the response come from the queried servers. Catalyst switches support the RADIUS CoA extensions defined in RFC 5176 that are typically used in a pushed model and allow for the dynamic reconfiguring of sessions from external AAA or policy servers.

The switch supports these per-session CoA requests:

- Session reauthentication
- Session termination
- Session termination with port shutdown
- Session termination with port bounce

This feature is integrated with Cisco Secure Access Control Server (ACS) 5.1.

The RADIUS interface is enabled by default on Catalyst switches. However, some basic configuration is required for the following attributes:

- Security and Password—refer to the “Preventing Unauthorized Access to Your Switch” section in this guide.
- Accounting—refer to the “Starting RADIUS Accounting” section in the Configuring Switch-Based Authentication chapter in this guide.

Cisco IOS software supports the RADIUS CoA extensions defined in RFC 5176 that are typically used in a push model to allow the dynamic reconfiguring of sessions from external AAA or policy servers. Per-session CoA requests are supported for session identification, session termination, host reauthentication, port shutdown, and port bounce. This model comprises one request (CoA-Request) and two possible response codes:

- CoA acknowledgement (ACK) [CoA-ACK]
- CoA nonacknowledgement (NAK) [CoA-NAK]

The request is initiated from a CoA client (typically a AAA or policy server) and directed to the device that acts as a listener.

The table below shows the RADIUS CoA commands and vendor-specific attributes (VSAs) supported by Identity-Based Networking Services. All CoA commands must include the session identifier between the device and the CoA client.

**Table 1: RADIUS CoA Commands Supported by Identity-Based Networking Services**

CoA Command	Cisco VSA
Activate service	Cisco:Avpair="subscriber:command=activate-service" Cisco:Avpair="subscriber:service-name=<service-name>" Cisco:Avpair="subscriber:precedence=<precedence-number>" Cisco:Avpair="subscriber:activation-mode=replace-all"
Deactivate service	Cisco:Avpair="subscriber:command=deactivate-service" Cisco:Avpair="subscriber:service-name=<service-name>"
Bounce host port	Cisco:Avpair="subscriber:command=bounce-host-port"
Disable host port	Cisco:Avpair="subscriber:command=disable-host-port"
Session query	Cisco:Avpair="subscriber:command=session-query"
Session reauthenticate	Cisco:Avpair="subscriber:command=reauthenticate" Cisco:Avpair="subscriber:reauthenticate-type=last" or Cisco:Avpair="subscriber:reauthenticate-type=rerun"
Session terminate	This is a standard disconnect request and does not require a VSA.
Interface template	Cisco:AVpair="interface-template-name=<interfacetemplate>"

## Change-of-Authorization Requests

Change of Authorization (CoA) requests, as described in RFC 5176, are used in a push model to allow for session identification, host reauthentication, and session termination. The model is comprised of one request (CoA-Request) and two possible response codes:

- CoA acknowledgment (ACK) [CoA-ACK]
- CoA non-acknowledgment (NAK) [CoA-NAK]

The request is initiated from a CoA client (typically a RADIUS or policy server) and directed to the switch that acts as a listener.

## RFC 5176 Compliance

The Disconnect Request message, which is also referred to as Packet of Disconnect (POD), is supported by the switch for session termination.

This table shows the IETF attributes are supported for this feature.

**Table 2: Supported IETF Attributes**

Attribute Number	Attribute Name
24	State
31	Calling-Station-ID
44	Acct-Session-ID
80	Message-Authenticator
101	Error-Cause

This table shows the possible values for the Error-Cause attribute.

**Table 3: Error-Cause Values**

Value	Explanation
201	Residual Session Context Removed
202	Invalid EAP Packet (Ignored)
401	Unsupported Attribute
402	Missing Attribute
403	NAS Identification Mismatch
404	Invalid Request
405	Unsupported Service
406	Unsupported Extension
407	Invalid Attribute Value
501	Administratively Prohibited
502	Request Not Routable (Proxy)
503	Session Context Not Found

Value	Explanation
504	Session Context Not Removable
505	Other Proxy Processing Error
506	Resources Unavailable
507	Request Initiated
508	Multiple Session Selection Unsupported

### Preconditions

To use the CoA interface, a session must already exist on the switch. CoA can be used to identify a session and enforce a disconnect request. The update affects only the specified session.

## CoA Request Response Code

The CoA Request response code can be used to convey a command to the switch.

The packet format for a CoA Request Response code as defined in RFC 5176 consists of the following fields: Code, Identifier, Length, Authenticator, and Attributes in the Type:Length:Value (TLV) format. The Attributes field is used to carry Cisco vendor-specific attributes (VSAs).

### Related Topics

[CoA Request Commands](#), on page 9

### Session Identification

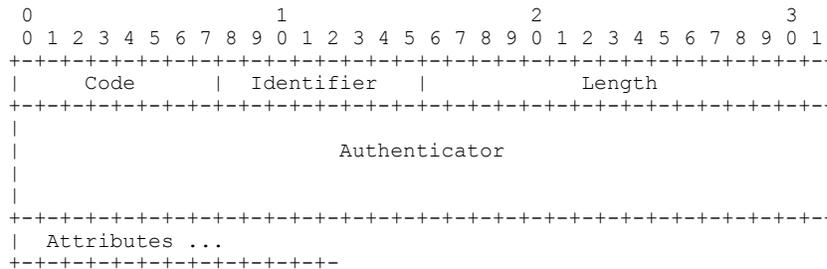
For disconnect and CoA requests targeted at a particular session, the switch locates the session based on one or more of the following attributes:

- Acct-Session-Id (IETF attribute #44)
- Audit-Session-Id (Cisco VSA)
- Calling-Station-Id (IETF attribute #31 which contains the host MAC address)
- IPv6 Attributes, which can be one of the following:
  - Framed-IPv6-Prefix (IETF attribute #97) and Framed-Interface-Id (IETF attribute #96), which together create a full IPv6 address per RFC 3162
  - Framed-IPv6-Address
- Plain IP Address (IETF attribute #8)

Unless all session identification attributes included in the CoA message match the session, the switch returns a Disconnect-NAK or CoA-NAK with the “Invalid Attribute Value” error-code attribute.

If more than one session identification attribute is included in the message, all the attributes must match the session or the switch returns a Disconnect- negative acknowledgment (NAK) or CoA-NAK with the error code “Invalid Attribute Value.”

The packet format for a CoA Request code as defined in RFC 5176 consists of the fields: Code, Identifier, Length, Authenticator, and Attributes in Type:Length:Value (TLV) format.



The attributes field is used to carry Cisco vendor-specific attributes (VSAs).

For CoA requests targeted at a particular enforcement policy, the device returns a CoA-NAK with the error code “Invalid Attribute Value” if any of the above session identification attributes are included in the message.

**Related Topics**

- [CoA Disconnect-Request, on page 11](#)
- [CoA Request: Disable Host Port, on page 11](#)
- [CoA Request: Bounce-Port, on page 12](#)

**CoA ACK Response Code**

If the authorization state is changed successfully, a positive acknowledgment (ACK) is sent. The attributes returned within CoA ACK will vary based on the CoA Request and are discussed in individual CoA Commands.

**CoA NAK Response Code**

A negative acknowledgment (NAK) indicates a failure to change the authorization state and can include attributes that indicate the reason for the failure. Use **show** commands to verify a successful CoA.

**CoA Request Commands**

*Table 4: CoA Commands Supported on the switch*

Command	Cisco VSA
<a href="#">1</a>	
Reauthenticate host	Cisco:Avpair="subscriber:command=reauthenticate"
Terminate session	This is a standard disconnect request that does not require a VSA.
Bounce host port	Cisco:Avpair="subscriber:command=bounce-host-port"

Command 1	Cisco VSA
Disable host port	Cisco:Avpair="subscriber:command=disable-host-port"

<sup>1</sup> All CoA commands must include the session identifier between the switch and the CoA client.

### Related Topics

[CoA Request Response Code, on page 8](#)

## Session Reauthentication

The AAA server typically generates a session reauthentication request when a host with an unknown identity or posture joins the network and is associated with a restricted access authorization profile (such as a guest VLAN). A reauthentication request allows the host to be placed in the appropriate authorization group when its credentials are known.

To initiate session authentication, the AAA server sends a standard CoA-Request message which contains a Cisco VSA in this form: *Cisco:Avpair="subscriber:command=reauthenticate"* and one or more session identification attributes.

The current session state determines the switch response to the message. If the session is currently authenticated by IEEE 802.1x, the switch responds by sending an EAPoL (Extensible Authentication Protocol over Lan) -RequestId message to the server.

If the session is currently authenticated by MAC authentication bypass (MAB), the switch sends an access-request to the server, passing the same identity attributes used for the initial successful authentication.

If session authentication is in progress when the switch receives the command, the switch terminates the process, and restarts the authentication sequence, starting with the method configured to be attempted first.

If the session is not yet authorized, or is authorized via guest VLAN, or critical VLAN, or similar policies, the reauthentication message restarts the access control methods, beginning with the method configured to be attempted first. The current authorization of the session is maintained until the reauthentication leads to a different authorization result.

## Session Reauthentication in a Switch Stack

When a switch stack receives a session reauthentication message:

- It checkpoints the need for a re-authentication before returning an acknowledgment (ACK).
- It initiates reauthentication for the appropriate session.
- If authentication completes with either success or failure, the signal that triggered the reauthentication is removed from the stack member.
- If the stack master fails before authentication completes, reauthentication is initiated after stack master switch-over based on the original command (which is subsequently removed).
- If the stack master fails before sending an ACK, the new stack master treats the re-transmitted command as a new command.

## Session Termination

There are three types of CoA requests that can trigger session termination. A CoA Disconnect-Request terminates the session, without disabling the host port. This command causes re-initialization of the authenticator state machine for the specified host, but does not restrict that host access to the network.

To restrict a host's access to the network, use a CoA Request with the Cisco:Avpair="subscriber:command=disable-host-port" VSA. This command is useful when a host is known to be causing problems on the network, and you need to immediately block network access for the host. When you want to restore network access on the port, re-enable it using a non-RADIUS mechanism.

When a device with no supplicant, such as a printer, needs to acquire a new IP address (for example, after a VLAN change), terminate the session on the host port with port-bounce (temporarily disable and then re-enable the port).

## CoA Disconnect-Request

This command is a standard Disconnect-Request. If the session cannot be located, the switch returns a Disconnect-NAK message with the "Session Context Not Found" error-code attribute. If the session is located, the switch terminates the session. After the session has been completely removed, the switch returns a Disconnect-ACK.

If the switch fails-over to a standby switch before returning a Disconnect-ACK to the client, the process is repeated on the new active switch when the request is re-sent from the client. If the session is not found following re-sending, a Disconnect-ACK is sent with the "Session Context Not Found" error-code attribute.

### Related Topics

[Session Identification, on page 8](#)

## CoA Request: Disable Host Port

The RADIUS server CoA disable port command administratively shuts down the authentication port that is hosting a session, resulting in session termination. This command is useful when a host is known to cause problems on the network and network access needs to be immediately blocked for the host. To restore network access on the port, reenable it using a non-RADIUS mechanism. This command is carried in a standard CoA-Request message that has this new vendor-specific attribute (VSA):

```
Cisco:Avpair="subscriber:command=disable-host-port"
```

Because this command is session-oriented, it must be accompanied by one or more of the session identification attributes described in the "Session Identification" section. If the session cannot be located, the switch returns a CoA-NAK message with the "Session Context Not Found" error-code attribute. If the session is located, the switch disables the hosting port and returns a CoA-ACK message.

If the switch fails before returning a CoA-ACK to the client, the process is repeated on the new active switch when the request is re-sent from the client. If the switch fails after returning a CoA-ACK message to the client but before the operation has completed, the operation is restarted on the new active switch.

**Note**

A Disconnect-Request failure following command re-sending could be the result of either a successful session termination before change-over (if the Disconnect-ACK was not sent) or a session termination by other means (for example, a link failure) that occurred after the original command was issued and before the standby switch became active.

**Related Topics**

[Session Identification, on page 8](#)

**CoA Request: Bounce-Port**

A RADIUS server CoA bounce port sent from a RADIUS server can cause a link flap on an authentication port, which triggers DHCP renegotiation from one or more hosts connected to this port. This incident can occur when there is a VLAN change and the endpoint is a device (such as a printer) that does not have a mechanism to detect a change on this authentication port. The CoA bounce port is carried in a standard CoA-Request message that contains the following VSA:

```
Cisco:Avpair="subscriber:command=bounce-host-port"
```

Because this command is session-oriented, it must be accompanied by one or more of the session identification attributes. If the session cannot be located, the switch returns a CoA-NAK message with the "Session Context Not Found" error-code attribute. If the session is located, the switch disables the hosting port for a period of 10 seconds, re-enables it (port-bounce), and returns a CoA-ACK.

If the switch fails before returning a CoA-ACK to the client, the process is repeated on the new active switch when the request is re-sent from the client. If the switch fails after returning a CoA-ACK message to the client but before the operation has completed, the operation is re-started on the new active switch.

**Related Topics**

[Session Identification, on page 8](#)

**Stacking Guidelines for Session Termination**

No special handling is required for CoA Disconnect-Request messages in a switch stack.

**Stacking Guidelines for CoA-Request Bounce-Port**

Because the **bounce-port** command is targeted at a session, not a port, if the session is not found, the command cannot be executed.

When the Auth Manager command handler on the stack master receives a valid **bounce-port** command, it checkpoints the following information before returning a CoA-ACK message:

- the need for a port-bounce
- the port-id (found in the local session context)

The switch initiates a port-bounce (disables the port for 10 seconds, then re-enables it).

If the port-bounce is successful, the signal that triggered the port-bounce is removed from the standby stack master.

If the stack master fails before the port-bounce completes, a port-bounce is initiated after stack master change-over based on the original command (which is subsequently removed).

If the stack master fails before sending a CoA-ACK message, the new stack master treats the re-sent command as a new command.

### Stacking Guidelines for CoA-Request Disable-Port

Because the **disable-port** command is targeted at a session, not a port, if the session is not found, the command cannot be executed.

When the Auth Manager command handler on the stack master receives a valid **disable-port** command, it verifies this information before returning a CoA-ACK message:

- the need for a port-disable
- the port-id (found in the local session context)

The switch attempts to disable the port.

If the port-disable operation is successful, the signal that triggered the port-disable is removed from the standby stack master.

If the stack master fails before the port-disable operation completes, the port is disabled after stack master change-over based on the original command (which is subsequently removed).

If the stack master fails before sending a CoA-ACK message, the new stack master treats the re-sent command as a new command.

## Default RADIUS Configuration

RADIUS and AAA are disabled by default.

To prevent a lapse in security, you cannot configure RADIUS through a network management application. When enabled, RADIUS can authenticate users accessing the switch through the CLI.

## RADIUS Server Host

Switch-to-RADIUS-server communication involves several components:

- Hostname or IP address
- Authentication destination port
- Accounting destination port
- Key string
- Timeout period
- Retransmission value

You identify RADIUS security servers by their hostname or IP address, hostname and specific UDP port numbers, or their IP address and specific UDP port numbers. The combination of the IP address and the UDP port number creates a unique identifier, allowing different ports to be individually defined as RADIUS hosts

providing a specific AAA service. This unique identifier enables RADIUS requests to be sent to multiple UDP ports on a server at the same IP address.

If two different host entries on the same RADIUS server are configured for the same service—for example, accounting—the second host entry configured acts as a fail-over backup to the first one. Using this example, if the first host entry fails to provide accounting services, the %RADIUS-4-RADIUS\_DEAD message appears, and then the switch tries the second host entry configured on the same device for accounting services. (The RADIUS host entries are tried in the order that they are configured.)

A RADIUS server and the switch use a shared secret text string to encrypt passwords and exchange responses. To configure RADIUS to use the AAA security commands, you must specify the host running the RADIUS server daemon and a secret text (key) string that it shares with the switch.

The timeout, retransmission, and encryption key values can be configured globally for all RADIUS servers, on a per-server basis, or in some combination of global and per-server settings.

#### Related Topics

[Identifying the RADIUS Server Host, on page 27](#)

[Defining AAA Server Groups, on page 32](#)

[Configuring Settings for All RADIUS Servers, on page 38](#)

[Configuring RADIUS Login Authentication, on page 30](#)

## RADIUS Login Authentication

To configure AAA authentication, you define a named list of authentication methods and then apply that list to various ports. The method list defines the types of authentication to be performed and the sequence in which they are performed; it must be applied to a specific port before any of the defined authentication methods are performed. The only exception is the default method list. The default method list is automatically applied to all ports except those that have a named method list explicitly defined.

A method list describes the sequence and authentication methods to be queried to authenticate a user. You can designate one or more security protocols to be used for authentication, thus ensuring a backup system for authentication in case the initial method fails. The software uses the first method listed to authenticate users; if that method fails to respond, the software selects the next authentication method in the method list. This process continues until there is successful communication with a listed authentication method or until all defined methods are exhausted. If authentication fails at any point in this cycle—meaning that the security server or local username database responds by denying the user access—the authentication process stops, and no other authentication methods are attempted.

#### Related Topics

[Configuring RADIUS Login Authentication, on page 30](#)

## AAA Server Groups

You can configure the switch to use AAA server groups to group existing server hosts for authentication. You select a subset of the configured server hosts and use them for a particular service. The server group is used with a global server-host list, which lists the IP addresses of the selected server hosts.

Server groups also can include multiple host entries for the same server if each entry has a unique identifier (the combination of the IP address and UDP port number), allowing different ports to be individually defined as RADIUS hosts providing a specific AAA service. This unique identifier enables RADIUS requests to be

sent to different UDP ports on a server at the same IP address. If you configure two different host entries on the same RADIUS server for the same service, (for example, accounting), the second configured host entry acts as a fail-over backup to the first one. If the first host entry fails to provide accounting services, the network access server tries the second host entry configured on the same device for accounting services. (The RADIUS host entries are tried in the order in which they are configured.)

#### Related Topics

[Defining AAA Server Groups, on page 32](#)

## AAA Authorization

AAA authorization limits the services available to a user. When AAA authorization is enabled, the switch uses information retrieved from the user's profile, which is in the local user database or on the security server, to configure the user's session. The user is granted access to a requested service only if the information in the user profile allows it.

#### Related Topics

[Configuring RADIUS Authorization for User Privileged Access and Network Services, on page 34](#)

## RADIUS Accounting

The AAA accounting feature tracks the services that users are using and the amount of network resources that they are consuming. When you enable AAA accounting, the switch reports user activity to the RADIUS security server in the form of accounting records. Each accounting record contains accounting attribute-value (AV) pairs and is stored on the security server. You can then analyze the data for network management, client billing, or auditing.

#### Related Topics

[Starting RADIUS Accounting, on page 36](#)

## Vendor-Specific RADIUS Attributes

The Internet Engineering Task Force (IETF) draft standard specifies a method for communicating vendor-specific information between the switch and the RADIUS server by using the vendor-specific attribute (attribute 26). Vendor-specific attributes (VSAs) allow vendors to support their own extended attributes not suitable for general use. The Cisco RADIUS implementation supports one vendor-specific option by using the format recommended in the specification. Cisco's vendor-ID is 9, and the supported option has vendor-type 1, which is named *cisco-avpair*. The value is a string with this format:

```
protocol : attribute sep value *
```

*Protocol* is a value of the Cisco protocol attribute for a particular type of authorization. *Attribute* and *value* are an appropriate attributevalue (AV) pair defined in the Cisco TACACS+ specification, and *sep* is = for mandatory attributes and is \* for optional attributes. The full set of features available for TACACS+ authorization can then be used for RADIUS.

For example, the following AV pair causes Cisco's "multiple named IP address pools" feature to be activated during IP authorization (during PPP's Internet Protocol Control Protocol (IPCP) address assignment):

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

If you insert an "\*", the AV pair "ip:addr-pool=first" becomes optional. Note that any AV pair can be made optional:

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

The following example shows how to cause a user logging in from a network access server to have immediate access to EXEC commands:

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

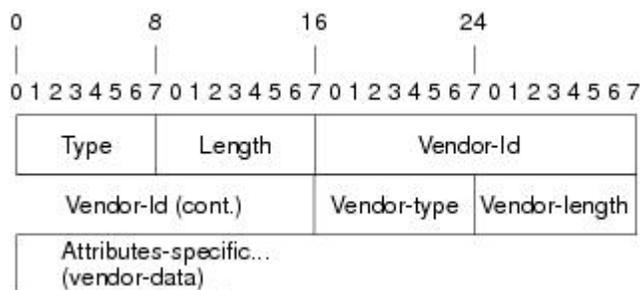
Other vendors have their own unique vendor-IDs, options, and associated VSAs. For more information about vendor-IDs and VSAs, see RFC 2138, "Remote Authentication Dial-In User Service (RADIUS)."

Attribute 26 contains the following three elements:

- Type
- Length
- String (also known as data)
  - Vendor-Id
  - Vendor-Type
  - Vendor-Length
  - Vendor-Data

The figure below shows the packet format for a VSA encapsulated "behind" attribute 26.

**Figure 2: VSA Encapsulated Behind Attribute 26**



**Note**

It is up to the vendor to specify the format of their VSA. The Attribute-Specific field (also known as Vendor-Data) is dependent on the vendor's definition of that attribute.

The table below describes significant fields listed in the Vendor-Specific RADIUS IETF Attributes table (second table below), which lists supported vendor-specific RADIUS attributes (IETF attribute 26).

**Table 5: Vendor-Specific Attributes Table Field Descriptions**

Field	Description
Number	All attributes listed in the following table are extensions of IETF attribute 26.
Vendor-Specific Command Codes	A defined code used to identify a particular vendor. Code 9 defines Cisco VSAs, 311 defines Microsoft VSAs, and 529 defines Ascend VSAs.
Sub-Type Number	The attribute ID number. This number is much like the ID numbers of IETF attributes, except it is a “second layer” ID number encapsulated behind attribute 26.
Attribute	The ASCII string name of the attribute.
Description	Description of the attribute.

**Table 6: Vendor-Specific RADIUS IETF Attributes**

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
MS-CHAP Attributes				
26	311	1	MSCHAP-Response	Contains the response value provided by a PPP MS-CHAP user in response to the challenge. It is only used in Access-Request packets. This attribute is identical to the PPP CHAP Identifier. ( <a href="#">RFC 2548</a> )
26	311	11	MSCHAP-Challenge	Contains the challenge sent by a network access server to an MS-CHAP user. It can be used in both Access-Request and Access-Challenge packets. ( RFC 2548 )
VPDN Attributes				

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	1	l2tp-cm-local-window-size	Specifies the maximum receive window size for L2TP control messages. This value is advertised to the peer during tunnel establishment.
26	9	1	l2tp-drop-out-of-order	Respects sequence numbers on data packets by dropping those that are received out of order. This does not ensure that sequence numbers will be sent on data packets, just how to handle them if they are received.
26	9	1	l2tp-hello-interval	Specifies the number of seconds for the hello keepalive interval. Hello packets are sent when no data has been sent on a tunnel for the number of seconds configured here.
26	9	1	l2tp-hidden-avp	When enabled, sensitive AVPs in L2TP control messages are scrambled or hidden.
26	9	1	l2tp-nosession-timeout	Specifies the number of seconds that a tunnel will stay active with no sessions before timing out and shutting down.
26	9	1	tunnel-tos-reflect	Copies the IP ToS field from the IP header of each payload packet to the IP header of the tunnel packet for packets entering the tunnel at the LNS.
26	9	1	l2tp-tunnel-authen	If this attribute is set, it performs L2TP tunnel authentication.

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	1	l2tp-tunnel-password	Shared secret used for L2TP tunnel authentication and AVP hiding.
26	9	1	l2tp-udp-checksum	This is an authorization attribute and defines whether L2TP should perform UDP checksums for data packets. Valid values are "yes" and "no." The default is no.
Store and Forward Fax Attributes				
26	9	3	Fax-Account-Id-Origin	Indicates the account ID origin as defined by system administrator for the <b>mmp</b> <b>aaa receive-id</b> or the <b>mmp</b> <b>aaa send-id</b> commands.
26	9	4	Fax-Msg-Id=	Indicates a unique fax message identification number assigned by Store and Forward Fax.
26	9	5	Fax-Pages	Indicates the number of pages transmitted or received during this fax session. This page count includes cover pages.
26	9	6	Fax-Coverpage-Flag	Indicates whether or not a cover page was generated by the off-ramp gateway for this fax session. True indicates that a cover page was generated; false means that a cover page was not generated.

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	7	Fax-Modem-Time	Indicates the amount of time in seconds the modem sent fax data (x) and the amount of time in seconds of the total fax session (y), which includes both fax-mail and PSTN time, in the form x/y. For example, 10/15 means that the transfer time took 10 seconds, and the total fax session took 15 seconds.
26	9	8	Fax-Connect-Speed	Indicates the modem speed at which this fax-mail was initially transmitted or received. Possible values are 1200, 4800, 9600, and 14400.
26	9	9	Fax-Recipient-Count	Indicates the number of recipients for this fax transmission. Until e-mail servers support Session mode, the number should be 1.
26	9	10	Fax-Process-Abort-Flag	Indicates that the fax session was aborted or successful. True means that the session was aborted; false means that the session was successful.
26	9	11	Fax-Dsn-Address	Indicates the address to which DSNs will be sent.
26	9	12	Fax-Dsn-Flag	Indicates whether or not DSN has been enabled. True indicates that DSN has been enabled; false means that DSN has not been enabled.
26	9	13	Fax-Mdn-Address	Indicates the address to which MDNs will be sent.

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	14	Fax-Mdn-Flag	Indicates whether or not message delivery notification (MDN) has been enabled. True indicates that MDN had been enabled; false means that MDN had not been enabled.
26	9	15	Fax-Auth-Status	Indicates whether or not authentication for this fax session was successful. Possible values for this field are success, failed, bypassed, or unknown.
26	9	16	Email-Server-Address	Indicates the IP address of the e-mail server handling the on-ramp fax-mail message.
26	9	17	Email-Server-Ack-Flag	Indicates that the on-ramp gateway has received a positive acknowledgment from the e-mail server accepting the fax-mail message.
26	9	18	Gateway-Id	Indicates the name of the gateway that processed the fax session. The name appears in the following format: hostname.domain-name.
26	9	19	Call-Type	Describes the type of fax activity: fax receive or fax send.
26	9	20	Port-Used	Indicates the slot/port number of the Cisco AS5300 used to either transmit or receive this fax-mail.

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	21	Abort-Cause	If the fax session aborts, indicates the system component that signaled the abort. Examples of system components that could trigger an abort are FAP (Fax Application Process), TIFF (the TIFF reader or the TIFF writer), fax-mail client, fax-mail server, ESMTP client, or ESMTP server.
H323 Attributes				
26	9	23	Remote-Gateway-ID (h323-remote-address)	Indicates the IP address of the remote gateway.
26	9	24	Connection-ID (h323-conf-id)	Identifies the conference ID.
26	9	25	Setup-Time (h323-setup-time)	Indicates the setup time for this connection in Coordinated Universal Time (UTC) formerly known as Greenwich Mean Time (GMT) and Zulu time.
26	9	26	Call-Origin (h323-call-origin)	Indicates the origin of the call relative to the gateway. Possible values are originating and terminating (answer).
26	9	27	Call-Type (h323-call-type)	Indicates call leg type. Possible values are <b>telephony</b> and <b>VoIP</b> .
26	9	28	Connect-Time (h323-connect-time)	Indicates the connection time for this call leg in UTC.
26	9	29	Disconnect-Time (h323-disconnect-time)	Indicates the time this call leg was disconnected in UTC.

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	30	Disconnect-Cause (h323-disconnect-cause)	Specifies the reason a connection was taken offline per Q.931 specification.
26	9	31	Voice-Quality (h323-voice-quality)	Specifies the impairment factor (ICPIF) affecting voice quality for a call.
26	9	33	Gateway-ID (h323-gw-id)	Indicates the name of the underlying gateway.
Large Scale Dialout Attributes				
26	9	1	callback-dialstring	Defines a dialing string to be used for callback.
26	9	1	data-service	No description available.
26	9	1	dial-number	Defines the number to dial.
26	9	1	force-56	Determines whether the network access server uses only the 56 K portion of a channel, even when all 64 K appear to be available.
26	9	1	map-class	Allows the user profile to reference information configured in a map class of the same name on the network access server that dials out.
26	9	1	send-auth	Defines the protocol to use (PAP or CHAP) for username-password authentication following CLID authentication.

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	1	send-name	<p>PPP name authentication. To apply for PAP, do not configure the <b>ppp pap sent-name password</b> command on the interface. For PAP, “preauth:send-name” and “preauth:send-secret” will be used as the PAP username and PAP password for outbound authentication. For CHAP, “preauth:send-name” will be used not only for outbound authentication, but also for inbound authentication. For a CHAP inbound case, the NAS will use the name defined in “preauth:send-name” in the challenge packet to the caller box.</p> <p><b>Note</b> The send-name attribute has changed over time: Initially, it performed the functions now provided by both the send-name and remote-name attributes. Because the remote-name attribute has been added, the send-name attribute is restricted to its current behavior.</p>

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	1	send-secret	PPP password authentication. The vendor-specific attributes (VSAs) "preauth:send-name" and "preauth:send-secret" will be used as the PAP username and PAP password for outbound authentication. For a CHAP outbound case, both "preauth:send-name" and "preauth:send-secret" will be used in the response packet.
26	9	1	remote-name	Provides the name of the remote host for use in large-scale dial-out. Dialer checks that the large-scale dial-out remote name matches the authenticated name, to protect against accidental user RADIUS misconfiguration. (For example, dialing a valid phone number but connecting to the wrong device.)
Miscellaneous Attributes				

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	2	Cisco-NAS-Port	<p>Specifies additional vendor specific attribute (VSA) information for NAS-Port accounting. To specify additional NAS-Port information in the form an Attribute-Value Pair (AVPair) string, use the <b>radius-server vsa send</b> global configuration command.</p> <p><b>Note</b> This VSA is typically used in Accounting, but may also be used in Authentication (Access-Request) packets.</p>
26	9	1	min-links	Sets the minimum number of links for MLP.
26	9	1	proxyacl#<n>	Allows users to configure the downloadable user profiles (dynamic ACLs) by using the authentication proxy feature so that users can have the configured authorization to permit traffic going through the configured interfaces.

Number	Vendor-Specific Company Code	Sub-Type Number	Attribute	Description
26	9	1	spi	Carries the authentication information needed by the home agent to authenticate a mobile node during registration. The information is in the same syntax as the <b>ip mobile secure host &lt;addr&gt;</b> configuration command. Basically it contains the rest of the configuration command that follows that string, verbatim. It provides the Security Parameter Index (SPI), key, authentication algorithm, authentication mode, and replay protection timestamp range.

#### Related Topics

[Configuring the Switch to Use Vendor-Specific RADIUS Attributes, on page 39](#)

## Vendor-Proprietary RADIUS Server Communication

Although an IETF draft standard for RADIUS specifies a method for communicating vendor-proprietary information between the switch and the RADIUS server, some vendors have extended the RADIUS attribute set in a unique way. Cisco IOS software supports a subset of vendor-proprietary RADIUS attributes.

As mentioned earlier, to configure RADIUS (whether vendor-proprietary or IETF draft-compliant), you must specify the host running the RADIUS server daemon and the secret text string it shares with the switch. You specify the RADIUS host and secret text string by using the **radius server** global configuration commands.

#### Related Topics

[Configuring the Switch for Vendor-Proprietary RADIUS Server Communication, on page 41](#)

## How to Configure RADIUS

### Identifying the RADIUS Server Host

To apply these settings globally to all RADIUS servers communicating with the Switch, use the three unique global configuration commands: **radius-server timeout**, **radius-server retransmit**, and **radius-server key**.

You can configure the Switch to use AAA server groups to group existing server hosts for authentication. For more information, see Related Topics below.

You also need to configure some settings on the RADIUS server. These settings include the IP address of the Switch and the key string to be shared by both the server and the Switch. For more information, see the RADIUS server documentation.

Follow these steps to configure per-server RADIUS server communication.

### Before You Begin

If you configure both global and per-server functions (timeout, retransmission, and key commands) on the switch, the per-server timer, retransmission, and key value commands override global timer, retransmission, and key value commands. For information on configuring these settings on all RADIUS servers, see Related Topics below.

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **radius-server host** {*hostname* | *ip-address*} [**auth-port** *port-number*] [**acct-port** *port-number*] [**timeout** *seconds*] [**retransmit** *retries*] [**key** *string*]
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Switch> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Switch# <b>configure terminal</b>	Enters the global configuration mode.
<b>Step 3</b>	<b>radius-server host</b> { <i>hostname</i>   <i>ip-address</i> } [ <b>auth-port</b> <i>port-number</i> ] [ <b>acct-port</b> <i>port-number</i> ] [ <b>timeout</b> <i>seconds</i> ] [ <b>retransmit</b> <i>retries</i> ] [ <b>key</b> <i>string</i> ]  <b>Example:</b> Switch(config)# <b>radius-server host 172.29.36.49 auth-port 1612</b>	Specifies the IP address or hostname of the remote RADIUS server host. <ul style="list-style-type: none"> <li>• (Optional) For <b>auth-port</b> <i>port-number</i>, specify the UDP destination port for authentication requests.</li> <li>• (Optional) For <b>acct-port</b> <i>port-number</i>, specify the UDP destination port for accounting requests.</li> <li>• (Optional) For <b>timeout</b> <i>seconds</i>, specify the time interval that the Switch waits for the RADIUS server to reply before resending. The range is 1 to 1000. This setting overrides the <b>radius-server timeout</b> global configuration</li> </ul>

	Command or Action	Purpose
	<pre>key rad1</pre>	<p>command setting. If no timeout is set with the <b>radius-server host</b> command, the setting of the <b>radius-server timeout</b> command is used.</p> <ul style="list-style-type: none"> <li>• (Optional) For <b>retransmit retries</b>, specify the number of times a RADIUS request is resent to a server if that server is not responding or responding slowly. The range is 1 to 1000. If no retransmit value is set with the <b>radius-server host</b> command, the setting of the <b>radius-server retransmit</b> global configuration command is used.</li> <li>• (Optional) For <b>key string</b>, specify the authentication and encryption key used between the Switch and the RADIUS daemon running on the RADIUS server.</li> </ul> <p><b>Note</b> The key 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. 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 are part of the key.</p> <p>From Cisco IOS XE Release 3.7.4E and higher, the command <b>radius-server host {hostname   ip-address}</b> is deprecated. Instead, use the new <b>radius server hostname</b> command.</p> <p>To configure the Switch to recognize more than one host entry associated with a single IP address, enter this command as many times as necessary, making sure that each UDP port number is different. The Switch software searches for hosts in the order in which you specify them. Set the timeout, retransmit, and encryption key values to use with the specific RADIUS host.</p>
<b>Step 4</b>	<pre>end</pre> <p><b>Example:</b></p> <pre>Switch(config)# end</pre>	Returns to privileged EXEC mode.
<b>Step 5</b>	<pre>show running-config</pre> <p><b>Example:</b></p> <pre>Switch# show running-config</pre>	Verifies your entries.
<b>Step 6</b>	<pre>copy running-config startup-config</pre> <p><b>Example:</b></p> <pre>Switch# copy running-config startup-config</pre>	(Optional) Saves your entries in the configuration file.

**Related Topics**

[RADIUS Server Host](#), on page 13

[Defining AAA Server Groups](#), on page 32

[Configuring Settings for All RADIUS Servers](#), on page 38

## Configuring RADIUS Login Authentication

Follow these steps to configure RADIUS login authentication:

**Before You Begin**

To secure the switch for HTTP access by using AAA methods, you must configure the switch with the **ip http authentication aaa** global configuration command. Configuring AAA authentication does not secure the switch for HTTP access by using AAA methods.

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **aaa new-model**
4. **aaa authentication login {default | list-name} method1 [method2...]**
5. **line [console | tty | vty] line-number [ending-line-number]**
6. **login authentication {default | list-name}**
7. **end**
8. **show running-config**
9. **copy running-config startup-config**

**DETAILED STEPS**

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Switch> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Switch# <b>configure terminal</b>	Enters the global configuration mode.

	Command or Action	Purpose
Step 3	<p><b>aaa new-model</b></p> <p><b>Example:</b></p> <pre>Switch(config)# aaa new-model</pre>	Enables AAA.
Step 4	<p><b>aaa authentication login {default   list-name} method1 [method2...]</b></p> <p><b>Example:</b></p> <pre>Switch(config)# aaa authentication login default local</pre>	<p>Creates a login authentication method list.</p> <ul style="list-style-type: none"> <li>• To create a default list that is used when a named list is <i>not</i> specified in the <b>login authentication</b> command, use the <b>default</b> keyword followed by the methods that are to be used in default situations. The default method list is automatically applied to all ports.</li> <li>• For <i>list-name</i>, specify a character string to name the list you are creating.</li> <li>• For <i>method1...</i>, specify the actual method the authentication algorithm tries. The additional methods of authentication are used only if the previous method returns an error, not if it fails.</li> </ul> <p>Select one of these methods:</p> <ul style="list-style-type: none"> <li>◦ <i>enable</i>—Use the enable password for authentication. Before you can use this authentication method, you must define an enable password by using the <b>enable password</b> global configuration command.</li> <li>◦ <i>group radius</i>—Use RADIUS authentication. Before you can use this authentication method, you must configure the RADIUS server.</li> <li>◦ <i>line</i>—Use the line password for authentication. Before you can use this authentication method, you must define a line password. Use the <b>password password</b> line configuration command.</li> <li>◦ <i>local</i>—Use the local username database for authentication. You must enter username information in the database. Use the <b>username name password</b> global configuration command.</li> <li>◦ <i>local-case</i>—Use a case-sensitive local username database for authentication. You must enter username information in the database by using the <b>username password</b> global configuration command.</li> <li>◦ <i>none</i>—Do not use any authentication for login.</li> </ul>
Step 5	<p><b>line [console   tty   vty] line-number [ending-line-number]</b></p> <p><b>Example:</b></p> <pre>Switch(config)# line 1 4</pre>	Enters line configuration mode, and configure the lines to which you want to apply the authentication list.

	Command or Action	Purpose
<b>Step 6</b>	<b>login authentication</b> {default   <i>list-name</i> }  <b>Example:</b> <pre>Switch(config)# login authentication default</pre>	Applies the authentication list to a line or set of lines. <ul style="list-style-type: none"> <li>• If you specify <b>default</b>, use the default list created with the <b>aaa authentication login</b> command.</li> <li>• For <i>list-name</i>, specify the list created with the <b>aaa authentication login</b> command.</li> </ul>
<b>Step 7</b>	<b>end</b>  <b>Example:</b> <pre>Switch(config)# end</pre>	Returns to privileged EXEC mode.
<b>Step 8</b>	<b>show running-config</b>  <b>Example:</b> <pre>Switch# show running-config</pre>	Verifies your entries.
<b>Step 9</b>	<b>copy running-config startup-config</b>  <b>Example:</b> <pre>Switch# copy running-config startup-config</pre>	(Optional) Saves your entries in the configuration file.

### Related Topics

[RADIUS Login Authentication, on page 14](#)

[RADIUS Server Host, on page 13](#)

## Defining AAA Server Groups

You use the **server** group server configuration command to associate a particular server with a defined group server. You can either identify the server by its IP address or identify multiple host instances or entries by using the optional **auth-port** and **acct-port** keywords.

Follow these steps to define AAA server groups:

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **radius server *name***
4. **address {*ipv4* | *ipv6*} {*ip-address* | *hostname*} **auth-port** *port-number* **acct-port** *port-number***
5. **key *string***
6. **end**
7. **show running-config**
8. **copy running-config startup-config**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Switch> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Switch# <b>configure terminal</b>	Enters the global configuration mode.
<b>Step 3</b>	<b>radius server <i>name</i></b>  <b>Example:</b> Switch(config)# <b>radius server ISE</b>	Specifies the name of the RADIUS server configuration for Protected Access Credential (PAC) provisioning and enters RADIUS server configuration mode.  The switch also supports RADIUS for IPv6.
<b>Step 4</b>	<b>address {<i>ipv4</i>   <i>ipv6</i>} {<i>ip-address</i>   <i>hostname</i>} <b>auth-port</b> <i>port-number</i> <b>acct-port</b> <i>port-number</i></b>  <b>Example:</b> Switch(config-radius-server)# <b>address ipv4 10.1.1.1 auth-port 1645 acct-port 1646</b>	Configures the IPv4 address for the RADIUS server accounting and authentication parameters.
<b>Step 5</b>	<b>key <i>string</i></b>  <b>Example:</b> Switch(config-radius-server)# <b>key cisco123</b>	Specifies the authentication and encryption key for all RADIUS communications between the device and the RADIUS server.

	Command or Action	Purpose
<b>Step 6</b>	<b>end</b>  <b>Example:</b> Switch(config-radius-server) # <b>end</b>	Exits RADIUS server configuration mode and returns to privileged EXEC mode.
<b>Step 7</b>	<b>show running-config</b>  <b>Example:</b> Switch# <b>show running-config</b>	Verifies your entries.
<b>Step 8</b>	<b>copy running-config startup-config</b>  <b>Example:</b> Switch# <b>copy running-config startup-config</b>	(Optional) Saves your entries in the configuration file.

### Related Topics

[Identifying the RADIUS Server Host, on page 27](#)

[RADIUS Server Host, on page 13](#)

[AAA Server Groups, on page 14](#)

## Configuring RADIUS Authorization for User Privileged Access and Network Services



### Note

Authorization is bypassed for authenticated users who log in through the CLI even if authorization has been configured.

Follow these steps to configure RADIUS authorization for user privileged access and network services:

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **aaa authorization network radius**
4. **aaa authorization exec radius**
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Switch&gt; enable</pre>	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Switch# configure terminal</pre>	Enters the global configuration mode.
Step 3	<p><b>aaa authorization network radius</b></p> <p><b>Example:</b></p> <pre>Switch(config)# aaa authorization network radius</pre>	Configures the switch for user RADIUS authorization for all network-related service requests.
Step 4	<p><b>aaa authorization exec radius</b></p> <p><b>Example:</b></p> <pre>Switch(config)# aaa authorization exec radius</pre>	<p>Configures the switch for user RADIUS authorization if the user has privileged EXEC access.</p> <p>The <b>exec</b> keyword might return user profile information (such as <b>autocommand</b> information).</p>
Step 5	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Switch(config)# end</pre>	Returns to privileged EXEC mode.
Step 6	<p><b>show running-config</b></p> <p><b>Example:</b></p> <pre>Switch# show running-config</pre>	Verifies your entries.
Step 7	<p><b>copy running-config startup-config</b></p> <p><b>Example:</b></p> <pre>Switch# copy running-config startup-config</pre>	(Optional) Saves your entries in the configuration file.

**What to Do Next**

You can use the **aaa authorization** global configuration command with the **radius** keyword to set parameters that restrict a user's network access to privileged EXEC mode.

The **aaa authorization exec radius local** command sets these authorization parameters:

- Use RADIUS for privileged EXEC access authorization if authentication was performed by using RADIUS.
- Use the local database if authentication was not performed by using RADIUS.

**Related Topics**

[AAA Authorization, on page 15](#)

## Starting RADIUS Accounting

Follow these steps to start RADIUS accounting:

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **aaa accounting network start-stop radius**
4. **aaa accounting exec start-stop radius**
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

**DETAILED STEPS**

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Switch> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Switch# <b>configure terminal</b>	Enters the global configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<b>aaa accounting network start-stop radius</b>  <b>Example:</b> Switch(config)# <b>aaa accounting network start-stop radius</b>	Enables RADIUS accounting for all network-related service requests.
<b>Step 4</b>	<b>aaa accounting exec start-stop radius</b>  <b>Example:</b> Switch(config)# <b>aaa accounting exec start-stop radius</b>	Enables RADIUS accounting to send a start-record accounting notice at the beginning of a privileged EXEC process and a stop-record at the end.
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Switch(config)# <b>end</b>	Returns to privileged EXEC mode.
<b>Step 6</b>	<b>show running-config</b>  <b>Example:</b> Switch# <b>show running-config</b>	Verifies your entries.
<b>Step 7</b>	<b>copy running-config startup-config</b>  <b>Example:</b> Switch# <b>copy running-config startup-config</b>	(Optional) Saves your entries in the configuration file.

### What to Do Next

To establishing a session with a router if the AAA server is unreachable, use the **aaa accounting system guarantee-first** command. This command guarantees system accounting as the first record, which is the default condition. In some situations, users might be prevented from starting a session on the console or terminal connection until after the system reloads, which can take more than 3 minutes.

To establish a console or Telnet session with the router if the AAA server is unreachable when the router reloads, use the **no aaa accounting system guarantee-first** command.

### Related Topics

[RADIUS Accounting, on page 15](#)

## Establishing a Session with a Router if the AAA Server is Unreachable

The `aaa accounting system guarantee-first` command guarantees system accounting as the first record, which is the default condition. In some situations, users might be prevented from starting a session on the console or terminal connection until after the system reloads, which can take more than 3 minutes.

To establish a console or Telnet session with the router if the AAA server is unreachable when the router reloads, use the `no aaa accounting system guarantee-first` command.

## Configuring Settings for All RADIUS Servers

Beginning in privileged EXEC mode, follow these steps to configure settings for all RADIUS servers:

### SUMMARY STEPS

1. `configure terminal`
2. `radius-server key string`
3. `radius-server retransmit retries`
4. `radius-server timeout seconds`
5. `radius-server deadtime minutes`
6. `end`
7. `show running-config`
8. `copy running-config startup-config`

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<p><code>configure terminal</code></p> <p><b>Example:</b></p> <pre>Switch# configure terminal</pre>	Enters the global configuration mode.
Step 2	<p><code>radius-server key string</code></p> <p><b>Example:</b></p> <pre>Switch(config)# radius-server key your_server_key  Switch(config)# key your_server_key</pre>	<p>Specifies the shared secret text string used between the switch and all RADIUS servers.</p> <p><b>Note</b> The key is a text string that must match the encryption key used on the RADIUS server. 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 are part of the key.</p>
Step 3	<p><code>radius-server retransmit retries</code></p> <p><b>Example:</b></p> <pre>Switch(config)# radius-server retransmit</pre>	Specifies the number of times the switch sends each RADIUS request to the server before giving up. The default is 3; the range 1 to 1000.

	Command or Action	Purpose
	5	
<b>Step 4</b>	<b>radius-server timeout</b> <i>seconds</i>  <b>Example:</b> Switch(config)# <b>radius-server timeout 3</b>	Specifies the number of seconds a switch waits for a reply to a RADIUS request before resending the request. The default is 5 seconds; the range is 1 to 1000.
<b>Step 5</b>	<b>radius-server deadtime</b> <i>minutes</i>  <b>Example:</b> Switch(config)# <b>radius-server deadtime 0</b>	When a RADIUS server is not responding to authentication requests, this command specifies a time to stop the request on that server. This avoids the wait for the request to timeout before trying the next configured server. The default is 0; the range is 1 to 1440 minutes.
<b>Step 6</b>	<b>end</b>  <b>Example:</b> Switch(config)# <b>end</b>	Returns to privileged EXEC mode.
<b>Step 7</b>	<b>show running-config</b>  <b>Example:</b> Switch# <b>show running-config</b>	Verifies your entries.
<b>Step 8</b>	<b>copy running-config startup-config</b>  <b>Example:</b> Switch# <b>copy running-config startup-config</b>	(Optional) Saves your entries in the configuration file.

### Related Topics

[Identifying the RADIUS Server Host, on page 27](#)

[RADIUS Server Host, on page 13](#)

## Configuring the Switch to Use Vendor-Specific RADIUS Attributes

Follow these steps to configure the switch to use vendor-specific RADIUS attributes:

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **radius-server vsa send [accounting | authentication]**
4. **end**
5. **show running-config**
6. **copy running-config startup-config**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Switch> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Switch# <b>configure terminal</b>	Enters the global configuration mode.
<b>Step 3</b>	<b>radius-server vsa send [accounting   authentication]</b>  <b>Example:</b> Switch(config)# <b>radius-server vsa send accounting</b>	<p>Enables the switch to recognize and use VSAs as defined by RADIUS IETF attribute 26.</p> <ul style="list-style-type: none"> <li>• (Optional) Use the <b>accounting</b> keyword to limit the set of recognized vendor-specific attributes to only accounting attributes.</li> <li>• (Optional) Use the <b>authentication</b> keyword to limit the set of recognized vendor-specific attributes to only authentication attributes.</li> </ul> <p>If you enter this command without keywords, both accounting and authentication vendor-specific attributes are used.</p>
<b>Step 4</b>	<b>end</b>  <b>Example:</b> Switch(config)# <b>end</b>	Returns to privileged EXEC mode.
<b>Step 5</b>	<b>show running-config</b>  <b>Example:</b> Switch# <b>show running-config</b>	Verifies your entries.

	Command or Action	Purpose
Step 6	<b>copy running-config startup-config</b>  <b>Example:</b>  Switch# <b>copy running-config startup-config</b>	(Optional) Saves your entries in the configuration file.

### Related Topics

[Vendor-Specific RADIUS Attributes, on page 15](#)

## Configuring the Switch for Vendor-Proprietary RADIUS Server Communication

Follow these steps to configure the switch to use vendor-proprietary RADIUS server communication:

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **radius-server host {hostname | ip-address} non-standard**
4. **radius-server key string**
5. **end**
6. **show running-config**
7. **copy running-config startup-config**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b>  Switch> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	<b>configure terminal</b>  <b>Example:</b>  Switch# <b>configure terminal</b>	Enters the global configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<p><b>radius-server host</b> {<i>hostname</i>   <i>ip-address</i>} <b>non-standard</b></p> <p><b>Example:</b></p> <pre>Switch(config)# radius-server host 172.20.30.15 non-standard</pre>	<p>Specifies the IP address or hostname of the remote RADIUS server host and identifies that it is using a vendor-proprietary implementation of RADIUS.</p> <p><b>Note</b> From Cisco IOS XE Release 3.7.4E and higher, the command <b>radius-server host</b> {<i>hostname</i>   <i>ip-address</i>} is deprecated. Instead, use the new <b>radius server</b> <i>hostname</i> command.</p>
<b>Step 4</b>	<p><b>radius-server key</b> <i>string</i></p> <p><b>Example:</b></p> <pre>Switch(config)# radius-server key rad124</pre>	<p>Specifies the shared secret text string used between the switch and the vendor-proprietary RADIUS server. The switch and the RADIUS server use this text string to encrypt passwords and exchange responses.</p> <p><b>Note</b> The key is a text string that must match the encryption key used on the RADIUS server. 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 are part of the key.</p>
<b>Step 5</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Switch(config)# end</pre>	Returns to privileged EXEC mode.
<b>Step 6</b>	<p><b>show running-config</b></p> <p><b>Example:</b></p> <pre>Switch# show running-config</pre>	Verifies your entries.
<b>Step 7</b>	<p><b>copy running-config startup-config</b></p> <p><b>Example:</b></p> <pre>Switch# copy running-config startup-config</pre>	(Optional) Saves your entries in the configuration file.

### Related Topics

[Vendor-Proprietary RADIUS Server Communication, on page 27](#)

## Configuring CoA on the Switch

Follow these steps to configure CoA on a switch. This procedure is required.

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **aaa new-model**
4. **aaa server radius dynamic-author**
5. **client** {*ip-address* | *name*} [*vrf vrfname*] [**server-key** *string*]
6. **server-key** [0 | 7] *string*
7. **port** *port-number*
8. **auth-type** {*any* | *all* | *session-key*}
9. **ignore session-key**
10. **ignore server-key**
11. **authentication command bounce-port ignore**
12. **authentication command disable-port ignore**
13. **end**
14. **show running-config**
15. **copy running-config startup-config**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Switch> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Switch# <b>configure terminal</b>	Enters the global configuration mode.
<b>Step 3</b>	<b>aaa new-model</b>  <b>Example:</b> Switch(config)# <b>aaa new-model</b>	Enables AAA.
<b>Step 4</b>	<b>aaa server radius dynamic-author</b>  <b>Example:</b> Switch(config)# <b>aaa server radius dynamic-author</b>	Configures the switch as an authentication, authorization, and accounting (AAA) server to facilitate interaction with an external policy server.

	Command or Action	Purpose
<b>Step 5</b>	<b>client</b> { <i>ip-address</i>   <i>name</i> } [ <i>vrf vrfname</i> ] [ <i>server-key string</i> ]	Enters dynamic authorization local server configuration mode and specifies a RADIUS client from which a device will accept CoA and disconnect requests.
<b>Step 6</b>	<b>server-key</b> [0   7] <i>string</i>  <b>Example:</b>  Switch(config-sg-radius)# <b>server-key</b> <b>your_server_key</b>	Configures the RADIUS key to be shared between a device and RADIUS clients.
<b>Step 7</b>	<b>port</b> <i>port-number</i>  <b>Example:</b>  Switch(config-sg-radius)# <b>port 25</b>	Specifies the port on which a device listens for RADIUS requests from configured RADIUS clients.
<b>Step 8</b>	<b>auth-type</b> { <i>any</i>   <i>all</i>   <i>session-key</i> }  <b>Example:</b>  Switch(config-sg-radius)# <b>auth-type any</b>	Specifies the type of authorization the switch uses for RADIUS clients.  The client must match all the configured attributes for authorization.
<b>Step 9</b>	<b>ignore session-key</b>	(Optional) Configures the switch to ignore the session-key.  For more information about the <b>ignore</b> command, see the <i>Cisco IOS Intelligent Services Gateway Command Reference</i> on Cisco.com.
<b>Step 10</b>	<b>ignore server-key</b>  <b>Example:</b>  Switch(config-sg-radius)# <b>ignore</b> <b>server-key</b>	(Optional) Configures the switch to ignore the server-key.  For more information about the <b>ignore</b> command, see the <i>Cisco IOS Intelligent Services Gateway Command Reference</i> on Cisco.com.
<b>Step 11</b>	<b>authentication command bounce-port ignore</b>  <b>Example:</b>  Switch(config-sg-radius)# <b>authentication</b> <b>command bounce-port ignore</b>	(Optional) Configures the switch to ignore a CoA request to temporarily disable the port hosting a session. The purpose of temporarily disabling the port is to trigger a DHCP renegotiation from the host when a VLAN change occurs and there is no supplicant on the endpoint to detect the change.
<b>Step 12</b>	<b>authentication command disable-port ignore</b>  <b>Example:</b>  Switch(config-sg-radius)# <b>authentication</b> <b>command disable-port ignore</b>	(Optional) Configures the switch to ignore a nonstandard command requesting that the port hosting a session be administratively shut down. Shutting down the port results in termination of the session.  Use standard CLI or SNMP commands to re-enable the port.

	Command or Action	Purpose
Step 13	<b>end</b>  <b>Example:</b> Switch(config-sg-radius) # <b>end</b>	Returns to privileged EXEC mode.
Step 14	<b>show running-config</b>  <b>Example:</b> Switch# <b>show running-config</b>	Verifies your entries.
Step 15	<b>copy running-config startup-config</b>  <b>Example:</b> Switch# <b>copy running-config startup-config</b>	(Optional) Saves your entries in the configuration file.

## Configuring RADIUS Server Load Balancing

This feature allows access and authentication requests to be evenly across all RADIUS servers in a server group. For more information, see the “RADIUS Server Load Balancing” chapter of the *Cisco IOS Security Configuration Guide, Release 12.4*.

## Monitoring CoA Functionality

*Table 7: Privileged EXEC show Commands*

Command	Purpose
<b>show aaa attributes protocol radius</b>	Displays AAA attributes of RADIUS commands.

*Table 8: Global Troubleshooting Commands*

Command	Purpose
<b>debug radius</b>	Displays information for troubleshooting RADIUS.
<b>debug aaa coa</b>	Displays information for troubleshooting CoA processing.

Command	Purpose
<code>debug aaa pod</code>	Displays information for troubleshooting POD packets.
<code>debug aaa subsys</code>	Displays information for troubleshooting POD packets.
<code>debug cmdhd [detail   error   events]</code>	Displays information for troubleshooting command headers.

For detailed information about the fields in these displays, see the command reference for this release.

## Configuration Examples for Controlling Switch Access with RADIUS

### Examples: Identifying the RADIUS Server Host

This example shows how to configure one RADIUS server to be used for authentication and another to be used for accounting:

```
Switch(config)# radius-server host 172.29.36.49 auth-port 1612 key rad1
Switch(config)# radius-server host 172.20.36.50 acct-port 1618 key rad2
```

This example shows how to configure *host1* as the RADIUS server and to use the default ports for both authentication and accounting:

```
Switch(config)# radius-server host host1
```

### Example: Using Two Different RADIUS Group Servers

In this example, the switch is configured to recognize two different RADIUS group servers (*group1* and *group2*). Group1 has two different host entries on the same RADIUS server configured for the same services. The second host entry acts as a fail-over backup to the first entry.

```
Switch(config)# radius-server host 172.20.0.1 auth-port 1000 acct-port 1001
Switch(config)# radius-server host 172.10.0.1 auth-port 1645 acct-port 1646
Switch(config)# aaa new-model
Switch(config)# aaa group server radius group1
Switch(config-sg-radius)# server 172.20.0.1 auth-port 1000 acct-port 1001
Switch(config-sg-radius)# exit
Switch(config)# aaa group server radius group2
Switch(config-sg-radius)# server 172.20.0.1 auth-port 2000 acct-port 2001
Switch(config-sg-radius)# exit
```

## Examples: Configuring the Switch to Use Vendor-Specific RADIUS Attributes

For example, this AV pair activates Cisco's *multiple named ip address pools* feature during IP authorization (during PPP IPCP address assignment):

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

This example shows how to provide a user logging in from a switch with immediate access to privileged EXEC commands:

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

This example shows how to specify an authorized VLAN in the RADIUS server database:

```
cisco-avpair= "tunnel-type (#64)=VLAN (13)"
cisco-avpair= "tunnel-medium-type (#65)=802 media (6)"
cisco-avpair= "tunnel-private-group-id (#81)=vlanid"
```

This example shows how to apply an input ACL in ASCII format to an interface for the duration of this connection:

```
cisco-avpair= "ip:inacl#1=deny ip 10.10.10.10 0.0.255.255 20.20.20.20 255.255.0.0"
cisco-avpair= "ip:inacl#2=deny ip 10.10.10.10 0.0.255.255 any"
cisco-avpair= "mac:inacl#3=deny any any decnet-iv"
```

This example shows how to apply an output ACL in ASCII format to an interface for the duration of this connection:

```
cisco-avpair= "ip:outacl#2=deny ip 10.10.10.10 0.0.255.255 any"
```

## Example: Configuring the Switch for Vendor-Proprietary RADIUS Server Communication

This example shows how to specify a vendor-proprietary RADIUS host and to use a secret key of *rad124* between the switch and the server:

```
Switch(config)# radius-server host 172.20.30.15 nonstandard
Switch(config)# radius-server key rad124
```

## Additional References for Configuring Secure Shell

### Related Documents

Related Topic	Document Title
Configuring Identity Control policies and Identity Service templates for Session Aware networking.	<a href="#">Session Aware Networking Configuration Guide, Cisco IOS XE Release 3SE (Catalyst 3850 Switches)</a>

Related Topic	Document Title
Configuring RADIUS, TACACS+, Secure Shell, 802.1X and AAA.	<a href="#">Securing User Services Configuration Guide Library, Cisco IOS XE Release 3SE (Catalyst 3850 Switches)</a>

### Error Message Decoder

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

### Standards and RFCs

Standard/RFC	Title
None	

### MIBs

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

### Technical Assistance

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

## Feature Information for RADIUS

Release	Feature Information
Cisco IOS XE 3.2SE	This feature was introduced.
Cisco IOS 15.2(1)E	The RADIUS Progress Codes feature adds additional progress codes to RADIUS attribute 196 (Ascend-Connect-Progress), which indicates a connection state before a call is disconnected through progress codes.
Cisco IOS 15.2(1)E	<p>The Enhanced Test Command feature allows a named user profile to be created with calling line ID (CLID) or Dialed Number Identification Service (DNIS) attribute values. The CLID or DNIS attribute values can be associated with the RADIUS record that is sent with the user profile so that the RADIUS server can access CLID or DNIS attribute information for all incoming calls.</p> <p>The following commands were introduced or modified: <b>aaa attribute</b>, <b>aaa user profile</b>, and <b>test aaa group</b></p>

