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Configuring Authentication

Authentication provides a method to identify users, which includes the login and password dialog, challenge and response, messaging support, and encryption, depending on the selected security protocol. Authentication is the way a user is identified prior to being allowed access to the network and network services.

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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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Configuring Authentication

The Cisco IOS XE implementation of authentication is divided into AAA Authentication and non-authentication methods. Cisco recommends that, whenever possible, AAA security services be used to implement authentication.
Restrictions for Configuring Authentication

The number of AAA method lists that can be configured is 250.

Information About Configuring Authentication

The following sections describe how AAA authentication is configured by defining a named list of authentication methods and then applying that list to various interfaces. This section also describes how AAA authentication is handled by using RADIUS Change in Authorization (CoA):

Named Method Lists for Authentication

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

A method list is a sequential list describing the authentication methods to be queried in order to authenticate a user. Method lists enable you to designate one or more security protocols to be used for authentication, thus ensuring a backup system for authentication in case the initial method fails. Cisco IOS XE software uses the first listed method to authenticate users. If that method fails to respond, the Cisco IOS XE software selects the next authentication method listed in the method list. This process continues until there is successful communication with a listed authentication method, or all methods defined in the method list are exhausted.

It is important to note that the Cisco IOS XE software attempts authentication with the next listed authentication method only when there is no response from the previous method. 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.

Note

The number of AAA method lists that can be configured is 250.

Method Lists and Server Groups

A server group is a way to group existing RADIUS or TACACS+ server hosts for use in method lists. The figure below shows a typical AAA network configuration that includes four security servers: R1 and R2 are
RADIUS servers and T1 and T2 are TACACS+ servers. R1 and R2 make up the group of RADIUS servers. T1 and T2 make up the group of TACACS+ servers.

Figure 1: Typical AAA Network Configuration

Using server groups, you can specify a subset of the configured server hosts and use them for a particular service. For example, server groups allow you to define R1 and R2 as a server group, and define T1 and T2 as a separate server group. For example, you can specify R1 and T1 in the method list for authentication login, while specifying R2 and T2 in the method list for PPP authentication.

Server groups also can include multiple host entries for the same server, as long as each entry has a unique identifier. The combination of an IP address and a UDP port number creates a unique identifier, allowing different ports to be individually defined as RADIUS hosts providing a specific AAA service. In other words, this unique identifier enables RADIUS requests to be sent to different 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, authentication—the second host entry configured acts as failover backup to the first one. Using this example, if the first host entry fails to provide accounting services, the network access server will try the second host entry configured on the same device for accounting services. (The RADIUS host entries will be tried in the order in which they are configured.)

For more information about configuring server groups and about configuring server groups based on Dialed Number Identification Service (DNIS) numbers, refer to the "Configuring RADIUS" or "Configuring TACACS+" chapter.

Method List Examples

Suppose the system administrator has decided on a security solution where all interfaces will use the same authentication methods to authenticate PPP connections. In the RADIUS group, R1 is contacted first for authentication information, then if there is no response, R2 is contacted. If R2 does not respond, T1 in the TACACS+ group is contacted; if T1 does not respond, T2 is contacted. If all designated servers fail to respond, authentication falls to the local username database on the access server itself. To implement this solution, the system administrator would create a default method list by entering the following command:

```shell
aaa authentication ppp default group radius group tacacs+ local
```
In this example, "default" is the name of the method list. The protocols included in this method list are listed after the name, in the order they are to be queried. The default list is automatically applied to all interfaces.

When a remote user attempts to dial into the network, the network access server first queries R1 for authentication information. If R1 authenticates the user, it issues a PASS response to the network access server and the user is allowed to access the network. If R1 returns a FAIL response, the user is denied access and the session is terminated. If R1 does not respond, then the network access server processes that as an ERROR and queries R2 for authentication information. This pattern would continue through the remaining designated methods until the user is either authenticated or rejected, or until the session is terminated.

It is important to remember that a FAIL response is significantly different from an ERROR. A FAIL means that the user has not met the criteria contained in the applicable authentication database to be successfully authenticated. Authentication ends with a FAIL response. An ERROR means that the security server has not responded to an authentication query. Because of this, no authentication has been attempted. Only when an ERROR is detected will AAA select the next authentication method defined in the authentication method list.

Suppose the system administrator wants to apply a method list only to a particular interface or set of interfaces. In this case, the system administrator creates a named method list and then applies this named list to the applicable interfaces. The following example shows how the system administrator can implement an authentication method that will be applied only to interface 3:

```
aaa authentication ppp default group radius group tacacs+ local
aaa authentication ppp apple group radius group tacacs+ local none
    interface async 3
    ppp authentication chap apple
```

In this example, "apple" is the name of the method list, and the protocols included in this method list are listed after the name in the order in which they are to be performed. After the method list has been created, it is applied to the appropriate interface. Note that the method list name (apple) in both the AAA and PPP authentication commands must match.

In the following example, the system administrator uses server groups to specify that only R2 and T2 are valid servers for PPP authentication. To do this, the administrator must define specific server groups whose members are R2 (172.16.2.7) and T2 (172.16.2.77), respectively. In this example, the RADIUS server group "rad2only" is defined as follows using the `aaa group server` command:

```
aaa group server radius rad2only
    server 172.16.2.7
```

The TACACS+ server group "tac2only" is defined as follows using the `aaa group server` command:

```
aaa group server tacacs+ tac2only
    server 172.16.2.77
```

The administrator then applies PPP authentication using the server groups. In this example, the default methods list for PPP authentication follows this order: `group rad2only`, `group tac2only`, and `local`:

```
aaa authentication ppp default group rad2only group tac2only local
```

### About RADIUS Change of Authorization

A standard RADIUS interface is typically used in a pulled model, in which the request originates from a device attached to a network and the response is sent from the queried servers. The Cisco software supports the RADIUS CoA request defined in RFC 5176 that is used in a pushed model, in which the request originates from the external server to the device attached to the network, and enables the dynamic reconfiguring of sessions from external authentication, authorization, and accounting (AAA) or policy servers.

Use the following per-session CoA requests:
• Session reauthentication
• Session termination
• Session termination with port shutdown
• Session termination with port bounce
• Security and Password
• Accounting

CoA Requests

CoA requests, as described in RFC 5176, are used in a pushed model to allow for session identification, host reauthentication, and session termination. The model comprises 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 device 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 device for a session termination.

The following table shows the IETF attributes that are supported for the RADIUS Change of Authorization (CoA) feature.

Table 1: Supported IETF Attributes

<table>
<thead>
<tr>
<th>Attribute Number</th>
<th>Attribute Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>State</td>
</tr>
<tr>
<td>31</td>
<td>Calling-Station-ID</td>
</tr>
<tr>
<td>44</td>
<td>Acct-Session-ID</td>
</tr>
<tr>
<td>80</td>
<td>Message-Authenticator</td>
</tr>
<tr>
<td>101</td>
<td>Error-Cause</td>
</tr>
</tbody>
</table>

The following table shows the possible values for the Error-Cause attribute.
Table 2: Error-Cause Values

<table>
<thead>
<tr>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>201</td>
<td>Residual Session Context Removed</td>
</tr>
<tr>
<td>202</td>
<td>Invalid EAP Packet (Ignored)</td>
</tr>
<tr>
<td>401</td>
<td>Unsupported Attribute</td>
</tr>
<tr>
<td>402</td>
<td>Missing Attribute</td>
</tr>
<tr>
<td>403</td>
<td>NAS Identification Mismatch</td>
</tr>
<tr>
<td>404</td>
<td>Invalid Request</td>
</tr>
<tr>
<td>405</td>
<td>Unsupported Service</td>
</tr>
<tr>
<td>406</td>
<td>Unsupported Extension</td>
</tr>
<tr>
<td>407</td>
<td>Invalid Attribute Value</td>
</tr>
<tr>
<td>501</td>
<td>Administratively Prohibited</td>
</tr>
<tr>
<td>502</td>
<td>Request Not Routable (Proxy)</td>
</tr>
<tr>
<td>503</td>
<td>Session Context Not Found</td>
</tr>
<tr>
<td>504</td>
<td>Session Context Not Removable</td>
</tr>
<tr>
<td>505</td>
<td>Other Proxy Processing Error</td>
</tr>
<tr>
<td>506</td>
<td>Resources Unavailable</td>
</tr>
<tr>
<td>507</td>
<td>Request Initiated</td>
</tr>
<tr>
<td>508</td>
<td>Multiple Session Selection Unsupported</td>
</tr>
</tbody>
</table>

**CoA Request Response Code**

The CoA Request Response code can be used to issue a command to the device. The supported commands are listed in the “CoA Request Commands” section.

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 VSAs.
Session Identification

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

- Acct-Session-Id (IETF attribute #44)
- Audit-Session-Id (Cisco vendor-specific attribute (VSA))
- Calling-Station-Id (IETF attribute #31, which contains the host MAC address)

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

Note

A CoA NAK message is not sent for all CoA requests with a key mismatch. The message is sent only for the first three requests for a client. After that, all the packets from that client are dropped. When there is a key mismatch, the response authenticator sent with the CoA NAK message is calculated from a dummy key value.

CoA ACK Response Code

If an authorization state is changed successfully, a positive acknowledgment (ACK) is sent. The attributes returned within a CoA ACK can vary based on the CoA Request.

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.

CoA Request Commands

The commands supported on the device are shown in the table below. All CoA commands must include the session identifier between the device and the CoA client.

Table 3: CoA Request Commands Supported on the Device

<table>
<thead>
<tr>
<th>Command</th>
<th>Cisco VSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bounce host port</td>
<td>Cisco:Avpair=&quot;subscriber:command=bounce-host-port&quot;</td>
</tr>
<tr>
<td>Disable host port</td>
<td>Cisco:Avpair=&quot;subscriber:command=disable-host-port&quot;</td>
</tr>
<tr>
<td>Reauthenticate host</td>
<td>Cisco:Avpair=&quot;subscriber:command=reauthenticate&quot;</td>
</tr>
<tr>
<td>Terminate session</td>
<td>This is a standard disconnect request that does not require a VSA</td>
</tr>
</tbody>
</table>
Session Reauthentication

To initiate session reauthentication, the authentication, authorization, and accounting (AAA) server sends a standard CoA-Request message that contains a Cisco VSA and one or more session identification attributes. The Cisco VSA is in the form of Cisco:Avpair="subscriber:command=reauthenticate".

The current session state determines the device’s response to the message in the following scenarios:

- If the session is currently authenticated by IEEE 802.1x, the device responds by sending an Extensible Authentication Protocol over LAN (EAPoL)-RequestId message to the server.
- If the session is currently authenticated by MAC authentication bypass (MAB), the device 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 device receives the command, the device terminates the process and restarts the authentication sequence, starting with the method configured to be attempted first.

Session Termination

A CoA Disconnect-Request terminates the session without disabling the host port. CoA Disconnect-Request termination causes reinitialization of the authenticator state machine for the specified host, but does not restrict the host’s access to the network. If the session cannot be located, the device returns a Disconnect-NAK message with the "Session Context Not Found" error-code attribute. If the session is located, the device terminates the session. After the session has been completely removed, the device returns a Disconnect-ACK message.

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 cause problems on the network and network access needs to be immediately blocked for the host. If you want to restore network access on the port, reenable it using a non-RADIUS mechanism.

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. If you want 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 the following 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 device cannot locate the session, it returns a CoA-NAK message with the “Session Context Not Found” error-code attribute. If the device locates the session, it disables the hosting port and returns a CoA-ACK message.

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

To ignore the RADIUS server CoA disable port command, see the “Configuring the Device to Ignore Bounce and Disable RADIUS CoA Requests” section.
**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 described in the Session Identification. If the session cannot be located, the device returns a CoA-NAK message with the "Session Context Not Found" error-code attribute. If the session is located, the device disables the hosting port for a period of 10 seconds, reenables it (port-bounce), and returns a CoA-ACK.

To ignore the RADIUS server CoA bounce port, see the “Configuring the Device to Ignore Bounce and Disable RADIUS CoA Requests” section.

**Domain Stripping**

You can remove the domain name from the username received at the global level by using the `radius-server domain-stripping` command. When the `radius-server domain-stripping` command is configured, all the AAA requests with "user@example.com" go to the remote RADIUS server with the reformatted username "user." The domain name is removed from the request.

- **Note** Domain stripping will not be done in a TACACS configuration.

The AAA Broadcast Accounting feature allows accounting information to be sent to multiple AAA servers at the same time, that is, accounting information can be broadcast to one or more AAA servers simultaneously. This functionality allows you to send accounting information to private and public AAA servers. It also provides redundant billing information for voice applications.

The Domain Stripping feature allows domain stripping to be configured at the server group level.

Per-server group configuration overrides the global configuration. If domain stripping is not enabled globally, but it is enabled in a server group, then it is enabled only for that server group. Also, if virtual routing and forwarding (VRF)-specific domain stripping is configured globally and in a server group for a different VRF, domain stripping is enabled in both the VRFs. VRF configurations are taken from server-group configuration mode. If server-group configurations are disabled in global configuration mode but are available in server-group configuration mode, all configurations in server-group configuration mode are applicable.

After the domain stripping and broadcast accounting are configured, you can create separate accounting records as per the configurations.

**How to Configure AAA Authentication Methods**

- **Note** AAA features are not available until you enable AAA globally using the `aaa new-model` command.
For authentication configuration examples using the commands in this chapter, refer to the Authentication Examples.

### Configuring Login Authentication Using AAA

The AAA security services facilitate a variety of login authentication methods. Use the `aaa authentication login` command to enable AAA authentication no matter which of the supported login authentication methods you decide to use. With the `aaa authentication login` command, you create one or more lists of authentication methods that are tried at login. These lists are applied using the `login authentication` line configuration command.

To configure login authentication by using AAA, use the following commands beginning in global configuration mode:

#### SUMMARY STEPS

1. `Router(config)# aaa new-model`
2. `Router(config)# aaa authentication login {default | list-name} method1 [method2 ...]`
3. `Router(config)# line [aux | console | tty | vty] line-number [ending-line-number]`
4. `Router(config-line)# login authentication`

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Router(config)# aaa new-model</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Router(config)# aaa authentication login {default</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Router(config)# line [aux</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Router(config-line)# login authentication</td>
</tr>
<tr>
<td>Example:</td>
<td>`{default</td>
</tr>
</tbody>
</table>

#### What to Do Next

The `list-name` is a character string used to name the list you are creating. The method argument refers to 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. To specify that the authentication should succeed even if all methods return an error, specify `none` as the final method in the command line.
For example, to specify that authentication should succeed even if (in this example) the TACACS+ server returns an error, enter the following command:

```
aaa authentication login default group tacacs+ none
```

**Note** Because the `none` keyword enables any user logging in to successfully authenticate, it should be used only as a backup method of authentication.

To create a default list that is used when a named list is not specified in the `login authentication` command, use the `default` keyword followed by the methods that are to be used in default situations. The default method list is automatically applied to all interfaces.

For example, to specify RADIUS as the default method for user authentication during login, enter the following command:

```
aaa authentication login default group radius
```

The table below lists the supported login authentication methods.

**Table 4: AAA Authentication Login Methods**

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>enable</td>
<td>Uses the enable password for authentication.</td>
</tr>
<tr>
<td>krb5</td>
<td>Uses Kerberos 5 for authentication.</td>
</tr>
<tr>
<td>krb5-telnet</td>
<td>Uses Kerberos 5 Telnet authentication protocol when using Telnet to connect to the router. If selected, this keyword must be listed as the first method in the method list.</td>
</tr>
<tr>
<td>line</td>
<td>Uses the line password for authentication.</td>
</tr>
<tr>
<td>local</td>
<td>Uses the local username database for authentication.</td>
</tr>
<tr>
<td>local-case</td>
<td>Uses case-sensitive local username authentication.</td>
</tr>
<tr>
<td>none</td>
<td>Uses no authentication.</td>
</tr>
<tr>
<td>group radius</td>
<td>Uses the list of all RADIUS servers for authentication.</td>
</tr>
<tr>
<td>group tacacs+</td>
<td>Uses the list of all TACACS+ servers for authentication.</td>
</tr>
<tr>
<td>group group-name</td>
<td>Uses a subset of RADIUS or TACACS+ servers for authentication as defined by the <code>aaa group server radius</code> or <code>aaa group server tacacs+</code> command.</td>
</tr>
</tbody>
</table>
The `login` command only changes username and privilege level but does not execute a shell; therefore autocommands will not be executed. To execute autocommands under this circumstance, you need to establish a Telnet session back into the router (loop-back). Make sure that the router has been configured for secure Telnet sessions if you choose to implement autocommands this way.

---

**Login Authentication Using Enable Password**

Use the `aaa authentication login` command with the `enable` method keyword to specify the enable password as the login authentication method. For example, to specify the enable password as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication login default enable
```

Before you can use the enable password as the login authentication method, you need to define the enable password. For more information about defining enable passwords, refer to the chapter "Configuring Passwords and Privileges."

**Login Authentication Using Kerberos**

Authentication via Kerberos is different from most other authentication methods: the user’s password is never sent to the remote access server. Remote users logging in to the network are prompted for a username. If the key distribution center (KDC) has an entry for that user, it creates an encrypted ticket granting ticket (TGT) with the password for that user and sends it back to the router. The user is then prompted for a password, and the router attempts to decrypt the TGT with that password. If it succeeds, the user is authenticated and the TGT is stored in the user’s credential cache on the router.

While krb5 does use the KINIT program, a user does not need to run the KINIT program to get a TGT to authenticate to the router. This is because KINIT has been integrated into the login procedure in the Cisco IOS XE implementation of Kerberos.

Use the `aaa authentication login` command with the `krb5` method keyword to specify Kerberos as the login authentication method. For example, to specify Kerberos as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication login default krb5
```

Before you can use Kerberos as the login authentication method, you need to enable communication with the Kerberos security server. For more information about establishing communication with a Kerberos server, refer to the chapter "Configuring Kerberos."

**Login Authentication Using Line Password**

Use the `aaa authentication login` command with the `line` method keyword to specify the line password as the login authentication method. For example, to specify the line password as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication login default line
```

Before you can use a line password as the login authentication method, you need to define a line password. For more information about defining line passwords, refer to the Configuring Line Password Protection.
Login Authentication Using Local Password

Use the `aaa authentication login` command with the `local` method keyword to specify that the Cisco router or access server will use the local username database for authentication. For example, to specify the local username database as the method of user authentication at login when no other method list has been defined, enter the following command:

```sh
aaa authentication login default local
```

For information about adding users into the local username database, refer to the Establishing Username Authentication.

Login Authentication Using Group RADIUS

Use the `aaa authentication login` command with the `group radius` method to specify RADIUS as the login authentication method. For example, to specify RADIUS as the method of user authentication at login when no other method list has been defined, enter the following command:

```sh
aaa authentication login default group radius
```

Before you can use RADIUS as the login authentication method, you need to enable communication with the RADIUS security server. For more information about establishing communication with a RADIUS server, refer to the chapter “Configuring RADIUS.”

Configuring RADIUS Attribute 8 in Access Requests

After you have used the `aaa authentication login` command to specify RADIUS and your login host has been configured to request its IP address from the NAS, you can send attribute 8 (Framed-IP-Address) in access-request packets by using the `radius-server attribute 8 include-in-access-req` command in global configuration mode. This command makes it possible for NAS to provide the RADIUS server a hint of the user IP address in advance for user authentication. For more information about attribute 8, refer to the appendix “RADIUS Attributes” at the end of the book.

Login Authentication Using Group TACACS

Use the `aaa authentication login` command with the `group tacacs+` method to specify TACACS+ as the login authentication method. For example, to specify TACACS+ as the method of user authentication at login when no other method list has been defined, enter the following command:

```sh
aaa authentication login default group tacacs+
```

Before you can use TACACS+ as the login authentication method, you need to enable communication with the TACACS+ security server. For more information about establishing communication with a TACACS+ server, refer to the chapter “Configuring TACACS+.”

Login Authentication Using group group-name

Use the `aaa authentication login` command with the `group group-name` method to specify a subset of RADIUS or TACACS+ servers to use as the login authentication method. To specify and define the group name and
Configuring Authentication

Configuring PPP Authentication Using AAA

Many users access network access servers through dialup via async or ISDN. Dialup via async or ISDN bypasses the CLI completely; instead, a network protocol (such as PPP or ARA) starts as soon as the connection is established.

The AAA security services facilitate a variety of authentication methods for use on serial interfaces running PPP. Use the `aaa authentication ppp` command to enable AAA authentication no matter which of the supported PPP authentication methods you decide to use.

To configure AAA authentication methods for serial lines using PPP, use the following commands in global configuration mode:

**SUMMARY STEPS**

1. Router(config)# aaa new-model
2. Router(config)# aaa authentication ppp {default | list-name} method1[method2...]
3. Router(config)# interface interface-type interface-number
4. Router(config-if)# ppp authentication {protocol1 [protocol2...]} [if-needed] {default | list-name} [callin] [one-time][optional]

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Router(config)# aaa new-model</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Router(config)# aaa authentication ppp {default</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Router(config)# interface interface-type interface-number</td>
</tr>
</tbody>
</table>
What to Do Next

With the `aaa authentication ppp` command, you create one or more lists of authentication methods that are tried when a user tries to authenticate via PPP. These lists are applied using the `ppp authentication` line configuration command.

To create a default list that is used when a named list is not specified in the `ppp authentication` command, use the `default` keyword followed by the methods you want used in default situations.

For example, to specify the local username database as the default method for user authentication, enter the following command:

```
aaa authentication ppp default local
```

The `list-name` is any character string used to name the list you are creating. The method argument refers to 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. To specify that the authentication should succeed even if all methods return an error, specify `none` as the final method in the command line.

For example, to specify that authentication should succeed even if (in this example) the TACACS+ server returns an error, enter the following command:

```
aaa authentication ppp default group tacacs+ none
```

Because `none` allows all users logging in to authenticate successfully, it should be used as a backup method of authentication.

The table below lists the supported login authentication methods.

**Table 5: AAA Authentication PPP Methods**

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>if-needed</td>
<td>Does not authenticate if user has already been authenticated on a TTY line.</td>
</tr>
<tr>
<td>krb5</td>
<td>Uses Kerberos 5 for authentication (can only be used for PAP authentication).</td>
</tr>
<tr>
<td>local</td>
<td>Uses the local username database for authentication.</td>
</tr>
</tbody>
</table>
### PPP Authentication Using Kerberos

Use the `aaa authentication ppp` command with the `krb5` method keyword to specify Kerberos as the authentication method for use on interfaces running PPP. For example, to specify Kerberos as the method of user authentication when no other method list has been defined, enter the following command:

```
aaa authentication ppp default krb5
```

Before you can use Kerberos as the PPP authentication method, you need to enable communication with the Kerberos security server. For more information about establishing communication with a Kerberos server, refer to the chapter “Configuring Kerberos”.

**Note** Kerberos login authentication works only with PPP PAP authentication.

### PPP Authentication Using Local Password

Use the `aaa authentication ppp` command with the `method` keyword `local` to specify that the Cisco router or access server will use the local username database for authentication. For example, to specify the local username database as the method of authentication for use on lines running PPP when no other method list has been defined, enter the following command:

```
aaa authentication ppp default local
```

For information about adding users into the local username database, refer to the Establishing Username Authentication.

### PPP Authentication Using Group RADIUS

Use the `aaa authentication ppp` command with the `group radius` method to specify RADIUS as the login authentication method. For example, to specify RADIUS as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication ppp default group radius
```
Before you can use RADIUS as the PPP authentication method, you need to enable communication with the RADIUS security server. For more information about establishing communication with a RADIUS server, refer to the chapter “Configuring RADIUS.”

**Configuring RADIUS Attribute 44 in Access Requests**

After you have used the `aaa authentication ppp` command with the `group radius` method to specify RADIUS as the login authentication method, you can configure your device to send attribute 44 (Acct-Session-ID) in access-request packets by using the `radius-server attribute 44 include-in-access-req` command in global configuration mode. This command allows the RADIUS daemon to track a call from the beginning to the end.

**PPP Authentication Using Group TACACS**

Use the `aaa authentication ppp` command with the `group tacacs+` method to specify TACACS+ as the login authentication method. For example, to specify TACACS+ as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication ppp default group tacacs+
```

Before you can use TACACS+ as the PPP authentication method, you need to enable communication with the TACACS+ security server. For more information about establishing communication with a TACACS+ server, refer to the chapter “Configuring TACACS+.”

**PPP Authentication Using group group-name**

Use the `aaa authentication ppp` command with the `group group-name` method to specify a subset of RADIUS or TACACS+ servers to use as the login authentication method. To specify and define the group name and the members of the group, use the `aaa group server` command. For example, use the `aaa group server` command to first define the members of `group pprrad`:

```
aaa group server radius pprrad
   server 172.16.2.3
   server 172.16.2 17
   server 172.16.2.32
```

This command specifies RADIUS servers 172.16.2.3, 172.16.2.17, and 172.16.2.32 as members of the group `pprrad`.

To specify `group pprrad` as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication ppp default group pprrad
```

Before you can use a group name as the PPP authentication method, you need to enable communication with the RADIUS or TACACS+ security server. For more information about establishing communication with a RADIUS server, refer to the chapter “Configuring RADIUS”. For more information about establishing communication with a TACACS+ server, refer to the chapter "Configuring TACACS+.”

**Configuring AAA Scalability for PPP Requests**

You can configure and monitor the number of background processes allocated by the PPP manager in the network access server (NAS) to deal with AAA authentication and authorization requests. The AAA Scalability
feature enables you to configure the number of processes used to handle AAA requests for PPP, thus increasing the number of users that can be simultaneously authenticated or authorized.

To allocate a specific number of background processes to handle AAA requests for PPP, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config)# aaa processes number</code></td>
<td>Allocates a specific number of background processes to handle AAA authentication and authorization requests for PPP.</td>
</tr>
</tbody>
</table>

The argument `number` defines the number of background processes earmarked to process AAA authentication and authorization requests for PPP and can be configured for any value from 1 to 2147483647. Because of the way the PPP manager handles requests for PPP, this argument also defines the number of new users that can be simultaneously authenticated. This argument can be increased or decreased at any time.

Allocating additional background processes can be expensive. You should configure the minimum number of background processes capable of handling the AAA requests for PPP.

---

**Configuring ARAP Authentication Using AAA**

Using the `aaa authentication arap` command, you can create one or more lists of authentication methods that are tried when AppleTalk Remote Access Protocol (ARAP) users attempt to log in to the device. These lists are used with the `arap authentication` line configuration command.

Use the following commands starting in global configuration mode:

**SUMMARY STEPS**

1. `Device(config)# aaa new-model`
2. `Device(config)# aaa authentication arap`
3. `Device(config)# line number`
4. `Device(config-line)# autoselect arap`
5. `Device(config-line)# autoselect during-login`
6. `Device(config-line)# arap authentication list-name`
7. `Device(config-line)# end`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 <code>Device(config)# aaa new-model</code></td>
<td>Enables AAA globally.</td>
</tr>
<tr>
<td>Step 2 <code>Device(config)# aaa authentication arap</code></td>
<td></td>
</tr>
</tbody>
</table>
### Purpose

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>Enables authentication for ARAP users.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Device(config)# line number</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Device(config-line)# autoselect arap</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Device(config-line)# autoselect during-login</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>Device(config-line)# arap authentication list-name</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>Device(config-line)# end</td>
</tr>
</tbody>
</table>

### What to Do Next

The *list-name* is any character string used to name the list you are creating. The *method* argument refers to the actual list of methods the authentication algorithm tries, in the sequence entered.

To create a default list that is used when a named list is not specified in the `arap authentication` command, use the `default` keyword followed by the methods you want to use in default situations.

The additional methods of authentication are used only if the previous method returns an error, not if it fails. To specify that the authentication should succeed even if all methods return an error, specify `none` as the final method in the command line.

#### Note

Because `none` allows all users logging in to be authenticated, it should be used as a backup method of authentication.

The following table lists the supported login authentication methods.

**Table 6: AAA Authentication ARAP Methods**

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>auth-guest</td>
<td>Allows guest logins only if the user has already logged in to EXEC mode.</td>
</tr>
<tr>
<td>guest</td>
<td>Allows guest logins.</td>
</tr>
<tr>
<td>line</td>
<td>Uses the line password for authentication.</td>
</tr>
<tr>
<td>local</td>
<td>Uses the local username database for authentication.</td>
</tr>
<tr>
<td>Keyword</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>local-case</td>
<td>Uses case-sensitive local username authentication.</td>
</tr>
<tr>
<td>group radius</td>
<td>Uses the list of all RADIUS servers for authentication.</td>
</tr>
<tr>
<td>group tacacs+</td>
<td>Uses the list of all TACACS+ servers for authentication.</td>
</tr>
<tr>
<td>group group-name</td>
<td>Uses a subset of RADIUS or TACACS+ servers for authentication as defined by the aaa group server radius or aaa group server tacacs+ command.</td>
</tr>
</tbody>
</table>

For example, to create a default AAA authentication method list used with ARAP, use the following command:

```
aaa authentication arap default if-needed none
```

To create the same authentication method list for ARAP and name the list *MIS-access*, use the following command:

```
aaa authentication arap MIS-access if-needed none
```

This section includes the following sections:

**ARAP Authentication Allowing Authorized Guest Logins**

Use the `aaa authentication arap` command with the `auth-guest` keyword to allow guest logins only if the user has already successfully logged in to the EXEC. This method must be the first listed in the ARAP authentication method list but it can be followed by other methods if it does not succeed. For example, to allow all authorized guest logins—meaning logins by users who have already successfully logged in to the EXEC—as the default method of authentication, using RADIUS only if that method fails, enter the following command:

```
aaa authentication arap default auth-guest group radius
```

**Note**

By default, guest logins through ARAP are disabled when you initialize AAA. To allow guest logins, you must use the `aaa authentication arap` command with either the `guest` or the `auth-guest` keyword.

**ARAP Authentication Allowing Guest Logins**

Use the `aaa authentication arap` command with the `guest` keyword to allow guest logins. This method must be the first listed in the ARAP authentication method list but it can be followed by other methods if it does not succeed. For example, to allow all guest logins as the default method of authentication, using RADIUS only if that method fails, enter the following command:

```
aaa authentication arap default guest group radius
```
ARAP Authentication Using Line Password

Use the `aaa authentication arap` command with the `method` keyword `line` to specify the line password as the authentication method. For example, to specify the line password as the method of ARAP user authentication when no other method list has been defined, enter the following command:

```
aaa authentication arap default line
```

Before you can use a line password as the ARAP authentication method, you need to define a line password. For more information about defining line passwords, refer to the section Configuring Line Password Protection in this chapter.

ARAP Authentication Using Local Password

Use the `aaa authentication arap` command with the `method` keyword `local` to specify that the Cisco router or access server will use the local username database for authentication. For example, to specify the local username database as the method of ARAP user authentication when no other method list has been defined, enter the following command:

```
aaa authentication arap default local
```

For information about adding users to the local username database, refer to the Establishing Username Authentication.

ARAP Authentication Using Group RADIUS

Use the `aaa authentication arap` command with the `group radius` method to specify RADIUS as the ARAP authentication method. For example, to specify RADIUS as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication arap default group radius
```

Before you can use RADIUS as the ARAP authentication method, you need to enable communication with the RADIUS security server. For more information about establishing communication with a RADIUS server, refer to the chapter "Configuring RADIUS."

ARAP Authentication Using Group TACACS

Use the `aaa authentication arap` command with the `group tacacs+` method to specify TACACS+ as the ARAP authentication method. For example, to specify TACACS+ as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication arap default group tacacs+
```

Before you can use TACACS+ as the ARAP authentication method, you need to enable communication with the TACACS+ security server. For more information about establishing communication with a TACACS+ server, refer to the chapter "Configuring TACACS+.”

ARAP Authentication Using Group group-name

Use the `aaa authentication arap` command with the `group group-name` method to specify a subset of RADIUS or TACACS+ servers to use as the ARAP authentication method. To specify and define the group name and
the members of the group, use the `aaa group server` command. For example, use the `aaa group server` command to first define the members of group `araprad`:

```
aaa group server radius araprad
  server 172.16.2.3
  server 172.16.2.17
  server 172.16.2.32
```

This command specifies RADIUS servers 172.16.2.3, 172.16.2.17, and 172.16.2.32 as members of the group `araprad`.

To specify `group araprad` as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication arap default group araprad
```

Before you can use a group name as the ARAP authentication method, you need to enable communication with the RADIUS or TACACS+ security server. For more information about establishing communication with a RADIUS server, refer to the chapter “Configuring RADIUS.” For more information about establishing communication with a TACACS+ server, refer to the chapter “Configuring TACACS+.”

### Configuring NASI Authentication Using AAA

Using the `aaa authentication nasi` command, you can create one or more lists of authentication methods that are tried when NetWare Asynchronous Services Interface (NASI) users attempt to log in to the device. These lists are used with the `nasi authentication line` configuration command.

To configure NASI authentication using AAA, use the following commands starting in global configuration mode:

**SUMMARY STEPS**

1. Device(config)# `aaa new-model`
2. Device(config)# `aaa authentication nasi`
3. Device(config)# `line number`
4. Device(config-line)# `nasi authentication list-name`
5. Device(config-line)# `end`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Device(config)# <code>aaa new-model</code> Enables AAA globally.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Device(config)# <code>aaa authentication nasi</code> Enables authentication for NASI users. Example: Device(config)# <code>aaa authentication nasi</code></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Device(config)# <code>line number</code> (Optional--not needed if <code>default</code> is used in the <code>aaa authentication nasi</code> command) Enters line configuration mode.</td>
</tr>
</tbody>
</table>
### Purpose

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 4</td>
<td>Device(config-line)# <code>nasi authentication list-name</code></td>
</tr>
<tr>
<td>Step 5</td>
<td>Device(config-line)# <code>end</code></td>
</tr>
</tbody>
</table>

### What to Do Next

The `list-name` is any character string used to name the list you are creating. The `method` argument refers to the actual list of methods that the authentication algorithm tries, in the sequence entered.

To create a default list that is used when a named list is not specified in the `aaa authentication nasi` command, use the `default` keyword followed by the methods you want to use in default situations.

The additional methods of authentication are used only if the previous method returns an error, not if it fails. To specify that the authentication should succeed even if all methods return an error, specify `none` as the final method in the command line.

**Note**

Because `none` allows all users logging in to be authenticated, it should be used as a backup method of authentication.

The table below lists the supported NASI authentication methods.

**Table 7: AAA Authentication NASI Methods**

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>enable</code></td>
<td>Uses the enable password for authentication.</td>
</tr>
<tr>
<td><code>line</code></td>
<td>Uses the line password for authentication.</td>
</tr>
<tr>
<td><code>local</code></td>
<td>Uses the local username database for authentication.</td>
</tr>
<tr>
<td><code>local-case</code></td>
<td>Uses case-sensitive local username authentication.</td>
</tr>
<tr>
<td><code>none</code></td>
<td>Uses no authentication.</td>
</tr>
<tr>
<td><code>group radius</code></td>
<td>Uses the list of all RADIUS servers for authentication.</td>
</tr>
<tr>
<td><code>group tacacs+</code></td>
<td>Uses the list of all TACACS+ servers for authentication.</td>
</tr>
<tr>
<td><code>group group-name</code></td>
<td>Uses a subset of RADIUS or TACACS+ servers for authentication as defined by the <code>aaa group server radius</code> or <code>aaa group server tacacs+</code> command.</td>
</tr>
</tbody>
</table>
NASI Authentication Using Enable Password

Use the `aaa authentication nasi` command with the keyword `enable` to specify the enable password as the authentication method. For example, to specify the enable password as the method of NASI user authentication when no other method list has been defined, use the following command:

```
aaa authentication nasi default enable
```

Before you can use the enable password as the authentication method, you need to define the enable password. For more information about defining enable passwords, refer to the chapter “Configuring Passwords and Privileges.”

NASI Authentication Using Line Password

Use the `aaa authentication nasi` command with the `method` keyword `line` to specify the line password as the authentication method. For example, to specify the line password as the method of NASI user authentication when no other method list has been defined, enter the following command:

```
aaa authentication nasi default line
```

Before you can use a line password as the NASI authentication method, you need to define a line password. For more information about defining line passwords, refer to the Configuring Line Password Protection.

NASI Authentication Using Local Password

Use the `aaa authentication nasi` command with the `method` keyword `local` to specify that the Cisco router or access server will use the local username database for authentication information. For example, to specify the local username database as the method of NASI user authentication when no other method list has been defined, enter the following command:

```
aaa authentication nasi default local
```

For information about adding users to the local username database, refer to the Establishing Username Authentication.

NASI Authentication Using Group RADIUS

Use the `aaa authentication nasi` command with the `group radius` method to specify RADIUS as the NASI authentication method. For example, to specify RADIUS as the method of NASI user authentication when no other method list has been defined, enter the following command:

```
aaa authentication nasi default group radius
```

Before you can use RADIUS as the NASI authentication method, you need to enable communication with the RADIUS security server. For more information about establishing communication with a RADIUS server, refer to the chapter “Configuring RADIUS.”
NASI Authentication Using Group TACACS

Use the `aaa authentication nasi` command with the `group tacacs+` method keyword to specify TACACS+ as the NASI authentication method. For example, to specify TACACS+ as the method of NASI user authentication when no other method list has been defined, enter the following command:

```
aaa authentication nasi default group tacacs+
```

Before you can use TACACS+ as the authentication method, you need to enable communication with the TACACS+ security server. For more information about establishing communication with a TACACS+ server, refer to the chapter “Configuring TACACS+.”

NASI Authentication Using group group-name

Use the `aaa authentication nasi` command with the `group group-name` method to specify a subset of RADIUS or TACACS+ servers to use as the NASI authentication method. To specify and define the group name and the members of the group, use the `aaa group server` command. For example, use the `aaa group server` command to first define the members of `group nasirad`:

```
aaa group server radius nasirad
  server 172.16.2.3
  server 172.16.2.17
  server 172.16.2.32
```

This command specifies RADIUS servers 172.16.2.3, 172.16.2.17, and 172.16.2.32 as members of the group `nasirad`.

To specify `group nasirad` as the method of user authentication at login when no other method list has been defined, enter the following command:

```
aaa authentication nasi default group nasirad
```

Before you can use a group name as the NASI authentication method, you need to enable communication with the RADIUS or TACACS+ security server. For more information about establishing communication with a RADIUS server, refer to the chapter “Configuring RADIUS”. For more information about establishing communication with a TACACS+ server, refer to the chapter “Configuring TACACS+.”

Specifying the Amount of Time for Login Input

The `timeout login response` command allows you to specify how long the system will wait for login input (such as username and password) before timing out. The default login value is 30 seconds; with the `timeout login response` command, you can specify a timeout value from 1 to 300 seconds. To change the login timeout value from the default of 30 seconds, use the following command in line configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config-line)# timeout login response seconds</code></td>
<td>Specifies how long the system will wait for login information before timing out.</td>
</tr>
</tbody>
</table>
Enabling Password Protection at the Privileged Level

Use the `aaa authentication enable default` command to create a series of authentication methods that are used to determine whether a user can access the privileged EXEC command level. You can specify up to four authentication methods. The additional methods of authentication are used only if the previous method returns an error, not if it fails. To specify that the authentication should succeed even if all methods return an error, specify `none` as the final method in the command line.

Use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>aaa authentication enable default method1 [method2...]</code></td>
<td>Enables user ID and password checking for users requesting privileged EXEC level.</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong> All <code>aaa authentication enable default</code> requests sent by the router to a RADIUS server include the username “Senab15$.” Requests sent to a TACACS+ server will include the username that is entered for login authentication.</td>
</tr>
</tbody>
</table>

The method argument refers to the actual list of methods the authentication algorithm tries, in the sequence entered. The table below lists the supported enable authentication methods.

**Table 8: AAA Authentication Enable Default Methods**

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>enable</td>
<td>Uses the enable password for authentication.</td>
</tr>
<tr>
<td>line</td>
<td>Uses the line password for authentication.</td>
</tr>
<tr>
<td>none</td>
<td>Uses no authentication.</td>
</tr>
<tr>
<td>group radius</td>
<td>Uses the list of all RADIUS hosts for authentication.</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong> The RADIUS method does not work on a per-username basis.</td>
</tr>
<tr>
<td>group tacacs+</td>
<td>Uses the list of all TACACS+ hosts for authentication.</td>
</tr>
<tr>
<td>group group-name</td>
<td>Uses a subset of RADIUS or TACACS+ servers for authentication as defined by the <code>aaa group server radius</code> or <code>aaa group server tacacs+</code> command.</td>
</tr>
</tbody>
</table>
Changing the Text Displayed at the Password Prompt

Use the `aaa authentication password-prompt` command to change the default text that the Cisco IOS XE software displays when prompting a user to enter a password. This command changes the password prompt for the enable password as well as for login passwords that are not supplied by remote security servers. The `no` form of this command returns the password prompt to the following default value:

```
Password:
```

The `aaa authentication password-prompt` command does not change any dialog that is supplied by a remote TACACS+ or RADIUS server.

The `aaa authentication password-prompt` command works when RADIUS is used as the login method. You will be able to see the password prompt defined in the command shown even when the RADIUS server is unreachable. The `aaa authentication password-prompt` command does not work with TACACS+. TACACS+ supplies the NAS with the password prompt to display to the users. If the TACACS+ server is reachable, the NAS gets the password prompt from the server and uses that prompt instead of the one defined in the `aaa authentication password-prompt` command. If the TACACS+ server is not reachable, the password prompt defined in the `aaa authentication password-prompt` command may be used.

Use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>aaa authentication password-prompt text-string</code></td>
<td>Changes the default text displayed when a user is prompted to enter a password.</td>
</tr>
</tbody>
</table>

Preventing an Access Request with a Blank Username from Being Sent to the RADIUS Server

The following configuration steps provide the ability to prevent an Access Request with a blank username from being sent to the RADIUS server. This functionality ensures that unnecessary RADIUS server interaction is avoided, and RADIUS logs are kept short.

Note

The `aaa authentication suppress null-username` command is available beginning in Cisco IOS XE Release 2.4.

SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `aaa new-model`
4. `aaa authentication suppress null-username`
### Detailed Steps

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>enable</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>configure terminal</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>aaa new-model</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Enables AAA globally.</td>
</tr>
<tr>
<td>Router(config)# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>aaa authentication suppress null-username</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Prevents an Access Request with a blank username from being sent to the RADIUS server.</td>
</tr>
<tr>
<td>Router(config)# aaa authentication suppress null-username</td>
<td></td>
</tr>
</tbody>
</table>

### Configuring Message Banners for AAA Authentication

AAA supports the use of configurable, personalized login and failed-login banners. You can configure message banners that will be displayed when a user logs in to the system to be authenticated using AAA and when, for whatever reason, authentication fails.

#### Configuring a Login Banner

To configure a banner that is displayed when a user logs in (replacing the default message for login), perform the following task:

**Before You Begin**

To create a login banner, you must configure a delimiting character that notifies the system that the following text string must be displayed as the banner, and then the text string itself. The delimiting character is repeated at the end of the text string to signify the end of the banner. The delimiting character can be any single character in the extended ASCII character set, but once defined as the delimiter, that character cannot be used in the text string for the banner.
SUMMARY STEPS

1. `aaa new-model` Device(config)# `aaa new-model`
2. `Device(config)# aaa authentication banner delimiter string delimiter`
3. `Device(config)# end`

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables AAA.</td>
</tr>
<tr>
<td><code>aaa new-model</code></td>
<td>Device(config)# <code>aaa new-model</code></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Creates a personalized login banner.</td>
</tr>
<tr>
<td><code>Device(config)# aaa authentication banner delimiter string delimiter</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><code>Device(config)# end</code></td>
<td></td>
</tr>
</tbody>
</table>

**What to Do Next**

After you have configured a login banner, you must complete basic authentication configuration using AAA if you have not already done so. For information about the different types of AAA authentication available, please refer to "Configuring Authentication" in the Authentication, Authorization, and Accounting Configuration Guide.

**Configuring a Failed-Login Banner**

To configure a message that is displayed when a user login fails (replacing the default message for failed login), perform the following task:

**Before You Begin**

To create a failed-login banner, you must configure a delimiting character, which notifies the system that the following text string must be displayed as the banner, and then configure the text string itself. The delimiting character is repeated at the end of the text string to signify the end of the failed-login banner. The delimiting character can be any single character in the extended ASCII character set, but once defined as the delimiter, that character cannot be used in the text string making up the banner.

SUMMARY STEPS

1. `Device(config)# aaa new-model`
2. `Device(config)# aaa authentication fail-message delimiter string delimiter`
3. `Device(config)# end`
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Device(config)# aaa new-model</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Device(config)# aaa authentication fail-message delimiter string delimiter</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Device(config)# end</td>
</tr>
</tbody>
</table>

### What to Do Next

After you have configured a failed-login banner, you must complete basic authentication configuration using AAA if you have not already done so. For information about the different types of AAA authentication available, please refer to “Configuring Authentication” in the *Authentication, Authorization, and Accounting Configuration Guide*.

### Configuring AAA Packet of Disconnect

Packet of disconnect (POD) terminates connections on the network access server (NAS) when particular session attributes are identified. By using session information obtained from AAA, the POD client residing on a UNIX workstation sends disconnect packets to the POD server running on the network access server. The NAS terminates any inbound user session with one or more matching key attributes. It rejects requests when required fields are missing or when an exact match is not found.

To configure POD, perform the following tasks in global configuration mode:

### SUMMARY STEPS

1. Router(config)# aaa accounting network default
2. Router(config)# aaa accounting delay-start
3. Router(config)# aaa pod server server-keystring
4. Router(config)# radius-server host IP address non-standard

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Router(config)# aaa accounting network default</td>
</tr>
<tr>
<td>Example:</td>
<td>start-stop radius</td>
</tr>
</tbody>
</table>
### Enabling Double Authentication

Depending on the Cisco release, PPP sessions could be authenticated only by using a single authentication method: either PAP or CHAP. Double authentication requires remote users to pass a second stage of authentication (after CHAP or PAP authentication) before gaining network access.

This second ("double") authentication requires a password that is known to the user but not stored on the user’s remote host. Therefore, the second authentication is specific to a user, not to a host. This provides an additional level of security that will be effective even if information from the remote host is stolen. In addition, this also provides greater flexibility by allowing customized network privileges for each user.

The second stage authentication can use one-time passwords such as token card passwords, which are not supported by CHAP. If one-time passwords are used, a stolen user password is of no use to the perpetrator.

### How Double Authentication Works

With double authentication, there are two authentication/authorization stages. These two stages occur after a remote user dials in and a PPP session is initiated.

In the first stage, the user logs in using the remote host name; CHAP (or PAP) authenticates the remote host, and then PPP negotiates with AAA to authorize the remote host. In this process, the network access privileges associated with the remote host are assigned to the user.

---

**Note**

We suggest that the network administrator restrict authorization at this first stage to allow only Telnet connections to the local host.

In the second stage, the remote user must Telnet to the network access server to be authenticated. When the remote user logs in, the user must be authenticated with AAA login authentication. The user then must enter the `access-profile` command to be reauthorized using AAA. When this authorization is complete, the user has been double authenticated, and can access the network according to per-user network privileges.

The system administrator determines what network privileges remote users will have after each stage of authentication by configuring appropriate parameters on a security server. To use double authentication, the user must activate it by issuing the `access-profile` command.
Double authentication can cause certain undesirable events if multiple hosts share a PPP connection to a network access server, as shown in the figure below. First, if a user, Bob, initiates a PPP session and activates double authentication at the network access server (per the figure below), any other user will automatically have the same network privileges as Bob until Bob’s PPP session expires. This happens because Bob’s authorization profile is applied to the network access server’s interface during the PPP session and any PPP traffic from other users will use the PPP session Bob established. Second, if Bob initiates a PPP session and activates double authentication, and then—before Bob’s PPP session has expired—another user, Jane, executes the `access-profile` command (or, if Jane Telnets to the network access server and `autocommand access-profile` is executed), a reauthorization will occur and Jane’s authorization profile will be applied to the interface—replacing Bob’s profile. This can disrupt or halt Bob’s PPP traffic, or grant Bob additional authorization privileges Bob should not have.

---

**Figure 2: Possibly Risky Topology: Multiple Hosts Share a PPP Connection to a Network Access Server**

---

### Configuring Double Authentication

To configure double authentication, you must complete the following steps:

1. Enable AAA by using the `aaa-new model` global configuration command. For more information about enabling AAA, refer to the chapter “AAA Overview.”

2. Use the `aaa authentication` command to configure your network access server to use login and PPP authentication method lists, then apply those method lists to the appropriate lines or interfaces.

3. Use the `aaa authorization` command to configure AAA network authorization at login. For more information about configuring network authorization, refer to the “Configuring Authorization” chapter.

4. Configure security protocol parameters (for example, RADIUS or TACACS+). For more information about RADIUS, refer to the chapter "Configuring RADIUS”. For more information about TACACS+, refer to the chapter “Configuring TACACS+.”

5. Use access control list AV pairs on the security server that the user can connect to the local host only by establishing a Telnet connection.

6. (Optional) Configure the `access-profile` command as an autocommand. If you configure the autocommand, remote users will not have to manually enter the `access-profile` command to access authorized rights associated with their personal user profile.
If the **access-profile** command is configured as an autocommand, users will still have to Telnet to the local host and log in to complete double authentication.

Follow these rules when creating the user-specific authorization statements (These rules relate to the default behavior of the **access-profile** command):

- Use valid AV pairs when configuring access control list AV pairs on the security server.
- If you want remote users to use the interface’s existing authorization (that which existed prior to the second stage authentication/authorization), but you want them to have different access control lists (ACLs), you should specify *only* ACL AV pairs in the user-specific authorization definition. This might be desirable if you set up a default authorization profile to apply to the remote host, but want to apply specific ACLs to specific users.
- When these user-specific authorization statements are later applied to the interface, they can either be added to the existing interface configuration or they can replace the existing interface configuration—depending on which form of the **access-profile** command is used to authorize the user. You should understand how the **access-profile** command works before configuring the authorization statements.
- If you will be using ISDN or Multilink PPP, you must also configure virtual templates at the local host.

To troubleshoot double authentication, use the **debug aaa per-user** debug command. For more information about this command, refer to the *Cisco IOS Debug Command Reference*.

### Accessing the User Profile After Double Authentication

In double authentication, when a remote user establishes a PPP link to the local host using the local host name, the remote host is CHAP (or PAP) authenticated. After CHAP (or PAP) authentication, PPP negotiates with AAA to assign network access privileges associated with the remote host to the user. (We suggest that privileges at this stage be restricted to allow the user to connect to the local host only by establishing a Telnet connection.)

When the user needs to initiate the second phase of double authentication, establishing a Telnet connection to the local host, the user enters a personal username and password (different from the CHAP or PAP username and password). This action causes AAA reauthentication to occur according to the personal username/password. The initial rights associated with the local host, though, are still in place. By using the **access-profile** command, the rights associated with the local host are replaced by or merged with those defined for the user in the user’s profile.

To access the user profile after double authentication, use the following command in EXEC configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router&gt; <strong>access-profile</strong> [merge</td>
<td>replace] [ignore-sanity-checks]</td>
</tr>
</tbody>
</table>

If you configured the **access-profile** command to be executed as an autocommand, it will be executed automatically after the remote user logs in.
Enabling Automated Double Authentication

You can make the double authentication process easier for users by implementing automated double authentication. Automated double authentication provides all of the security benefits of double authentication, but offers a simpler, more user-friendly interface for remote users. With double authentication, a second level of user authentication is achieved when the user Telnets to the network access server or router and enters a username and password. With automated double authentication, the user does not have to Telnet to the network access server; instead the user responds to a dialog box that requests a username and password or personal identification number (PIN). To use the automated double authentication feature, the remote user hosts must be running a companion client application.

Automated double authentication, like the existing double authentication feature, is for Multilink PPP ISDN connections only. Automated double authentication cannot be used with other protocols such as X.25 or SLIP.

Automated double authentication is an enhancement to the existing double authentication feature. To configure automated double authentication, you must first configure double authentication by completing the following steps:

1. Enable AAA by using the `aaa-new` model global configuration command.
2. Use the `aaa authentication` command to configure your network access server to use login and PPP authentication method lists, then apply those method lists to the appropriate lines or interfaces.
3. Use the `aaa authorization` command to configure AAA network authorization at login. For more information about configuring network authorization, refer to the chapter “Configuring Authorization.”
4. Configure security protocol parameters (for example, RADIUS or TACACS+). For more information about RADIUS, refer to the chapter "Configuring RADIUS”. For more information about TACACS+, refer to the chapter “Configuring TACACS+.”
5. Use access control list AV pairs on the security server that the user can connect to the local host only by establishing a Telnet connection.
6. Configure the `access-profile` command as an autocommand. If you configure the autocommand, remote users will not have to manually enter the `access-profile` command to access authorized rights associated with their personal user profile. To learn about configuring autocommands, refer to the autocommand command in the Cisco IOS Dial Technologies Command Reference , Release 12.2.

If the `access-profile` command is configured as an autocommand, users will still have to Telnet to the local host and log in to complete double authentication.

Follow these rules when creating the user-specific authorization statements (These rules relate to the default behavior of the `access-profile` command):

- Use valid AV pairs when configuring access control list AV pairs on the security server.
- If you want remote users to use the interface’s existing authorization (that which existed prior to the second stage authentication/authorization), but you want them to have different access control lists (ACLs), you should specify only ACL AV pairs in the user-specific authorization definition. This might
be desirable if you set up a default authorization profile to apply to the remote host, but want to apply specific ACLs to specific users.

• When these user-specific authorization statements are later applied to the interface, they can either be added to the existing interface configuration, or replace the existing interface configuration—depending on which form of the access-profile command is used to authorize the user. You should understand how the access-profile command works before configuring the authorization statements.

• If you will be using ISDN or Multilink PPP, you must also configure virtual templates at the local host.

To troubleshoot double authentication, use the **debug aaa per-user** debug command. For more information about this command, refer to the *Cisco IOS Debug Command Reference*.

After you have configured double authentication, you are ready to configure the automation enhancement.

### Configuring Automated Double Authentication

To configure automated double authentication, use the following commands, starting in global configuration mode.

#### SUMMARY STEPS

1. Router(config)# `ip trigger-authentication`
2. Do one of the following:
   • Router(config)# `interface bri number`
   •
      •
      •
   • Router(config)# `interface serial number :23`
3. Router(config-if)# `ip trigger-authentication`

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables automation of double authentication.</td>
</tr>
<tr>
<td>Router(config)# <code>ip trigger-authentication</code></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td><code>{timeout seconds} {port number}</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Selects an ISDN BRI or ISDN PRI interface and enter the interface configuration mode.</td>
</tr>
<tr>
<td>Do one of the following:</td>
<td></td>
</tr>
<tr>
<td>• Router(config)# <code>interface bri number</code></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td></td>
</tr>
<tr>
<td>• Router(config)# <code>interface serial number :23</code></td>
<td></td>
</tr>
</tbody>
</table>
### Troubleshooting Automated Double Authentication

To troubleshoot automated double authentication, use the following commands in privileged EXEC mode:

**SUMMARY STEPS**

1. Router# **show ip trigger-authentication**  
2. Router# **clear ip trigger-authentication**  
3. Router# **debug ip trigger-authentication**

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> Router# <strong>show ip trigger-authentication</strong></td>
<td>Displays the list of remote hosts for which automated double authentication has been attempted (successfully or unsuccessfully).</td>
</tr>
<tr>
<td><strong>Step 2</strong> Router# <strong>clear ip trigger-authentication</strong></td>
<td>Clears the list of remote hosts for which automated double authentication has been attempted. (This clears the table displayed by the <strong>show ip trigger-authentication</strong> command.)</td>
</tr>
<tr>
<td><strong>Step 3</strong> Router# <strong>debug ip trigger-authentication</strong></td>
<td>Displays debug output related to automated double authentication.</td>
</tr>
</tbody>
</table>

---

### Configuring the Dynamic Authorization Service for RADIUS CoA

Use the following procedure to enable the router as an authentication, authorization, and accounting (AAA) server for dynamic authorization service to support the CoA functionality that pushes the policy map in an input and output direction.
SUMMARY STEPS

1. enable
2. configure terminal
3. aaa new-model
4. aaa server radius dynamic-author
5. client \{ip_addr | hostname\} \{server-key \[0 | 7\] string\}
6. domain \{delimiter character\} \{stripping \{right-to-left\}\}
7. port \{port-num\}

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> aaa new-model</td>
<td>Enables AAA.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa new-model</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> aaa server radius dynamic-author</td>
<td>Sets up the local AAA server for dynamic authorization service, which must be enabled to support the CoA functionality to push the policy map in an input and output direction and enter dynamic authorization local server configuration mode. In this mode, the RADIUS application commands are configured.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa server radius dynamic-author</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> client {ip_addr</td>
<td>hostname} {server-key [0</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Configuring the server key at the client level overrides the server key configured at the global level.</td>
</tr>
<tr>
<td>Router(config-locsvr-da-radius)#client 192.168.0.5 server-key cisco1</td>
<td>Note</td>
</tr>
<tr>
<td><strong>Step 6</strong> domain {delimiter character} {stripping {right-to-left}}</td>
<td>(Optional) Configures username domain options for the RADIUS application.</td>
</tr>
</tbody>
</table>
### Configuring a Device to Ignore Bounce and Disable RADIUS CoA Requests

When an authentication port is authenticated with multiple hosts and there is a Change of Authorization (CoA) request for one host to flap on this port or one host session to be terminated on this port, the other hosts on this port are also affected. Thus, an authenticated port with multiple hosts can trigger a DHCP renegotiation from one or more hosts in the case of a flap, or it can administratively shut down the authentication port that is hosting the session for one or more hosts.

Perform the following steps to configure the device to ignore RADIUS server Change of Authorization (CoA) requests in the form of a bounce port command or disable port command.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `aaa new-model`
4. `authentication command bounce-port ignore`
5. `authentication command disable-port ignore`
6. `end`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
<td></td>
</tr>
</tbody>
</table>
### Configuring Authentication

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

**Step 2**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>Enables authentication, authorization, and accounting (AAA) globally.</td>
</tr>
<tr>
<td>aaa new-model</td>
<td></td>
</tr>
</tbody>
</table>

**Step 3**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>(Optional) Configures the device to ignore a RADIUS server bounce port command that causes a host to link flap on an authentication port, which causes DHCP renegotiation from one or more hosts connected to this port.</td>
</tr>
<tr>
<td>authentication command bounce-port ignore</td>
<td></td>
</tr>
</tbody>
</table>

**Step 4**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>(Optional) Configures the device to ignore a RADIUS server CoA disable port command that administratively shuts down the authentication port that hosts one or more host sessions. • The shutting down of the port causes session termination.</td>
</tr>
<tr>
<td>authentication command disable-port ignore</td>
<td></td>
</tr>
</tbody>
</table>

**Step 5**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example:</strong></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>end</td>
<td></td>
</tr>
</tbody>
</table>

### Configuring Domain Stripping at the Server Group Level

#### SUMMARY STEPS

1. enable
2. configure terminal
3. aaa group server radius server-name
4. domain-stripping [strip-suffix word] [right-to-left] [prefix-delimiter word] [delimiter word]
5. end
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> aaa group server radius server-name</td>
<td>Adds the RADIUS server and enters server group RADIUS configuration mode.</td>
</tr>
<tr>
<td>Example: Device(config)# aaa group server radius rad1</td>
<td>• The server-name argument specifies the RADIUS server group name.</td>
</tr>
<tr>
<td><strong>Step 4</strong> domain-stripping [strip-suffix word] [right-to-left ] [prefix-delimiter word] [delimiter word]</td>
<td>Configures domain stripping at the server group level.</td>
</tr>
<tr>
<td>Example: Device(config-sg-radius)# domain-stripping delimiter <a href="mailto:username@example.com">username@example.com</a></td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> end</td>
<td>Exits server group RADIUS configuration mode and returns to the privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device(config-sg-radius)# end</td>
<td></td>
</tr>
</tbody>
</table>

### Non-AAA Authentication Methods

#### Configuring Line Password Protection

You can This task is used to provide access control on a terminal line by entering the password and establishing password checking.

**Note** If you configure line password protection and then configure TACACS or extended TACACS, the TACACS username and password take precedence over line passwords. If you have not yet implemented a security policy, we recommend that you use AAA.
SUMMARY STEPS

1. enable
2. configure terminal
3. line [aux | console | tty | vty] line-number [ending-line-number]
4. password password
5. login

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td>Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>line [aux</td>
<td>console</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config)# line console 0</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
</tr>
<tr>
<td>password password</td>
<td>Assigns a password to a terminal or other device on a line. The password checker is case sensitive and can include spaces; for example, the password “Secret” is different from the password “secret,” and “two words” is an acceptable password.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config-line)# secret word</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td></td>
</tr>
<tr>
<td>login</td>
<td>Enables password checking at login.</td>
</tr>
<tr>
<td>Example:</td>
<td>You can disable line password verification by disabling password checking by using the no version of this command.</td>
</tr>
<tr>
<td>Router(config-line)# login</td>
<td></td>
</tr>
</tbody>
</table>

Note
The login command only changes username and privilege level but it does not execute a shell; therefore autocommands will not be executed. To execute autocommands under this circumstance, you need to establish a Telnet session back into the router (loop-back). Make sure that the router has been configured for secure Telnet sessions if you choose to implement autocommands this way.
Establishing Username Authentication

You can create a username-based authentication system, which is useful in the following situations:

- To provide a TACACS-like username and encrypted password-authentication system for networks that cannot support TACACS
- To provide special-case logins: for example, access list verification, no password verification, autocommand execution at login, and "no escape" situations

To establish username authentication, use the following commands in global configuration mode as needed for your system configuration:

**SUMMARY STEPS**

1. Do one of the following:
   - Router(config)# username name [nopassword | password password] [password encryption-type encrypted password]
   - Router(config)# username name [access-class number]

2. Router(config)# username name [privilege level]
3. Router(config)# username name [autocommand command]
4. Router(config)# username name [noescape] [nohangup]

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Do one of the following:</td>
</tr>
<tr>
<td></td>
<td>- Router(config)# username name [nopassword</td>
</tr>
<tr>
<td></td>
<td>- Router(config)# username name [access-class number]</td>
</tr>
<tr>
<td></td>
<td><strong>Establishes username authentication with encrypted passwords.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>or</strong></td>
</tr>
<tr>
<td></td>
<td><strong>(Optional) Establishes username authentication by access list.</strong></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Router(config)# username name [privilege level]</td>
</tr>
<tr>
<td></td>
<td><strong>(Optional) Sets the privilege level for the user.</strong></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Router(config)# username name [autocommand command]</td>
</tr>
<tr>
<td></td>
<td><strong>(Optional) Specifies a command to be executed automatically.</strong></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Router(config)# username name [noescape] [nohangup]</td>
</tr>
<tr>
<td></td>
<td><strong>(Optional) Sets a “no escape” login environment.</strong></td>
</tr>
</tbody>
</table>
What to Do Next

The keyword `noescape` prevents users from using escape characters on the hosts to which they are connected. The `nohangup` feature does not disconnect after using the `autocmd`.

---

**Caution**

Passwords will be displayed in clear text in your configuration unless you enable the `service password-encryption` command. For more information about the `service password-encryption` command, refer to the *Cisco IOS Security Command Reference*.

---

**Enabling CHAP or PAP Authentication**

One of the most common transport protocols used in Internet service providers’ (ISPs’) dial solutions is the Point-to-Point Protocol (PPP). Traditionally, remote users dial in to an access server to initiate a PPP session. After PPP has been negotiated, remote users are connected to the ISP network and to the Internet.

Because ISPs want only customers to connect to their access servers, remote users are required to authenticate to the access server before they can start up a PPP session. Normally, a remote user authenticates by typing in a username and password when prompted by the access server. Although this is a workable solution, it is difficult to administer and awkward for the remote user.

A better solution is to use the authentication protocols built into PPP. In this case, the remote user dials in to the access server and starts up a minimal subset of PPP with the access server. This does not give the remote user access to the ISP’s network—it merely allows the access server to talk to the remote device.

PPP currently supports two authentication protocols: Password Authentication Protocol (PAP) and Challenge Handshake Authentication Protocol (CHAP). Both are specified in RFC 1334 and are supported on synchronous and asynchronous interfaces. Authentication via PAP or CHAP is equivalent to typing in a username and password when prompted by the server. CHAP is considered to be more secure because the remote user’s password is never sent across the connection.

PPP (with or without PAP or CHAP authentication) is also supported in dialout solutions. An access server utilizes a dialout feature when it initiates a call to a remote device and attempts to start up a transport protocol such as PPP.

See the *Cisco IOS XE Dial Technologies Configuration Guide*, Release 2 for more information about CHAP and PAP.

---

**Note**

To use CHAP or PAP, you must be running PPP encapsulation.

When CHAP is enabled on an interface and a remote device attempts to connect to it, the access server sends a CHAP packet to the remote device. The CHAP packet requests or “challenges” the remote device to respond. The challenge packet consists of an ID, a random number, and the host name of the local router.

When the remote device receives the challenge packet, it concatenates the ID, the remote device’s password, and the random number, and then encrypts all of it using the remote device’s password. The remote device sends the results back to the access server, along with the name associated with the password used in the encryption process.

When the access server receives the response, it uses the name it received to retrieve a password stored in its user database. The retrieved password should be the same password the remote device used in its encryption.
Enabling CHAP or PAP Authentication

To use CHAP or PAP, you must perform the following tasks:

1. Enable PPP encapsulation.
2. Enable CHAP or PAP on the interface.
3. For CHAP, configure host name authentication and the secret or password for each remote system with which authentication is required.

Enabling PPP Encapsulation

To enable PPP encapsulation, use the following command in interface configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config-if)# encapsulation ppp</td>
<td>Enables PPP on an interface.</td>
</tr>
</tbody>
</table>

Enabling PAP or CHAP

To enable CHAP or PAP authentication on an interface configured for PPP encapsulation, use the following command in interface configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config-if)# ppp authentication {protocol1 [protocol2...] [if-needed] [default</td>
<td>list-name} [callin] [one-time]</td>
</tr>
</tbody>
</table>
If you configure `ppp authentication chap` on an interface, all incoming calls on that interface that initiate a PPP connection will have to be authenticated using CHAP; likewise, if you configure `ppp authentication pap`, all incoming calls that start a PPP connection will have to be authenticated via PAP. If you configure `ppp authentication chap pap`, the access server will attempt to authenticate all incoming calls that start a PPP session with CHAP. If the remote device does not support CHAP, the access server will try to authenticate the call using PAP. If the remote device does not support either CHAP or PAP, authentication will fail and the call will be dropped. If you configure `ppp authentication pap chap`, the access server will attempt to authenticate all incoming calls that start a PPP session with PAP. If the remote device does not support PAP, the access server will try to authenticate the call using CHAP. If the remote device does not support either protocol, authentication will fail and the call will be dropped. If you configure the `ppp authentication` command with the `callin` keyword, the access server will only authenticate the remote device if the remote device initiated the call.

Authentication method lists and the `one-time` keyword are only available if you have enabled AAA--they will not be available if you are using TACACS or extended TACACS. If you specify the name of an authentication method list with the `ppp authentication` command, PPP will attempt to authenticate the connection using the methods defined in the specified method list. If AAA is enabled and no method list is defined by name, PPP will attempt to authenticate the connection using the methods defined as the default. The `ppp authentication` command with the `one-time` keyword enables support for one-time passwords during authentication.

The `if-needed` keyword is only available if you are using TACACS or extended TACACS. The `ppp authentication` command with the `if-needed` keyword means that PPP will only authenticate the remote device via PAP or CHAP if they have not yet authenticated during the life of the current call. If the remote device authenticated via a standard login procedure and initiated PPP from the EXEC prompt, PPP will not authenticate via CHAP if `ppp authentication chap if-needed` is configured on the interface.

---

**Caution**

If you use a `list-name` that has not been configured with the `aaa authentication ppp` command, you disable PPP on the line.

For information about adding a `username` entry for each remote system from which the local router or access server requires authentication, see the Establishing Username Authentication, on page 42.

---

**Inbound and Outbound Authentication**

PPP supports two-way authentication. Normally, when a remote device dials in to an access server, the access server requests that the remote device prove that it is allowed access. This is known as inbound authentication. At the same time, the remote device can also request that the access server prove that it is who it says it is. This is known as outbound authentication. An access server also does outbound authentication when it initiates a call to a remote device.

**Enabling Outbound PAP Authentication**

To enable outbound PAP authentication, use the following command in interface configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config-if)# ppp pap sent-username username password password</code></td>
<td>Enables outbound PAP authentication.</td>
</tr>
</tbody>
</table>
The access server uses the username and password specified by the `ppp pap sent-username` command to authenticate itself whenever it initiates a call to a remote device or when it has to respond to a remote device's request for outbound authentication.

### Refusing PAP Authentication Requests

To refuse PAP authentication from peers requesting it, meaning that PAP authentication is disabled for all calls, use the following command in interface configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config-if)# ppp pap refuse</code></td>
<td>Refuses PAP authentication from peers requesting PAP authentication.</td>
</tr>
</tbody>
</table>

If the `refuse` keyword is not used, the router will not refuse any PAP authentication challenges received from the peer.

### Creating a Common CHAP Password

For remote CHAP authentication only, you can configure your router to create a common CHAP secret password to use in response to challenges from an unknown peer; for example, if your router calls a rotary of routers (either from another vendor, or running an older version of the Cisco IOS software) to which a new (that is, unknown) router has been added. The `ppp chap password` command allows you to replace several username and password configuration commands with a single copy of this command on any dialer interface or asynchronous group interface.

To enable a router calling a collection of routers to configure a common CHAP secret password, use the following command in interface configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config-if)# ppp chap password secret</code></td>
<td>Enables a router calling a collection of routers to configure a common CHAP secret password.</td>
</tr>
</tbody>
</table>

### Refusing CHAP Authentication Requests

To refuse CHAP authentication from peers requesting it, meaning that CHAP authentication is disabled for all calls, use the following command in interface configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config-if)# ppp chap refuse [callin]</code></td>
<td>Refuses CHAP authentication from peers requesting CHAP authentication.</td>
</tr>
</tbody>
</table>
If the callin keyword is used, the router will refuse to answer CHAP authentication challenges received from the peer, but will still require the peer to answer any CHAP challenges the router sends.

If outbound PAP has been enabled (using the `ppp pap sent-username` command), PAP will be suggested as the authentication method in the refusal packet.

### Delaying CHAP Authentication Until Peer Authenticates

To specify that the router will not authenticate to a peer requesting CHAP authentication until after the peer has authenticated itself to the router, use the following command in interface configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config-if)# ppp chap wait secret</code></td>
<td>Configures the router to delay CHAP authentication until after the peer has authenticated itself to the router.</td>
</tr>
</tbody>
</table>

This command (which is the default) specifies that the router will not authenticate to a peer requesting CHAP authentication until the peer has authenticated itself to the router. The `no ppp chap wait` command specifies that the router will respond immediately to an authentication challenge.

### Using MS-CHAP

Microsoft Challenge Handshake Authentication Protocol (MS-CHAP) is the Microsoft version of CHAP and is an extension of RFC 1994. Like the standard version of CHAP, MS-CHAP is used for PPP authentication; in this case, authentication occurs between a PC using Microsoft Windows NT or Microsoft Windows 95 and a Cisco device or access server acting as a network access server.

MS-CHAP differs from the standard CHAP as follows:

- MS-CHAP is enabled by negotiating CHAP Algorithm 0x80 in LCP option 3, Authentication Protocol.
- The MS-CHAP Response packet is in a format designed to be compatible with Microsoft Windows NT 3.5 and 3.51, Microsoft Windows 95, and Microsoft LAN Manager 2.x. This format does not require the authenticator to store a clear or reversibly encrypted password.
- MS-CHAP provides an authenticator-controlled authentication retry mechanism.
- MS-CHAP provides an authenticator-controlled change password mechanism.
- MS-CHAP defines a set of "reason-for-failure" codes returned in the Failure packet message field.

Depending on the security protocols you have implemented, PPP authentication using MS-CHAP can be used with or without AAA security services. If you have enabled AAA, PPP authentication using MS-CHAP can be used in conjunction with both TACACS+ and RADIUS. The table below lists the vendor-specific RADIUS attributes (IETF Attribute 26) that enable RADIUS to support MS-CHAP.
### Table 9: Vendor-Specific RADIUS Attributes for MS-CHAP

<table>
<thead>
<tr>
<th>Vendor-ID Number</th>
<th>Vendor-Type Number</th>
<th>Vendor-Proprietary Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>311</td>
<td>11</td>
<td>MSCHAP-Challenge</td>
<td>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.</td>
</tr>
<tr>
<td>211</td>
<td>11</td>
<td>MSCHAP-Response</td>
<td>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.</td>
</tr>
</tbody>
</table>

### Defining PPP Authentication using MS-CHAP

To define PPP authentication using MS-CHAP, use the following commands in interface configuration mode:

**SUMMARY STEPS**

1. `Router(config-if)# encapsulation ppp`
2. `Router(config-if)# ppp authentication ms-chap [if-needed] [list-name | default] [callin] [one-time]`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><strong>Step 1</strong> Router(config-if)# encapsulation ppp Enables PPP encapsulation.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>Step 2</strong> Router(config-if)# ppp authentication ms-chap [if-needed] [list-name</td>
</tr>
</tbody>
</table>

**What to Do Next**

If you configure `ppp authentication ms-chap` on an interface, all incoming calls on that interface that initiate a PPP connection will have to be authenticated using MS-CHAP. If you configure the `ppp authentication` command with the `callin` keyword, the access server will only authenticate the remote device if the remote device initiated the call.
Authentication method lists and the one-time keyword are only available if you have enabled AAA—they will not be available if you are using TACACS or extended TACACS. If you specify the name of an authentication method list with the ppp authentication command, PPP will attempt to authenticate the connection using the methods defined in the specified method list. If AAA is enabled and no method list is defined by name, PPP will attempt to authenticate the connection using the methods defined as the default. The ppp authentication command with the one-time keyword enables support for one-time passwords during authentication.

The if-needed keyword is only available if you are using TACACS or extended TACACS. The ppp authentication command with the if-needed keyword means that PPP will only authenticate the remote device via MS-CHAP if that device has not yet authenticated during the life of the current call. If the remote device authenticated through a standard login procedure and initiated PPP from the EXEC prompt, PPP will not authenticate through MS-CHAP if ppp authentication chap if-needed is configured.

Note If PPP authentication using MS-CHAP is used with username authentication, you must include the MS-CHAP secret in the local username/password database. For more information about username authentication, refer to the “Establish Username Authentication” section.

Authentication Examples

RADIUS Authentication Examples

This section provides two sample configurations using RADIUS.

The following example shows how to configure the router to authenticate and authorize using RADIUS:

```
aaa authentication login radius-login group radius local
aaa authentication ppp radius-ppp if-needed group radius
aaa authorization exec default group radius if-authenticated
aaa authorization network default group radius
line 3
login authentication radius-login
interface serial 0
ppp authentication radius-ppp
```

The lines in this sample RADIUS authentication and authorization configuration are defined as follows:

- The aaa authentication login radius-login group radius local command configures the router to use RADIUS for authentication at the login prompt. If RADIUS returns an error, the user is authenticated using the local database.
- The aaa authentication ppp radius-ppp if-needed group radius command configures the Cisco IOS XE software to use PPP authentication using CHAP or PAP if the user has not already logged in. If the EXEC facility has authenticated the user, PPP authentication is not performed.
- The aaa authorization exec default group radius if-authenticated command queries the RADIUS database for information that is used during EXEC authorization, such as autocommands and privilege levels, but only provides authorization if the user has successfully authenticated.
- The aaa authorization network default group radius command queries RADIUS for network authorization, address assignment, and other access lists.
The login authentication radius-login command enables the radius-login method list for line 3.

The ppp authentication radius-ppp command enables the radius-ppp method list for serial interface 0.

The following example shows how to configure the router to prompt for and verify a username and password, authorize the user’s EXEC level, and specify it as the method of authorization for privilege level 2. In this example, if a local username is entered at the username prompt, that username is used for authentication.

If the user is authenticated using the local database, EXEC authorization using RADIUS will fail because no data is saved from the RADIUS authentication. The method list also uses the local database to find an autocmd. If there is no autocmd, the user becomes the EXEC user. If the user then attempts to issue commands that are set at privilege level 2, TACACS+ is used to attempt to authorize the command.

```plaintext
aaa authentication login default group radius local
aaa authorization exec default group radius local
aaa authorization command 2 default group tacacs+ if-authenticated
radius-server host 172.16.71.146 auth-port 1645 acct-port 1646
radius-server attribute 44 include-in-access-req
radius-server attribute 8 include-in-access-req
```

The lines in this sample RADIUS authentication and authorization configuration are defined as follows:

- The aaa authentication login default group radius local command specifies that the username and password are verified by RADIUS or, if RADIUS is not responding, by the router’s local user database.
- The aaa authorization exec default group radius local command specifies that RADIUS authentication information be used to set the user’s EXEC level if the user authenticates with RADIUS. If no RADIUS information is used, this command specifies that the local user database be used for EXEC authorization.
- The aaa authorization command 2 default group tacacs+ if-authenticated command specifies TACACS+ authorization for commands set at privilege level 2, if the user has already successfully authenticated.
- The radius-server host 172.16.71.146 auth-port 1645 acct-port 1646 command specifies the IP address of the RADIUS server host, the UDP destination port for authentication requests, and the UDP destination port for accounting requests.
- The radius-server attribute 44 include-in-access-req command sends RADIUS attribute 44 (Acct-Session-ID) in access-request packets.
- The radius-server attribute 8 include-in-access-req command sends RADIUS attribute 8 (Framed-IP-Address) in access-request packets.

**TACACS Authentication Examples**

The following example shows how to configure TACACS+ as the security protocol to be used for PPP authentication:

```plaintext
aaa new-model
daual authentication ppp test group tacacs+ local
interface serial 0
ppp authentication chap pap test
tacacs-server host 192.0.2.3
tacacs-server key goaway
```

The lines in this sample TACACS+ authentication configuration are defined as follows:

- The aaa new-model command enables the AAA security services.
• The **aaa authentication** command defines a method list, “test,” to be used on serial interfaces running PPP. The keywords **group tacacs+** means that authentication will be done through TACACS+. If TACACS+ returns an ERROR of some sort during authentication, the keyword **local** indicates that authentication will be attempted using the local database on the network access server.

• The **interface** command selects the line.

• The **ppp authentication** command applies the test method list to this line.

• The **tacacs-server host** command identifies the TACACS+ daemon as having an IP address of 192.0.2.3.

• The **tacacs-server key** command defines the shared encryption key to be “goaway.”

The following example shows how to configure AAA authentication for PPP:

```
aaa authentication ppp default if-needed group tacacs+ local
```

In this example, the keyword **default** means that PPP authentication is applied by default to all interfaces. The **if-needed** keyword means that if the user has already authenticated by going through the ASCII login procedure, then PPP is not necessary and can be skipped. If authentication is needed, the keywords **group tacacs+** means that authentication will be done through TACACS+. If TACACS+ returns an ERROR of some sort during authentication, the keyword **local** indicates that authentication will be attempted using the local database on the network access server.

The following example shows how to create the same authentication algorithm for PAP, but it calls the method list "MIS-access" instead of "default":

```
aaa authentication ppp MIS-access if-needed group tacacs+ local
interface serial 0
ppp authentication pap MIS-access
```

In this example, because the list does not apply to any interfaces (unlike the default list, which applies automatically to all interfaces), the administrator must select interfaces to which this authentication scheme should apply by using the **interface** command. The administrator must then apply this method list to those interfaces by using the **ppp authentication** command.

### Kerberos Authentication Examples

To specify Kerberos as the login authentication method, use the following command:

```
aaa authentication login default krb5
```

To specify Kerberos authentication for PPP, use the following command:

```
aaa authentication ppp default krb5
```

### AAA Scalability Example

The following example shows a general security configuration using AAA with RADIUS as the security protocol. In this example, the network access server is configured to allocate 16 background processes to handle AAA requests for PPP.

```
aaa new-model
radius-server host alcatraz
radius-server key myRadiusPassword
radius-server configure-nas
username root password ALongPassword
```
aaa authentication ppp dialins group radius local
aaa authentication login admins local
aaa authorization network default group radius local
aaa accounting network default start-stop group radius
aaa processes 16
line 1 16
  autoselect ppp
  autoselect during-login
  login authentication admins
  modem dialin
interface group-async 1
group-range 1 16
encapsulation ppp
ppp authentication pap dialins

The lines in this sample RADIUS AAA configuration are defined as follows:

- The **aaa new-model** command enables AAA network security services.
- The **radius-server host** command defines the name of the RADIUS server host.
- The **radius-server key** command defines the shared secret text string between the network access server and the RADIUS server host.
- The **radius-server configure-nas** command defines that the Cisco router or access server will query the RADIUS server for static routes and IP pool definitions when the device first starts up.
- The **username** command defines the username and password to be used for the PPP Password Authentication Protocol (PAP) caller identification.
- The **aaa authentication ppp dialins group radius local** command defines the authentication method list "dialins," which specifies that RADIUS authentication, then (if the RADIUS server does not respond) local authentication will be used on serial lines using PPP.
- The **aaa authentication login admins local** command defines another method list, "admins," for login authentication.
- The **aaa authorization network default group radius local** command is used to assign an address and other network parameters to the RADIUS user.
- The **aaa authorization network default group radius local** command is used to assign an address and other network parameters to the RADIUS user.
- The **aaa accounting network default start-stop group radius** command tracks PPP usage.
- The **aaa processes** command allocates 16 background processes to handle AAA requests for PPP.
- The **line** command switches the configuration mode from global configuration to line configuration and identifies the specific lines being configured.
- The **autoselect ppp** command allows a PPP session to start up automatically on these selected lines.
- The **autoselect during-login** command is used to display the username and password prompt without pressing the Return key. After the user logs in, the autoselect function (in this case, PPP) begins.
- The **login authentication admins** command applies the "admins" method list for login authentication.
- The **modem dialin** command configures modems attached to the selected lines to only accept incoming calls.
- The **interface group-async** command selects and defines an asynchronous interface group.
- The **group-range** command defines the member asynchronous interfaces in the interface group.
- The **encapsulation ppp** command sets PPP as the encapsulation method used on the specified interfaces.
- The **ppp authentication pap dialins** command applies the "dialins" method list to the specified interfaces.
Example: Configuring Login and Failed/Login Banners for AAA Authentication

The following example shows how to configure a login banner that is displayed when a user logs in to the system, (in this case, the phrase "Unauthorized Access Prohibited"). The asterisk (*) is used as the delimiting character. RADIUS is specified as the default login authentication method.

```
Device> enable
Device# configure terminal
Device(config)# aaa new-model
Device(config)# aaa authentication banner *Unauthorized Access Prohibited*
Device(config)# aaa authentication login default group radius
```

This configuration displays the following login banner:

```
Unauthorized Access Prohibited
Username:
```

The following example shows how to configure a failed-login banner that is displayed when a user tries to log in to the system and fails, (in this case, the phrase "Failed login. Try again"). The asterisk (*) is used as the delimiting character. RADIUS is specified as the default login authentication method.

```
Device> enable
Device# configure terminal
Device(config)# aaa new-model
Device(config)# aaa authentication banner *Unauthorized Access Prohibited*
Device(config)# aaa authentication fail-message *Failed login. Try again.*
Device(config)# aaa authentication login default group radius
```

This configuration displays the following login and failed-login banner:

```
Unauthorized Access Prohibited
Username:
Password:
Failed login. Try again.
```

AAA Packet of Disconnect Server Key Example

The following example shows how to configure POD (packet of disconnect), which terminates connections on the network access server (NAS) when particular session attributes are identified.

```
aaa new-model
aaa authentication ppp default radius
aaa accounting network default start-stop radius
aaa accounting delay-start
aaa pod server server-key xyz123
radius-server host 192.0.2.3 non-standard
radius-server key rad123
```

Double Authentication Examples

The examples in this section illustrate possible configurations to be used with double authentication. Your configurations could differ significantly, depending on your network and security requirements.
**Double Authentication Examples**

These configuration examples include specific IP addresses and other specific information. This information is for illustration purposes only: your configuration will use different IP addresses, different usernames and passwords, and different authorization statements.

---

**Configuration of the Local Host for AAA with Double Authentication Examples**

These two examples show how to configure a local host to use AAA for PPP and login authentication, and for network and EXEC authorization. An example each is shown for RADIUS and for TACACS+.

In both the examples, the first three lines configure AAA with a specific server as the AAA server. The next two lines configure AAA for PPP and login authentication, and the last two lines configure network and EXEC authorization. The last line is necessary only if the **access-profile** command will be executed as an autocommand.

The following example shows device configuration with a RADIUS AAA server:

```plaintext
aaa new-model
radius-server host secureserver
radius-server key myradiuskey
aaa authentication ppp default group radius
aaa authentication login default group radius
aaa authorization network default group radius
aaa authorization exec default group radius
```

The following example shows device configuration with a TACACS+ server:

```plaintext
aaa new-model
tacacs-server host security
tacacs-server key mytacacskey
aaa authentication ppp default group tacacs+
aaa authentication login default group tacacs+
aaa authorization network default group tacacs+
aaa authorization exec default group tacacs+
```

---

**Configuration of the AAA Server for First-Stage PPP Authentication and Authorization Example**

This example shows a configuration on the AAA server. A partial sample AAA configuration is shown for RADIUS.

TACACS+ servers can be configured similarly. (See the Complete Configuration with TACACS Example.)

This example defines authentication/authorization for a remote host named "hostx" that will be authenticated by CHAP in the first stage of double authentication. Note that the ACL AV pair limits the remote host to Telnet connections to the local host. The local host has the IP address 10.0.0.2.

The following example shows a partial AAA server configuration for RADIUS:

```plaintext
hostx Password = "welcome"
User-Service-Type = Framed-User,
Framed-Protocol = PPP,
cisco-avpair = "lcp:interface-config-ip unnumbered fastethernet 0",
cisco-avpair = "ip:inac1#3=permit tcp any 172.21.114.0 0.0.0.255 eq telnet",
cisco-avpair = "ip:inac1#4=deny icmp any any",
cisco-avpair = "ip:route#5=10.0.0.0 255.0.0.0",
cisco-avpair = "ip:route#6=10.10.0.0 255.0.0.0",
cisco-avpair = "ipx:inac1#3=deny any"
```
Configuration of the AAA Server for Second-Stage Per-User Authentication and Authorization Examples

This section contains partial sample AAA configurations on a RADIUS server. These configurations define authentication and authorization for a user (Pat) with the username "patuser," who will be user-authenticated in the second stage of double authentication.

TACACS+ servers can be configured similarly. (See the Complete Configuration with TACACS Example.)

Three examples show sample RADIUS AAA configurations that could be used with each of the three forms of the `access-profile` command.

The first example shows a partial sample AAA configuration that works with the default form (no keywords) of the `access-profile` command. Note that only ACL AV pairs are defined. This example also sets up the `access-profile` command as an autocommand.

```
patuser Password = "welcome"
User-Service-Type = Shell-User,
cisco-avpair = "shell:autocmd-access-profile"
User-Service-Type = Framed-User,
Framed-Protocol = PPP,
cisco-avpair = "ip:inacl#3=permit tcp any host 10.0.0.2 eq telnet",
cisco-avpair = "ip:inacl#4=deny icmp any any"
```

The second example shows a partial sample AAA configuration that works with the `access-profile merge` form of the `access-profile` command. This example also sets up the `access-profile merge` command as an autocommand.

```
patuser Password = "welcome"
User-Service-Type = Shell-User,
cisco-avpair = "shell:autocmd-access-profile merge"
User-Service-Type = Framed-User,
Framed-Protocol = PPP,
cisco-avpair = "ip:inacl#3=permit tcp any any"
cisco-avpair = "ip:route=10.0.0.0 255.255.0.0",
cisco-avpair = "ip:route=10.1.0.0 255.255.0.0",
cisco-avpair = "ip:route=10.2.0.0 255.255.0.0"
```

The third example shows a partial sample AAA configuration that works with the `access-profile replace` form of the `access-profile` command. This example also sets up the `access-profile replace` command as an autocommand.

```
patuser Password = "welcome"
User-Service-Type = Shell-User,
cisco-avpair = "shell:autocmd-access-profile replace"
User-Service-Type = Framed-User,
Framed-Protocol = PPP,
cisco-avpair = "ip:inacl#3=permit tcp any any",
cisco-avpair = "ip:inacl#4=permit icmp any any",
cisco-avpair = "ip:route=10.10.0.0 255.255.0.0",
cisco-avpair = "ip:route=10.11.0.0 255.255.0.0",
cisco-avpair = "ip:route=10.12.0.0 255.255.0.0"
```

Complete Configuration with TACACS Example

This example shows TACACS+ authorization profile configurations both for the remote host (used in the first stage of double authentication) and for specific users (used in the second stage of double authentication). This TACACS+ example contains approximately the same configuration information as shown in the previous RADIUS examples.
This sample configuration shows authentication/authorization profiles on the TACACS+ server for the remote host "hostx" and for three users, with the usernames "pat_default," "pat_merge," and "pat_replace." The configurations for these three usernames illustrate different configurations that correspond to the three different forms of the access-profile command. The three user configurations also illustrate setting up the autocommand for each form of the access-profile command.

The figure below shows the topology. The example that follows the figure shows a TACACS+ configuration file.

**Figure 3: Example Topology for Double Authentication**

```
key = "mytacacskey"
default authorization = permit
#-----------------------------Remote Host (BRI)-------------------------
# This allows the remote host to be authenticated by the local host
# during fist-stage authentication, and provides the remote host
# authorization profile.
#-----------------------------Remote Host (BRI)-------------------------
user = hostx
    login = cleartext "welcome"
    chap = cleartext "welcome"
    service = ppp protocol = lcp {
        interface-config=ip unnumbered fastethernet 0
    }
    service = ppp protocol = ip {
        # It is important to have the hash sign and some string after
        # it. This indicates to the NAS that you have a per-user
        # config.
        inacl#3="permit tcp any 172.21.114.0 0.0.0.255 eq telnet"
        inacl#4="deny icmp any any"
        route#5="10.0.0.0 255.0.0.0"
        route#6="10.10.0.0 255.0.0.0"
    }
    service = ppp protocol = ipx {
        # see previous comment about the hash sign and string, in protocol = ip
        inacl#3="deny any"
    }
#-----------------------------"access-profile" default user "only acls"-----------------------------
user = pat_default
```

This sample configuration shows authentication/authorization profiles on the TACACS+ server for the remote host "hostx" and for three users, with the usernames "pat_default," "pat_merge," and "pat_replace."
login = cleartext "welcome"
chap = cleartext "welcome"
service = exec
{
    # This is the autocommand that executes when pat_default logs in.
    autocmd = "access-profile"
}
service = ppp protocol = ip {
# Put whatever access-lists, static routes, whatever
# here.
# If you leave this blank, the user will have NO IP
# access-lists (not even the ones installed prior to
# this)!
    inacl#3=permit tcp any host 10.0.0.2 eq telnet
    inacl#4=deny icmp any any
}

service = ppp protocol = ipx {
# Put whatever access-lists, static routes, whatever
# here.
# If you leave this blank, the user will have NO IPX
# access-lists (not even the ones installed prior to
# this)!
}

#---------------------
# With the 'merge' option, first all old access-lists are removed (as before),
# but then (almost) all AV pairs are uploaded and installed. This will allow
# for uploading any custom static routes, sap-filters, and so on, that the user
# may need in his or her profile. This needs to be used with care, as it leaves
# open the possibility of conflicting configurations.
#----------------------------------------------------------------------
user = pat_merge
{
    login = cleartext "welcome"
    chap = cleartext "welcome"
    service = exec
    {
        # This is the autocommand that executes when pat_merge logs in.
        autocmd = "access-profile merge"
    }
    service = ppp protocol = ip {
        # Put whatever access-lists, static routes, whatever
        # here.
        # If you leave this blank, the user will have NO IP
        # access-lists (not even the ones installed prior to
        # this)!
        inacl#3=permit tcp any host 10.0.0.2 eq telnet
        route#2=10.0.0.0 255.255.0.0
        route#3=10.1.0.0 255.255.0.0
        route#4=10.2.0.0 255.255.0.0
    }
    service = ppp protocol = ipx {
        # Put whatever access-lists, static routes, whatever
        # here.
        # If you leave this blank, the user will have NO IPX
        # access-lists (not even the ones installed prior to
        # this)!
    }
}
#---------------------
# With the 'replace' option, ALL old configuration is removed and ALL new
# configuration is installed.
# One caveat: access-profile checks the new configuration for address-pool and
# address AV pairs. As addresses cannot be renegotiated at this point, the
Automated Double Authentication Example

This example shows a complete configuration file with automated double authentication configured. The configuration commands that apply to automated double authentication are preceded by descriptions with a double asterisk (**).

Current configuration:
!
version 11.3
no service password-encryption
!
hostname myrouter
!
**The following AAA commands are used to configure double authentication:
!
**The following command enables AAA:
aaa new-model
**The following command enables user authentication via the RADIUS AAA server:

aaa authentication login default none
aaa authentication ppp default group radius
**The following command causes the remote user's authorization profile to be downloaded from the AAA server to the router when required:

aaa authorization network default group radius
**The following command enables the user to change their password:

enable password mypassword
The lines in this sample RADIUS AAA configuration are defined as follows:

- **The `aaa new-model`** command enables AAA network security services.
- **The `aaa authentication login admins local`** command defines another method list, "admins", for login authentication.
- **The `aaa authentication ppp dialins group radius local`** command defines the authentication method list "dialins," which specifies that RADIUS authentication then (if the RADIUS server does not respond) local authentication will be used on serial lines using PPP.
- **The `aaa authorization network default group radius local`** command is used to assign an address and other network parameters to the RADIUS user.
- **The `aaa accounting network default start-stop group radius`** command tracks PPP usage.
The **username** command defines the username and password to be used for the PPP Password Authentication Protocol (PAP) caller identification.

The **radius-server host** command defines the name of the RADIUS server host.

The **radius-server key** command defines the shared secret text string between the network access server and the RADIUS server host.

The **interface group-async** command selects and defines an asynchronous interface group.

The **group-range** command defines the member asynchronous interfaces in the interface group.

The **encapsulation ppp** command sets PPP as the encapsulation method used on the specified interfaces.

The **ppp authentication ms-chap dialins** command selects MS-CHAP as the method of PPP authentication and applies the "dialins" method list to the specified interfaces.

The **line** command switches the configuration mode from global configuration to line configuration and identifies the specific lines being configured.

The **autoselect ppp** command allows a PPP session to start up automatically on these selected lines.

The **autoselect during-login** command is used to display the username and password prompt without pressing the Return key. After the user logs in, the autoselect function (in this case, PPP) begins.

The **login authentication admins** command applies the "admins" method list for login authentication.

The **modem dialin** command configures modems attached to the selected lines to only accept incoming calls.

## Additional References

The following sections provide references related to the Configuring Authentication feature.

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security commands</td>
<td><em>Cisco IOS Security Command Reference</em></td>
</tr>
</tbody>
</table>
## Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.</td>
<td>--</td>
</tr>
</tbody>
</table>

## MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS XE software 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></td>
</tr>
</tbody>
</table>

## RFCs

<table>
<thead>
<tr>
<th>RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 1334</td>
<td>PPP Authentication Protocols</td>
</tr>
<tr>
<td>RFC 2433</td>
<td>Microsoft PPP CHAP Extensions</td>
</tr>
<tr>
<td>RFC 2903</td>
<td>Generic AAA Architecture</td>
</tr>
<tr>
<td>RFC 2904</td>
<td>AAA Authorization Framework</td>
</tr>
<tr>
<td>RFC 2906</td>
<td>AAA Authorization Requirements</td>
</tr>
<tr>
<td>RFC 2989</td>
<td>Criteria for Evaluating AAA Protocols for Network Access</td>
</tr>
</tbody>
</table>
Technical Assistance

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

Feature Information for Configuring Authentication

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

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

**Table 10: Feature Information for Configuring Authentication**

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA Method Lists Enhancement</td>
<td>Cisco IOS XE</td>
<td>This feature allows you to enable fallback methods for authentication, authorization or accounting. The fallback methods could include trying groups of RADIUS or TACACS+ servers or a local database in some cases.</td>
</tr>
<tr>
<td></td>
<td>Release 2.1</td>
<td>In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The following command was introduced or modified: aaa authentication ppp.</td>
</tr>
<tr>
<td>Feature Name</td>
<td>Releases</td>
<td>Feature Information</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| AAA Per-User Scalability             | Cisco IOS XE Release 2.3 | The AAA Per-User Scalability feature supports two RADIUS VSAs for **ip vrf** and **ip unnumbered** commands and creates subvirtual access interfaces if specified instead of full VA interface to achieve higher scalability.  
In Cisco IOS XE Release 2.3, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.                                                                                                               |
| Challenge Handshake Authentication Protocol (CHAP) | Cisco IOS XE Release 2.1 | PPP currently supports two authentication protocols: Password Authentication Protocol (PAP) and Challenge Handshake Authentication Protocol (CHAP). Both are specified in RFC 1334 and are supported on synchronous and asynchronous interfaces. Authentication via PAP or CHAP is equivalent to typing in a username and password when prompted by the server. CHAP is considered to be more secure because the remote user’s password is never sent across the connection.  
In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.  
The following commands were introduced or modified: **ppp authentication**, **ppp chap password**, **ppp chap refuse**. |
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| Domain Stripping at the Server Group Level       | Cisco IOS XE Release 3.4S     | The Domain Stripping feature allows domain stripping to be configured at the server group level. Per-server group configuration overrides the global configuration. The following sections provide information about this feature:  
  * Domain Stripping  
  * Configuring Domain Stripping at the Server Group Level  
  The following command was introduced: `domain-stripping`. |
<p>| Double Authentication                            | Cisco IOS XE Release 2.1      | In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: <code>aaa authentication</code>, <code>aaa authorization</code>, <code>access-profile</code>. |
| Message Banners for AAA Authentication           | Cisco IOS XE Release 2.1      | In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following command was introduced: <code>aaa authentication banner</code>. |</p>
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS-CHAP Version 1</td>
<td>Cisco IOS XE Release 2.1</td>
<td>Microsoft Challenge Handshake Authentication Protocol (MS-CHAP) is the Microsoft version of CHAP and is an extension of RFC 1994. Like the standard version of CHAP, MS-CHAP is used for PPP authentication; in this case, authentication occurs between a PC using Microsoft Windows NT or Microsoft Windows 95 and a Cisco router or access server acting as a network access server. In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: <code>ppp authentication</code>.</td>
</tr>
<tr>
<td>Password Authentication Protocol (PAP)</td>
<td>Cisco IOS XE Release 2.1</td>
<td>PPP currently supports two authentication protocols: Password Authentication Protocol (PAP) and Challenge Handshake Authentication Protocol (CHAP). Both are specified in RFC 1334 and are supported on synchronous and asynchronous interfaces. Authentication via PAP or CHAP is equivalent to typing in a username and password when prompted by the server. CHAP is considered to be more secure because the remote user's password is never sent across the connection. In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: <code>ppp authentication</code>, <code>ppp pap sent-username</code>, <code>ppp pap refuse</code>.</td>
</tr>
<tr>
<td>Feature Name</td>
<td>Releases</td>
<td>Feature Information</td>
</tr>
<tr>
<td>--------------</td>
<td>----------</td>
<td>---------------------</td>
</tr>
<tr>
<td>RADIUS—CLI to Prevent Sending of Access Request with a Blank Username</td>
<td>Cisco IOS XE Release 2.4</td>
<td>This authentication feature prevents an Access Request with a blank username from being sent to the RADIUS server. This functionality ensures that unnecessary RADIUS server interaction is avoided, and RADIUS logs are kept short. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following command was introduced: <code>aaa authentication suppress null-username</code>.</td>
</tr>
</tbody>
</table>
CHAPTER 2

RADIUS Change of Authorization

The RADIUS Change of Authorization (CoA) feature 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 the RADIUS CoA packets from the AAA server such as a Cisco Secure Access Control Server (ACS) to reinitialize authentication and apply the new policy.

- Finding Feature Information, page 67
- Information About RADIUS Change of Authorization, page 67
- How to Configure RADIUS Change of Authorization, page 72
- Configuration Examples for RADIUS Change of Authorization, page 77
- Additional References for RADIUS Change of Authorization, page 78
- Feature Information for RADIUS Change of Authorization, page 79

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About RADIUS Change of Authorization

About RADIUS Change of Authorization

A standard RADIUS interface is typically used in a pulled model, in which the request originates from a device attached to a network and the response is sent from the queried servers. The Cisco software supports the RADIUS CoA request defined in RFC 5176 that is used in a pushed model, in which the request originates...
from the external server to the device attached to the network, and enables the dynamic reconfiguring of sessions from external authentication, authorization, and accounting (AAA) or policy servers.

Use the following per-session CoA requests:

- Session reauthentication
- Session termination
- Session termination with port shutdown
- Session termination with port bounce
- Security and Password
- Accounting

**CoA Requests**

CoA requests, as described in RFC 5176, are used in a pushed model to allow for session identification, host reauthentication, and session termination. The model comprises 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 device 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 device for a session termination.

The following table shows the IETF attributes that are supported for the RADIUS Change of Authorization (CoA) feature.

<table>
<thead>
<tr>
<th>Attribute Number</th>
<th>Attribute Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>State</td>
</tr>
<tr>
<td>31</td>
<td>Calling-Station-ID</td>
</tr>
<tr>
<td>44</td>
<td>Acct-Session-ID</td>
</tr>
<tr>
<td>80</td>
<td>Message-Authenticator</td>
</tr>
<tr>
<td>101</td>
<td>Error-Cause</td>
</tr>
</tbody>
</table>

The following table shows the possible values for the Error-Cause attribute.
### Table 12: Error-Cause Values

<table>
<thead>
<tr>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>201</td>
<td>Residual Session Context Removed</td>
</tr>
<tr>
<td>202</td>
<td>Invalid EAP Packet (Ignored)</td>
</tr>
<tr>
<td>401</td>
<td>Unsupported Attribute</td>
</tr>
<tr>
<td>402</td>
<td>Missing Attribute</td>
</tr>
<tr>
<td>403</td>
<td>NAS Identification Mismatch</td>
</tr>
<tr>
<td>404</td>
<td>Invalid Request</td>
</tr>
<tr>
<td>405</td>
<td>Unsupported Service</td>
</tr>
<tr>
<td>406</td>
<td>Unsupported Extension</td>
</tr>
<tr>
<td>407</td>
<td>Invalid Attribute Value</td>
</tr>
<tr>
<td>501</td>
<td>Administratively Prohibited</td>
</tr>
<tr>
<td>502</td>
<td>Request Not Routable (Proxy)</td>
</tr>
<tr>
<td>503</td>
<td>Session Context Not Found</td>
</tr>
<tr>
<td>504</td>
<td>Session Context Not Removable</td>
</tr>
<tr>
<td>505</td>
<td>Other Proxy Processing Error</td>
</tr>
<tr>
<td>506</td>
<td>Resources Unavailable</td>
</tr>
<tr>
<td>507</td>
<td>Request Initiated</td>
</tr>
<tr>
<td>508</td>
<td>Multiple Session Selection Unsupported</td>
</tr>
</tbody>
</table>

### CoA Request Response Code

The CoA Request Response code can be used to issue a command to the device. The supported commands are listed in the "CoA Request Commands" section.

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 VSAs.
**Session Identification**

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

- Acct-Session-Id (IETF attribute #44)
- Audit-Session-Id (Cisco vendor-specific attribute (VSA))
- Calling-Station-Id (IETF attribute #31, which contains the host MAC address)

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

---

**Note**

A CoA NAK message is not sent for all CoA requests with a key mismatch. The message is sent only for the first three requests for a client. After that, all the packets from that client are dropped. When there is a key mismatch, the response authenticator sent with the CoA NAK message is calculated from a dummy key value.

---

**CoA ACK Response Code**

If an authorization state is changed successfully, a positive acknowledgment (ACK) is sent. The attributes returned within a CoA ACK can vary based on the CoA Request.

**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.

**CoA Request Commands**

The commands supported on the device are shown in the table below. All CoA commands must include the session identifier between the device and the CoA client.

<table>
<thead>
<tr>
<th>Command</th>
<th>Cisco VSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bounce host port</td>
<td>Cisco:Avpair=&quot;subscriber:command=bounce-host-port&quot;</td>
</tr>
<tr>
<td>Disable host port</td>
<td>Cisco:Avpair=&quot;subscriber:command=disable-host-port&quot;</td>
</tr>
<tr>
<td>Reauthenticate host</td>
<td>Cisco:Avpair=&quot;subscriber:command=reauthenticate&quot;</td>
</tr>
<tr>
<td>Terminate session</td>
<td>This is a standard disconnect request that does not require a VSA</td>
</tr>
</tbody>
</table>

---

**About RADIUS Change of Authorization**

RADIUS Change of Authorization
**Session Reauthentication**

To initiate session reauthentication, the authentication, authorization, and accounting (AAA) server sends a standard CoA-Request message that contains a Cisco VSA and one or more session identification attributes. The Cisco VSA is in the form of Cisco:Avpair="subscriber:command=reauthenticate".

The current session state determines the device's response to the message in the following scenarios:

- If the session is currently authenticated by IEEE 802.1x, the device responds by sending an Extensible Authentication Protocol over LAN (EAPoL)-RequestId message to the server.
- If the session is currently authenticated by MAC authentication bypass (MAB), the device 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 device receives the command, the device terminates the process and restarts the authentication sequence, starting with the method configured to be attempted first.

**Session Termination**

A CoA Disconnect-Request terminates the session without disabling the host port. CoA Disconnect-Request termination causes reinitialization of the authenticator state machine for the specified host, but does not restrict the host’s access to the network. If the session cannot be located, the device returns a Disconnect-NAK message with the "Session Context Not Found" error-code attribute. If the session is located, the device terminates the session. After the session has been completely removed, the device returns a Disconnect-ACK message.

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 cause problems on the network and network access needs to be immediately blocked for the host. If you want to restore network access on the port, reenable it using a non-RADIUS mechanism.

**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. If you want 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 the following 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 device cannot locate the session, it returns a CoA-NAK message with the "Session Context Not Found" error-code attribute. If the device locates the session, it disables the hosting port and returns a CoA-ACK message.

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

To ignore the RADIUS server CoA disable port command, see the "Configuring the Device to Ignore Bounce and Disable RADIUS CoA Requests" section.
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 described in the Session Identification. If the session cannot be located, the device returns a CoA-NAK message with the “Session Context Not Found” error-code attribute. If the session is located, the device disables the hosting port for a period of 10 seconds, reenables it (port-bounce), and returns a CoA-ACK.

To ignore the RADIUS server CoA bounce port, see the “Configuring the Device to Ignore Bounce and Disable RADIUS CoA Requests” section.

How to Configure RADIUS Change of Authorization

Configuring RADIUS Change of Authorization

SUMMARY STEPS

1. enable
2. configure terminal
3. aaa new-model
4. aaa server radius dynamic-author
5. client \{ip-address | name [vrf vrf-name]\} server-key [0 | 7] string
6. port port-number
7. auth-type \{any | all | session-key\}
8. ignore session-key
9. ignore server-key
10. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td>2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>aaa new-model</td>
<td>Enables authentication, authorization, and accounting (AAA) globally.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config)# aaa new-model</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>aaa server radius dynamic-author</td>
<td>Enters dynamic authorization local server configuration mode and specifies a RADIUS client from which a device accepts Change of Authorization (CoA) and disconnect requests. Configures the device as a AAA server to facilitate interaction with an external policy server.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config)# aaa server radius dynamic-author</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>client {ip-address</td>
<td>name [vrf vrf-name]} server-key [0</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config-locsvr-da-radius)# client 10.0.0.1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>port port-number</td>
<td>Specifies the port on which a device listens for RADIUS requests from configured RADIUS clients. <strong>Note</strong> The default port for packet of disconnect is 1700. Port 3799 is required to interoperate with ACS 5.1.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config-locsvr-da-radius)# port 3799</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>auth-type {any</td>
<td>all</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config-locsvr-da-radius)# auth-type all</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>ignore session-key</td>
<td>(Optional) Configures the device to ignore the session key.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config-locsvr-da-radius)# ignore session-key</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>ignore server-key</td>
<td>(Optional) Configures the device to ignore the server key.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config-locsvr-da-radius)# ignore server-key</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>exit</td>
<td>Returns to global configuration mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong> Device(config-locsvr-da-radius)# exit</td>
<td></td>
</tr>
</tbody>
</table>
Configuring a Device to Ignore Bounce and Disable RADIUS CoA Requests

When an authentication port is authenticated with multiple hosts and there is a Change of Authorization (CoA) request for one host to flap on this port or one host session to be terminated on this port, the other hosts on this port are also affected. Thus, an authenticated port with multiple hosts can trigger a DHCP renegotiation from one or more hosts in the case of a flap, or it can administratively shut down the authentication port that is hosting the session for one or more hosts.

Perform the following steps to configure the device to ignore RADIUS server Change of Authorization (CoA) requests in the form of a bounce port command or disable port command.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. aaa new-model
4. authentication command bounce-port ignore
5. authentication command disable-port ignore
6. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> aaa new-model</td>
<td>Enables authentication, authorization, and accounting (AAA) globally.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Device(config)# aaa new-model</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> authentication command bounce-port ignore</td>
<td>(Optional) Configures the device to ignore a RADIUS server bounce port command that causes a host to link flap on an authentication port, which causes DHCP renegotiation from one or more hosts connected to this port.</td>
</tr>
</tbody>
</table>
### Configuring the Dynamic Authorization Service for RADIUS CoA

Perform the following steps to enable the device as an authentication, authorization, and accounting (AAA) server for the dynamic authorization service. This service supports the Change of Authorization (CoA) functionality that pushes the policy map in an input and output direction.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. aaa new-model
4. aaa server radius dynamic-author
5. client \{ip-addr | hostname\} [server-key \[0 \| 7\] string]
6. domain \{delimiter character \|stripping \[\ulcorner right-to-left\]\}
7. port port-num
8. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>aaa new-model</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# aaa new-model</td>
</tr>
<tr>
<td></td>
<td>Enables AAA globally.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>aaa server radius dynamic-author</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# aaa server radius dynamic-author</td>
</tr>
<tr>
<td></td>
<td>Sets up the local AAA server for the dynamic authorization service, which must be enabled to support the CoA functionality to push the policy map in an input and output direction, and enters dynamic authorization local server configuration mode.</td>
</tr>
<tr>
<td></td>
<td>• In this mode, the RADIUS application commands are configured.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>**client {ip-addr</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-locsvr-da-radius)# client 192.168.0.5 server-key cisco1</td>
</tr>
<tr>
<td></td>
<td>Configures the IP address or hostname of the AAA server client.</td>
</tr>
<tr>
<td></td>
<td>• Use the optional server-key keyword and string argument to configure the server key at the client level.</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Configuring the server key at the client level overrides the server key configured at the global level.</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>**domain {delimiter character</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-locsvr-da-radius)# domain stripping right-to-left</td>
</tr>
<tr>
<td></td>
<td>(Optional) Configures username domain options for the RADIUS application.</td>
</tr>
<tr>
<td></td>
<td>• The delimiter keyword specifies the domain delimiter. One of the following options can be specified for the character argument: @, /, $, %, , #, or -.</td>
</tr>
<tr>
<td></td>
<td>• The stripping keyword compares the incoming username with the names oriented to the left of the @ domain delimiter.</td>
</tr>
<tr>
<td></td>
<td>• The right-to-left keyword terminates the string at the first delimiter going from right to left.</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td><strong>port port-num</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-locsvr-da-radius)# port 3799</td>
</tr>
<tr>
<td></td>
<td>Configures the UDP port for CoA requests.</td>
</tr>
<tr>
<td><strong>Step 8</strong></td>
<td><strong>end</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-locsvr-da-radius)# end</td>
</tr>
<tr>
<td></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
</tbody>
</table>

### Monitoring and Troubleshooting RADIUS Change of Authorization

The following commands can be used to monitor and troubleshoot the RADIUS Change of Authorization feature:
### Table 14: Monitoring and Troubleshooting RADIUS Change of Authorization

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>debug aaa coa</code></td>
<td>Displays debug information for CoA processing.</td>
</tr>
<tr>
<td><code>debug aaa pod</code></td>
<td>Displays debug messages related to packet of disconnect (POD) packets.</td>
</tr>
<tr>
<td><code>debug radius</code></td>
<td>Displays information associated with RADIUS.</td>
</tr>
<tr>
<td><code>show aaa attributes protocol radius</code></td>
<td>Displays the mapping between an authentication, authorization, and accounting (AAA) attribute number and the corresponding AAA attribute name.</td>
</tr>
</tbody>
</table>

### Configuration Examples for RADIUS Change of Authorization

**Example: Configuring RADIUS Change of Authorization**

```
Device> enable
Device# configure terminal
Device(config)# aaa new-model
Device(config)# aaa server radius dynamic-author
Device(config-localsvr-da-radius)# client 10.0.0.1
Device(config-localsvr-da-radius)# server-key cisco123
Device(config-localsvr-da-radius)# port 3799
Device(config-localsvr-da-radius)# auth-type all
Device(config-localsvr-da-radius)# ignore session-key
Device(config-localsvr-da-radius)# ignore server-key
Device(config-localsvr-da-radius)# end
```

**Example: Configuring a Device to Ignore Bounce and Disable a RADIUS Requests**

```
Device> enable
Device# configure terminal
Device(config)# aaa new-model
Device(config)# authentication command bounce-port ignore
Device(config)# authentication command disable-port ignore
Device(config)# end
```
Example: Configuring the Dynamic Authorization Service for RADIUS CoA

The following example shows how to configure the device as an authentication, authorization, and accounting (AAA) server to support Change of Authorization (CoA) functionality that pushes the policy map in an input and output direction:

```
Device> enable
Device# configure terminal
Device(config)# aaa new-model
Device(config)# aaa server radius dynamic-author
Device(config-locsvr-da-radius)# client 192.168.0.5 server-key cisco1
Device(config-locsvr-da-radius)# domain delimiter @
Device(config-locsvr-da-radius)# port 3799
Device(config-locsvr-da-radius)# end
```

Additional References for RADIUS Change of Authorization

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Command List, All Releases</td>
</tr>
<tr>
<td>Security commands</td>
<td>• Security Command Reference: Commands A to C</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands D to L</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands M to R</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands S to Z</td>
</tr>
<tr>
<td>Configuring AAA</td>
<td>Authentication, Authorization, and Accounting Configuration Guide</td>
</tr>
</tbody>
</table>

### Standards and RFCs

<table>
<thead>
<tr>
<th>Standard/RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 2903</td>
<td>Generic AAA Architecture</td>
</tr>
</tbody>
</table>
Feature Information for RADIUS Change of Authorization

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

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

<table>
<thead>
<tr>
<th>Standard/RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 5176</td>
<td>Dynamic Authorization Extensions to Remote Authentication Dial In User Service (RADIUS)</td>
</tr>
</tbody>
</table>

Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>
### Table 15: Feature Information for RADIUS Change of Authorization

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>RADIUS Change of Authorization</td>
<td>Cisco IOS XE 2.1</td>
<td>The RADIUS Change of Authorization (CoA) feature provides a mechanism to change the attributes of an AAA session after it is authenticated. When</td>
</tr>
<tr>
<td></td>
<td></td>
<td>policy changes for a user or user group in AAA, administrators can send the RADIUS CoA packets from the AAA server, such as the Cisco Secure Access Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Server (ACS), to reinitialize authentication and apply the new policy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The following commands were introduced or modified: <code>aaa server radius dynamic-author</code>, <code>authentication command bounce-port ignore</code>, and <code>authentication command disable-port ignore</code>.</td>
</tr>
</tbody>
</table>
Message Banners for AAA Authentication

The Message Banners for AAA authentication feature is used to configure personalized login and failed-login banners for user authentication. The message banners are displayed when a user logs in to the system to be authenticated using authentication, authorization, and accounting (AAA) and when an authentication fails.

- Finding Feature Information, page 81
- Information About Message Banners for AAA Authentication, page 81
- How to Configure Message Banners for AAA Authentication, page 82
- Configuration Examples for Message Banners for AAA Authentication, page 84
- Additional References for Message Banners for AAA Authentication, page 85
- Feature Information for Message Banners for AAA Authentication, page 86

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About Message Banners for AAA Authentication

Login and Failed-Login Banners for AAA Authentication

Login and failed-login banners use a delimiting character that notifies the system of the exact text string that must be displayed as the banner for authorization, authentication, and accounting (AAA) authentication. The delimiting character is repeated at the end of the text string to signify the end of the login or failed-login
banner. The delimiting character can be any single character in the extended ASCII character set, but once defined as the delimiter, that character cannot be used in the text string for the banner.

You can display a maximum of 2996 characters in a login or failed-login banner.

How to Configure Message Banners for AAA Authentication

Configuring a Login Banner for AAA Authentication

Perform this task to configure a banner that is displayed when a user logs in (replacing the default message for login). Use the `no aaa authentication banner` command to disable a login banner.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `aaa new-model`
4. `aaa authentication banner delimiter-string delimiter`
5. `end`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><code>aaa new-model</code></td>
<td>Enables AAA globally.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# aaa new-model</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><code>aaa authentication banner delimiter-string delimiter</code></td>
<td>Creates a personalized login banner.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device(config)# aaa authentication banner &quot;Unauthorized Access Prohibited&quot;</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# end</td>
<td></td>
</tr>
</tbody>
</table>

### Configuring a Failed-Login Banner for AAA Authentication

Perform this task to configure a failed-login banner that is displayed when a user login fails (replacing the default message for failed login). Use the `no aaa authentication fail-message` command to disable a failed-login banner.

#### SUMMARY STEPS

1. enable
2. configure terminal
3. aaa new-model
4. `aaa authentication banner delimiter-string delimiter`
5. `aaa authentication fail-message delimiter-string delimiter`
6. end

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>aaa new-model</td>
<td>Enters AAA globally.</td>
</tr>
<tr>
<td></td>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device(config)# aaa new-model</td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action | Purpose
--- | ---
**Step 4** | **aaa authentication banner** *delimiter-string delimiter*
Example: 
Device(config)# aaa authentication banner *Unauthorized Access Prohibited*
| Creates a personalized login banner.

**Step 5** | **aaa authentication fail-message** *delimiter-string delimiter*
Example: 
Device(config)# aaa authentication fail-message *Failed login. Try again*
| Creates a message to be displayed when a user login fails.

**Step 6** | **end**
Example: 
Device(config)# end
| Returns to privileged EXEC mode.

---

### Configuration Examples for Message Banners for AAA Authentication

#### Example: Configuring Login and Failed-Login Banners for AAA Authentication

The following example shows how to configure a login banner that is displayed when a user logs in to the system, (in this case, the phrase "Unauthorized Access Prohibited"). The asterisk (*) is used as the delimiting character. RADIUS is specified as the default login authentication method.

Device> enable
Device# configure terminal
Device(config)# aaa new-model
Device(config)# aaa authentication banner *Unauthorized Access Prohibited*
Device(config)# aaa authentication login default group radius

This configuration displays the following login banner:

Unauthorized Access Prohibited
Username:

The following example shows how to configure a failed-login banner that is displayed when a user tries to log in to the system and fails, (in this case, the phrase "Failed login. Try again"). The asterisk (*) is used as the delimiting character. RADIUS is specified as the default login authentication method.

Device> enable
Device# configure terminal
Device(config)# aaa new-model
Device(config)# aaa authentication banner *Unauthorized Access Prohibited*
Device(config)# aaa authentication fail-message *Failed login. Try again.*
Device(config)# aaa authentication login default group radius

This configuration displays the following login and failed-login banner:

Unauthorized Access Prohibited
Username:
Password:
Failed login. Try again.

### Additional References for Message Banners for AAA Authentication

#### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Command List, All Releases</td>
</tr>
<tr>
<td>Security commands</td>
<td>• Security Command Reference: Commands A to C</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands D to L</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands M to R</td>
</tr>
<tr>
<td>Configuring AAA</td>
<td>• Security Command Reference: Commands S to Z</td>
</tr>
<tr>
<td></td>
<td>Authentication, Authorization, and Accounting Configuration Guide</td>
</tr>
</tbody>
</table>
Feature Information for Message Banners for AAA Authentication

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

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

Table 16: Feature Information for Message Banners for AAA Authentication

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message Banners for AAA Authentication</td>
<td>Cisco IOS XE 2.1</td>
<td>The Message Banners for AAA Authentication feature enables you to configure personalized login and failed-login banners for user authentication. The message banners are displayed when a user logs in to the system to be authenticated using authentication, authorization, and accounting (AAA) and when an authentication fails. The following commands were introduced or modified: <code>aaa authentication banner</code>, <code>aaa authentication fail-message</code>, and <code>aaa new-model</code>.</td>
</tr>
</tbody>
</table>
AAA-Domain Stripping at Server Group Level

The AAA-Domain Stripping at Server Group Level feature allows domain stripping to be configured at the server group level.

- Finding Feature Information, page 87
- Information About AAA-Domain Stripping at Server Group Level, page 87
- How to Configure AAA-Domain Stripping at Server Level Group, page 88
- Configuration Example for AAA-Domain Stripping at Server Group Level, page 89
- Additional References, page 89
- Feature Information for AAA-Domain Stripping at Server Group Level, page 91

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About AAA-Domain Stripping at Server Group Level

You can remove the domain name from the username received at the global level by using the `radius-server domain-stripping` command. When the `radius-server domain-stripping` command is configured, all the AAA requests with "user@example.com" go to the remote RADIUS server with the reformatted username "user". The domain name is removed from the request.

**Note**

Domain stripping will not be done in a TACACS configuration.
The AAA Broadcast Accounting feature allows accounting information to be sent to multiple AAA servers at the same time, that is, accounting information can be broadcast to one or more AAA servers simultaneously. This functionality allows you to send accounting information to private and public AAA servers. It also provides redundant billing information for voice applications.

You can configure domain stripping at the server group level by using the `domain-stripping` command in server group RADIUS configuration mode. Per-server group configuration overrides the global configuration. If domain stripping is not enabled globally, but it is enabled in a server group, then it is enabled only for that server group. Also, if virtual routing and forwarding (VRF)-specific domain stripping is configured globally and in a server group for a different VRF, domain stripping is enabled in both the VRFs. VRF configurations are taken from server-group configuration mode. If server-group configurations are disabled in global configuration mode but are available in server-group configuration mode, all configurations in server-group configuration mode are applicable.

After the domain stripping and broadcast accounting are configured, you can create separate accounting records as per the configurations.

### How to Configure AAA-Domain Stripping at Server Level Group

#### Configuring Domain Stripping at the Server Group Level

**SUMMARY STEPS**

1. enable
2. configure terminal
3. aaa new-model
4. aaa group server radius server-name
5. domain-stripping [strip-suffix word] [right-to-left] [prefix-delimiter word] [delimiter word]
6. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Device# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 3</td>
<td>aaa new-model</td>
<td>Enables AAA.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# aaa new-model</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>aaa group server radius server-name</td>
<td>Adds the RADIUS server and enters server group RADIUS configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config)# aaa group server radius rad1</td>
<td>• The server-name argument specifies the RADIUS server group name.</td>
</tr>
<tr>
<td>Step 5</td>
<td>domain-stripping [strip-suffix word] [right-to-left ] [prefix-delimiter word] [delimiter word]</td>
<td>Configures domain stripping at the server group level.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-sg-radius)# domain-stripping delimiter <a href="mailto:username@example.com">username@example.com</a></td>
<td></td>
</tr>
<tr>
<td>Step 6</td>
<td>end</td>
<td>Exits server group RADIUS configuration mode and returns to the privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Device(config-sg-radius)# end</td>
<td></td>
</tr>
</tbody>
</table>

## Configuration Example for AAA-Domain Stripping at Server Group Level

**Example: AAA-Domain Stripping at Server Group Level**

The following example shows the domain stripping configuration at the server group level:

```
Device> enable
Device# configure terminal
Device(config)# aaa new-model
Device(config)# aaa group server radius rad1
Device(config-sg-radius)# domain-stripping right-to-left delimiter @$/
Device(config-sg-radius)# end
```

## Additional References

The following sections provide references related to the Configuring Authentication feature.
### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security commands</td>
<td><em>Cisco IOS Security Command Reference</em></td>
</tr>
</tbody>
</table>

### Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
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<tr>
<td>--</td>
<td>No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.</td>
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</table>

### MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
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<tbody>
<tr>
<td>--</td>
<td>No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.</td>
</tr>
<tr>
<td></td>
<td>To locate and download MIBs for selected platforms, Cisco IOS XE software 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></td>
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</table>

### RFCs

<table>
<thead>
<tr>
<th>RFC</th>
<th>Title</th>
</tr>
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<tbody>
<tr>
<td>RFC 1334</td>
<td>PPP Authentication Protocols</td>
</tr>
<tr>
<td>RFC 2433</td>
<td>Microsoft PPP CHAP Extensions</td>
</tr>
<tr>
<td>RFC 2903</td>
<td>Generic AAA Architecture</td>
</tr>
<tr>
<td>RFC 2904</td>
<td>AAA Authorization Framework</td>
</tr>
<tr>
<td>RFC 2906</td>
<td>AAA Authorization Requirements</td>
</tr>
<tr>
<td>RFC 2989</td>
<td>Criteria for Evaluating AAA Protocols for Network Access</td>
</tr>
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Technical Assistance

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

Feature Information for AAA-Domain Stripping at Server Group Level

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

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

Table 17: Feature Information for AAA-Domain Stripping at Server Group Level

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA-Domain Stripping at Server Group Level</td>
<td>Cisco IOS XE Release 3.4S</td>
<td>The AAA-Domain Stripping at Server Group Level feature allows domain stripping to be configured at the server group level. The following command was introduced: domain-stripping.</td>
</tr>
</tbody>
</table>
AAA Double Authentication Secured by Absolute Timeout

The AAA Double Authentication Secured by Absolute Timeout feature allows you to secure the double authentication mechanism by protecting it with a per-user session timeout. This feature optimizes the connections to the network that are authorized by service providers and increases the security of the overall access to the network by ensuring that no unwanted sessions are connected.

- Finding Feature Information, page 93
- Prerequisites for AAA Double Authentication Secured by Absolute Timeout, page 94
- Restrictions for AAA Double Authentication Secured by Absolute Timeout, page 94
- Information About AAA Double Authentication Secured by Absolute Timeout, page 94
- How to Apply AAA Double Authentication Secured by Absolute Timeout, page 95
- Configuration Examples for AAA Double Authentication Secured by Absolute Timeout, page 98
- Additional References, page 100
- Feature Information for AAA Double Authentication Secured by Absolute Timeout, page 101

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.
Prerequisites for AAA Double Authentication Secured by Absolute Timeout

- You need access to a Cisco RADIUS or TACACS+ server and should be familiar with configuring RADIUS or TACACS+.
- You should be familiar with configuring authentication, authorization, and accounting (AAA) and enabling AAA automated double authentication.

Restrictions for AAA Double Authentication Secured by Absolute Timeout

- The AAA Double Authentication Secured by Absolute Timeout feature is for PPP connections only. Automated double authentication cannot be used with other protocols, such as X.25 or Serial Line Internet Protocol (SLIP).
- There may be a minimal impact on performance if a TACACS+ server is used. However, there is no performance impact if a RADIUS server is used.

Information About AAA Double Authentication Secured by Absolute Timeout

AAA Double Authentication

Use the AAA double authentication mechanism to pass the first authentication using a host username and password. The second authentication, after the Challenge Handshake Authentication Protocol (CHAP) or the Password Authentication Protocol (PAP) authentication, uses a login username and password. In the first authentication, a PPP session timeout is applied to the virtual access interface if it is configured locally or remotely.

The AAA Double Authentication Secured by Absolute Timeout feature allows you to secure the double authentication mechanism by protecting it with a per-user session timeout. The per-user session timeout, which can be customized, supersedes the generic absolute timeout value. This method works on the same principle as per-user access control lists (ACLs) in double authentication.
How to Apply AAA Double Authentication Secured by Absolute Timeout

Applying AAA Double Authentication Secured by Absolute Timeout

To apply the absolute timeout, you must configure session-timeout in the login user profile as a link control protocol (LCP) per-user attribute. Use the **access-profile** command to enable AAA double authentication. This command is used to apply your per-user authorization attributes to an interface during a PPP session. Before you use the **access-profile** command, you must first reauthorize LCP per-user attributes (for example, Session-Timeout) and then reauthorize Network Control Protocols (NCPs) to apply other necessary criteria, such as ACLs and routes. See the section “Examples for AAA Double Authentication Secured by Absolute Timeout.”

**Note**
The Timeout configuration in a TACACS+ user profile is different from the configuration in a RADIUS user profile. In a RADIUS profile, only one session-timeout is configured, along with the autocmd **access-profile**. The timeout is applied to the EXEC session and to the PPP session respectively. In TACACS+, however, the timeout must be configured under the service types “exec” and “ppp” (LCP) to apply a timeout to the EXEC session and to the PPP session. If the timeout is configured only under the service type “ppp,” the timeout value will not be available during an EXEC authorization, and the timeout will not be applied to the EXEC session.

Verifying AAA Double Authentication Secured by Absolute Timeout

To verify that AAA double authentication has been secured by absolute timeout and to see information about various attributes associated with the authentication, perform the following steps. These **show** and **debug** commands can be used in any order.

**Note**
If idle timeout is configured on a full virtual access interface and a subvirtual access interface, the **show users** command displays the idle time for both interfaces. However, if the idle timeout is not configured on both interfaces, the **show users** command will display the idle time for the full virtual access interface only.
SUMMARY STEPS

1. enable
2. show users
3. show interfaces virtual-access  number [configuration]
4. debug aaa authentication
5. debug aaa authorization
6. debug aaa per-user
7. debug ppp authentication
8. Enter one of the following:
   • debug radius
     or
   debug tacacs

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2</td>
<td>show users</td>
<td>Displays information about active lines on the device.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# show users</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>show interfaces virtual-access  number [configuration]</td>
<td>Displays status, traffic data, and configuration information about a specified virtual access interface.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# show interfaces virtual-access 2 configuration</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>debug aaa authentication</td>
<td>Displays information about AAA TACACS+ authentication.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# debug aaa authentication</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>debug aaa authorization</td>
<td>Displays information about AAA TACACS+ authorization.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device# debug aaa authorization</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> debug aaa per-user</td>
<td>Displays the attributes that are applied to each user as the user gets authenticated.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong> Device# debug aaa per-user</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> debug ppp authentication</td>
<td>Displays whether a user is passing authentication.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong> Device# debug ppp authentication</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 8</strong> Enter one of the following: • debug radius or debug tacacs</td>
<td>Displays the debug information associated with the RADIUS server. or Displays the debug information associated with the TACACS+ server.</td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong> Device# debug radius</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong> Device# debug tacacs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Examples**

The following sample output is from the `show users` command:

```
Device# show users

<table>
<thead>
<tr>
<th>Line</th>
<th>User</th>
<th>Host(s)</th>
<th>Idle</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 0 con 0</td>
<td>aaapbx2</td>
<td>idle</td>
<td>00:00:00</td>
<td>aaacon2 10</td>
</tr>
<tr>
<td>8 vty 0</td>
<td>broker_def</td>
<td>idle</td>
<td>00:00:08</td>
<td>192.168.1.8</td>
</tr>
</tbody>
</table>

Interface User Mode Idle Peer Address
Vi2 broker_default VDP 00:00:01 192.168.1.8 <========
Se0:22 aaapbx2 Sync PPP 00:00:23
```

The following sample output is from the `show interfaces virtual-access` command:

```
Device# show interfaces virtual-access 2 configuration

Virtual-Access2 is a Virtual Profile (sub)interface
Derived configuration: 150 bytes
!
interface Virtual-Access2
  ip unnumbered Serial0:23
  no ip route-cache
timeout absolute 3 0
! The above line shows that the per-user session timeout has been applied.
  ppp authentication chap
```
Configuration Examples for AAA Double Authentication Secured by Absolute Timeout

Example: RADIUS User Profile

The following sample output shows that a RADIUS user profile has been applied and that AAA double authentication has been secured by an absolute timeout:

```
aaapbx2 Password = "password1",
Service-Type = Framed,
Framed-Protocol = PPP,
Session-Timeout = 180,
Idle-Timeout = 180000,
cisco-avpair = "ip:inacl#1=permit tcp any any eq telnet"
cisco-avpair = "ip:inacl#2=permit icmp any any"
broker_default Password = "password1",
Service-Type = Administrative,
cisco-avpair = "shell:autocmd-access-profile",
Session-Timeout = 360,
cisco-avpair = "ip:inacl#1=permit tcp any any"
cisco-avpair = "ip:inacl#2=permit icmp any any"
broker_merge Password = "password1",
Service-Type = Administrative,
cisco-avpair = "shell:autocmd-access-profile merge",
Session-Timeout = 360,
cisco-avpair = "ip:inacl#1=permit tcp any any"
cisco-avpair = "ip:inacl#2=permit icmp any any"
cisco-avpair = "ip:route#3=10.4.0.0 255.0.0.0"
cisco-avpair = "ip:route#4=10.5.0.0 255.0.0.0"
cisco-avpair = "ip:route#5=10.6.0.0 255.0.0.0"
broker_replace Password = "password1",
Service-Type = Administrative,
cisco-avpair = "shell:autocmd-access-profile replace",
Session-Timeout = 360,
cisco-avpair = "ip:inacl#1=permit tcp any any"
cisco-avpair = "ip:inacl#2=permit icmp any any"
cisco-avpair = "ip:route#3=10.4.0.0 255.0.0.0"
cisco-avpair = "ip:route#4=10.5.0.0 255.0.0.0"
cisco-avpair = "ip:route#5=10.6.0.0 255.0.0.0"
```

Example: TACACS User Profile

The following sample output shows that a TACACS+ user profile has been applied and that AAA double authentication has been secured by an absolute timeout.

Remote Host Authentication

The following example shows how to allow the remote host to be authenticated by the local host during the first-stage authentication and provides the remote host authorization profile.

```
user = aaapbx2
chap = cleartext Cisco
pap = cleartext cisco
login = cleartext cisco
```
Using the `access-profile` Command Without Any Arguments

Using the `access-profile` command without any arguments causes the removal of any access lists that are found in the old configuration (both per-user and per-interface) and ensures that the new profile contains only access-list definitions.

```plaintext
user = broker_default
login = cleartext Cisco
chap = cleartext "cisco"
service = exec
autocmd = "access-profile"
! This is the autocommand that executes when broker_default logs in.
timeout = 6
service = ppp protocol = lcp
timeout = 6
service = ppp protocol = ip
! Put access lists, static routes, and other requirements that are needed here. Read the software specifications for details. If you leave this blank, the user will have no access lists (not even the ones that were installed prior to the creation of this user profile)!
inacl#1="permit tcp any any eq telnet"
inacl#2="permit icmp host 10.0.0.0 any"
service = ppp protocol = ipx
```

Using the `access-profile` Command with the merge Keyword

The `merge` keyword in the `access-profile` command is used to remove all old access lists, and any attribute-value (AV) pair is allowed to be uploaded and installed. The use of the `merge` keyword will allow for the uploading of any custom static routes, Service Advertisement Protocol (SAP) filters, and other requirements that users may need in their profiles. Configure the `merge` keyword with care because it leaves everything open in terms of conflicting configurations.

```plaintext
user = broker_merge
login = cleartext Cisco
chap = cleartext "cisco"
service = exec
autocmd = "access-profile merge"
! This is the autocommand that executes when broker_merge logs in.
timeout = 6
service = ppp protocol = lcp
timeout = 6
service = ppp protocol = ip
! Put access lists, static routes, and other requirements that are needed here. Read the software specifications for details. If you leave this blank, the user will have no access lists (not even the ones that were installed prior to the creation of this user profile)!
route#1="10.4.0.0 255.0.0.0"
route#2="10.5.0.0 255.0.0.0"
route#3="10.6.0.0 255.0.0.0"
inac1#5="permit tcp any any"
inac1#6="permit icmp host 10.60.0.0 any"
service = ppp protocol = ipx
! Put access lists, static routes, and other requirements that are needed here. Read the software specifications for details. If you leave this blank, the user will have no access lists (not even the ones that were installed prior to the creation of this user profile)!
```
Using the `access-profile` Command with the `replace` Keyword

If you use the `access-profile` command with the `replace` keyword, any old configurations are removed and a new configuration is installed.

**Note**

When the `access-profile` command is configured, the new configuration is checked for address pools and address-AV pairs. Because addresses cannot be renegotiated at this point, the command will fail to work when it encounters such an address-AV pair.

```
user = broker_replace
login = cleartext Cisco
chap = cleartext "cisco"
```

```
service = exec
  autocmd = "access-profile replace"

! This is the autocmd that executes when broker_replace logs in.
  timeout = 6

service = ppp protocol = lcp
  timeout = 6

service = ppp protocol = ip
  ! Put access lists, static routes, and other requirements that are
  ! needed here. Read the software specifications for details. If you leave
  ! this blank, the user will have no access lists (not even the ones that were
  ! installed prior to the creation of this user profile)
  route#1="10.7.0.0 255.0.0.0"
  route#2="10.8.0.0 255.0.0.0"
  route#3="10.9.0.0 255.0.0.0"
  inacl#4="permit tcp any any"

service = ppp protocol = ipx
  ! Put access lists, static routes, and other requirements that are
  ! needed here. Read the software specifications for details. If you leave
  ! this blank, the user will have no access lists (not even the ones that were
  ! installed prior to the creation of this user profile)

The Timeout configuration in a TACACS+ user profile is different from the configuration in a RADIUS user profile. In a RADIUS profile, only one session-timeout is configured, along with the autocmd `access-profile`. The timeout will be applied to the EXEC session and to the PPP session. In the TACACS+ user profile, however, the timeout must be configured under the service types "exec" and "ppp" (LCP) to apply a timeout to the EXEC session and to the PPP session respectively. If the timeout is configured only under the service type "ppp," the timeout value will not be available during an EXEC authorization, and the timeout will not be applied to the EXEC session.

**Additional References**

**Related Documents**

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Master Command List, All Releases</td>
</tr>
</tbody>
</table>
Feature Information for AAA Double Authentication Secured by Absolute Timeout

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
### Table 18: Feature Information for AAA Double Authentication Secured by Absolute Timeout

<table>
<thead>
<tr>
<th>Feature Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA Double Authentication Secured by Absolute Timeout</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Releases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS XE 2.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>The AAA Double Authentication Secured by Absolute Timeout feature allows you to secure the double authentication mechanism by protecting it with a per-user session timeout. This feature optimizes the connection to the network by service providers to only connections that are authorized, and it increases the security of the overall access to the network by ensuring that no unwanted sessions are connected.</td>
</tr>
</tbody>
</table>
Throttling of AAA RADIUS Records

The Throttling of AAA (RADIUS) Records feature supports throttling of access (authentication and authorization) and accounting records that are sent to the RADIUS server. This feature allows a user to configure the appropriate throttling rate to avoid network congestion and instability; such as when there is insufficient bandwidth to accommodate a sudden burst of records generated from the router to the RADIUS server.

- Finding Feature Information, page 103
- Information About Throttling of AAA RADIUS Records, page 103
- How to Configure Throttling of AAA RADIUS Records, page 104
- Configuration Examples for Throttling of AAA RADIUS Records, page 107
- Additional References, page 108
- Feature Information for Throttling of AAA RADIUS Records, page 109

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.

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Information About Throttling of AAA RADIUS Records

Benefits of the Throttling of AAA RADIUS Records Feature

A Network Access Server (NAS), acting as RADIUS client, can generate a burst of accounting or access requests, causing severe network congestion or causing the RADIUS server to become overloaded with a
burst of RADIUS traffic. This problem could be compounded when multiple NASs interact with the RADIUS servers.

The following conditions can trigger a sudden burst of RADIUS traffic:

• An interface flap, which in turn brings down all the subscriber sessions and generates accounting requests for each subscriber.

• The High Availability (HA) program generating a START record for every session that survived a switchover, such as the scenario described the preceding bullet.

A large number of generated requests can make the network unstable if there is insufficient bandwidth or if the RADIUS server is slow to respond. Neither the User Datagram Protocol (UDP) transport layer nor the RADIUS protocol has a flow control mechanism. The throttling mechanism provided by this feature provides a solution for these issues.

Throttling Access Requests and Accounting Records

The Throttling of AAA (RADIUS) Records feature introduces a mechanism to control packets (flow control) at the NAS level, which improves the RADIUS server performance.

Because of their specific uses, access requests and accounting records must be treated separately. Access request packets are time sensitive, while accounting record packets are not.

• If a response to an access request is not returned to the client in a timely manner, the protocol or the user will time out, impacting the device transmission rates.

• Accounting records packets are not real-time critical.

When configuring threshold values on the same server, it is important to prioritize threshold values for the handling of the time-sensitive access request packets and to place a lesser threshold value on the accounting records packets.

In some cases, when an Internet Service Provider (ISP) is using separate RADIUS servers for access requests and accounting records, only accounting records throttling may be required.

Summary

• The Throttling of AAA (RADIUS) Records is disabled, by default.

• Throttling functionality can be configured globally or at server group level.

How to Configure Throttling of AAA RADIUS Records

This section describes how to configure throttling of access (authentication and authorization) and accounting records that are sent to the RADIUS server for both, global and server groups.

Server-group configurations are used to enable or disable throttling for a particular server group and to specify the threshold value for that server group.

Note

Server-group configurations override any configured global configurations.
Throttling Accounting and Access Request Packets Globally

To globally configure the throttling of accounting and access request packets, perform the following task.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `radius-server throttle { accounting { accounting threshold } [access threshold [access-timeout number-of-timeouts]]}
4. `exit`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>• Enter your password if prompted.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>radius-server throttle { accounting { accounting threshold } [access threshold [access-timeout number-of-timeouts]]}</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config)# radius-server throttle accounting 100 access 200 access-timeout 2</td>
<td>Configures global throttling for accounting and access request packets.</td>
</tr>
<tr>
<td>• The accounting threshold value (the range is 0-65536) is set to 100, and the access threshold value is set to 200.</td>
<td></td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>The default threshold value is 0 (throttling disabled).</td>
</tr>
<tr>
<td>• The number of timeouts per transaction value (the range is 1-10) is set to 2.</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>exit</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config)# exit</td>
<td>Exits global configuration mode.</td>
</tr>
</tbody>
</table>
Throttling Accounting and Access Request Packets Per Server Group

The following server-group configuration can be used to enable or disable throttling for a specified server group and to specify the threshold value for that server group.

To configure throttling of server-group accounting and access request packets, perform the following task.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. aaa group server radius server-group-name
4. throttle { [accounting threshold] [access threshold [access-timeout number-of-timeouts]]}
5. exit

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>aaa group server radius server-group-name</td>
</tr>
<tr>
<td>Example:</td>
<td>Enters server-group configuration mode.</td>
</tr>
<tr>
<td>Router(config)# aaa group server radius myservergroup</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>throttle { [accounting threshold] [access threshold [access-timeout number-of-timeouts]]}</td>
</tr>
<tr>
<td>Example:</td>
<td>Configures the specified server-group throttling values for accounting and access request packets.</td>
</tr>
<tr>
<td>Router(config-sg-radius)# throttle accounting 100 access 200 access-timeout 2</td>
<td>For this example:</td>
</tr>
<tr>
<td></td>
<td>• The accounting threshold value (the range is 0-65536) is set to 100, and the access threshold value is set to 200.</td>
</tr>
<tr>
<td></td>
<td>• The number of time-outs per transaction value (the range is 1-10) is set to 2.</td>
</tr>
<tr>
<td></td>
<td>Note</td>
</tr>
<tr>
<td></td>
<td>The default threshold value is 0 (throttling disabled).</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td></td>
</tr>
<tr>
<td>exit</td>
<td>Exits server-group configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config-sg-radius)# exit</td>
<td></td>
</tr>
</tbody>
</table>

## Configuration Examples for Throttling of AAA RADIUS Records

### Throttling Accounting and Access Request Packets Globally Example

The following example shows how to limit the number of accounting requests sent to a server to 100:

```plaintext
enable
cfg-term
radius-server throttle accounting 100
```

The following example shows how to limit the number of access requests packets sent to a server to 200 and sets the number of time-outs allowed per transactions to 2:

```plaintext
enable
cfg-term
radius-server throttle access 200
radius-server throttle access 200 access-timeout 2
```

The following example shows how to throttle both accounting and access request packets:

```plaintext
enable
cfg-term
radius-server throttle accounting 100 access 200
```

### Throttling Accounting and Access Request Packets Per Server Group Example

The following example shows how to limit the number of accounting requests sent to server-group-A to 100:

```plaintext
enable
cfg-term
aaa group server radius server-group-A
throttle accounting 100
```

The following example shows how to limit the number of access requests packets sent to server-group-A to 200 and sets the number of time-outs allowed per transactions to 2:

```plaintext
enable
cfg-term
aaa group server radius server-group-A
throttle access 200 access-timeout 2
```

The following example shows how to throttle both accounting and access request packets for server-group-A:

```plaintext
enable
cfg-term
```
Additional References

The following sections provide references related to the Throttling of AAA (RADIUS) Records feature.

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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<tbody>
<tr>
<td>Security commands</td>
<td><em>Cisco IOS Security Command Reference</em></td>
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### Standards

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<tr>
<td>for existing standards has not been modified by this feature.</td>
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### MIBs

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<th>MIB</th>
<th>MIBs Link</th>
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</thead>
<tbody>
<tr>
<td>No new or modified MIBs are supported by this feature, and support</td>
<td>To locate and download MIBs for selected platforms, Cisco IOSXE</td>
</tr>
<tr>
<td>for existing MIBs has not been modified by this feature.</td>
<td>software releases, and feature sets, use Cisco MIB Locator found at the</td>
</tr>
<tr>
<td></td>
<td>following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
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### RFCs

<table>
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<tr>
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<th>Title</th>
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<tbody>
<tr>
<td>No new or modified RFCs are supported by this feature, and support</td>
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</tr>
<tr>
<td>for existing RFCs has not been modified by this feature.</td>
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</tbody>
</table>
Technical Assistance

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

Feature Information for Throttling of AAA RADIUS Records

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throttling of AAA (RADIUS) Records</td>
<td>Cisco IOS XE Release 2.1</td>
<td>The Throttling of AAA (RADIUS) Records feature supports throttling of access (authentication and authorization) and accounting records that are sent to the RADIUS server. This feature allows a user to configure the appropriate throttling rate to avoid network congestion and instability; such as when there is insufficient bandwidth to accommodate a sudden burst of records generated from the Cisco IOS XE router to the RADIUS server. In Cisco IOS XE Release 2.1, this feature was introduced on Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified by this feature: radius-server throttle, throttle</td>
</tr>
</tbody>
</table>
CHAPTER 7

RADIUS Packet of Disconnect

The RADIUS Packet of Disconnect feature is used to terminate a connected voice call.

- Finding Feature Information, page 111
- Prerequisites for RADIUS Packet of Disconnect, page 111
- Restrictions for RADIUS Packet of Disconnect, page 111
- Information About RADIUS Packet of Disconnect, page 112
- How to Configure the RADIUS Packet of Disconnect, page 113
- Additional References, page 115
- Feature Information for RADIUS Packet of Disconnect, page 117
- Glossary, page 117

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.

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Prerequisites for RADIUS Packet of Disconnect


Restrictions for RADIUS Packet of Disconnect

Proper matching identification information must be communicated by the following:
Information About RADIUS Packet of Disconnect

The Packet of Disconnect (POD) is a RADIUS access_request packet and is intended to be used in situations where the authenticating agent server wants to disconnect the user after the session has been accepted by the RADIUS access_accept packet.

When the POD is Needed

The POD may be needed in at least two situations:

• Detection of fraudulent use, which cannot be performed before accepting the call. A price structure so complex that the maximum session duration cannot be estimated before accepting the call. This may be the case when certain types of discounts are applied or when multiple users use the same subscription simultaneously.

• To prevent unauthorized servers from disconnecting users, the authorizing agent that issues the POD packet must include three parameters in its packet of disconnect request. For a call to be disconnected, all parameters must match their expected values at the gateway. If the parameters do not match, the gateway discards the packet of disconnect packet and sends a NACK (negative acknowledgement message) to the agent.

POD Parameters

The POD has the following parameters:

• An h323-conf-id vendor-specific attribute (VSA) with the same content as received from the gateway for this call.

• An h323-call-origin VSA with the same content as received from the gateway for the leg of interest.

• A 16-byte MD5 hash value that is carried in the authentication field of the POD request.

• Cisco IOS XE software allocates POD code 50 as the code value for the Voice POD Request based on RFC 3576 Dynamic Authorization Extensions to RADIUS, which extends RADIUS standards to officially support both a Disconnect Message (DM) and Change-of-Authorization (CoA) that are supported through the POD.

RFC 3576 specifies the following POD codes:

• 40 - Disconnect-Request

• 41 - Disconnect-ACK

• 42 - Disconnect-NAK

• 43 - CoA-Request
• 44 - CoA-ACK
• 45 - CoA-NAK

How to Configure the RADIUS Packet of Disconnect

Configuring the RADIUS POD

Use the following tasks to configure the RADIUS POD:

SUMMARY STEPS

1. enable
2. configure terminal
3. Router (config)# aaa pod server [port port-number] [auth-type {any| all| session-key}] server-key [encryption-type] string
4. Router# end
5. Router# show running-configuration

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Router&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>

| **Step 2** configure terminal | Enters global configuration mode. |
| **Example:** Router# configure terminal | |

| **Step 3** Router (config)# aaa pod server [port port-number] [auth-type {any| all| session-key}] server-key [encryption-type] string | Enables inbound user sessions to be disconnected when specific session attributes are presented, where: |
| **Example:** Router(config)# aaa pod server server-key xyz123 | • port port-number --(Optional) The network access server User Datagram Protocol (UDP) port to use for POD requests. Default value is 1700. |
| | • auth-type --(Optional) The type of authorization required for disconnecting sessions. |
| | • any--Session that matches all of the attributes sent in the POD packet is disconnected. The POD packet may contain one or |
Purpose

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>more of four key attributes (user-name, framed-IP-address, session-ID, and session-key).</td>
<td></td>
</tr>
<tr>
<td>• <strong>all</strong>—Only a session that matches all four key attributes is disconnected. <strong>All</strong> is the default.</td>
<td></td>
</tr>
<tr>
<td>• <strong>session-key</strong>—Session with a matching session-key attribute is disconnected. All other attributes are ignored.</td>
<td></td>
</tr>
<tr>
<td>• <strong>server-key</strong>—Configures the shared-secret text string.</td>
<td></td>
</tr>
<tr>
<td>• <strong>encryption-type</strong>—(Optional) Single-digit number that defines whether the text immediately following is encrypted, and, if so, what type of encryption is used. Defined encryption types are 0, which means that the text immediately following is not encrypted, and 7, which means that the text is encrypted using an encryption algorithm defined by Cisco.</td>
<td></td>
</tr>
<tr>
<td>• <strong>string</strong>—The shared-secret text string that is shared between the network access server and the client workstation. This shared-secret string must be the same on both systems.</td>
<td></td>
</tr>
</tbody>
</table>

**Step 4**

Router# **end**

Exits global configuration mode and returns to privileged EXEC mode.

**Step 5**

Router# **show running-configuration**

Example:

Router# show running-configuration

Example:

!

Example:

aaa authentication login h323 group radius

Example:

aaa authorization exec h323 group radius

Example:

aaa accounting update newinfo
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>aaa accounting connection h323</td>
<td></td>
</tr>
<tr>
<td>start-stop group radius</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>aaa pod server server-key cisco</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>aaa session-id common</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>

**Troubleshooting Tips**

After you have configured AAA Dead-Server Detection, you should verify your configuration using the `show running-config` command. This verification is especially important if you have used the `no` form of the `radius-server dead-criteria` command. The output of the `show running-config` command must show the same values in the “Dead Criteria Details” field that you configured using the `radius-server dead-criteria` command.

**Verifying the RADIUS POD Configuration**

To verify the RADIUS POD configuration, use the `show running configuration` privileged EXEC command as shown in the following example:

```
Router# show running-configuration
!
aaa authentication login h323 group radius
aaa authorization exec h323 group radius
aaa accounting update newinfo
aaa accounting connection h323 start-stop group radius
aaa pod server server-key cisco
aaa session-id common
.
.
```

**Additional References**

The following sections provide references related to the RADIUS Packet of Disconnect feature.
Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security commands</td>
<td>Cisco IOS Security Command Reference</td>
</tr>
<tr>
<td>CLI Configuration</td>
<td>Cisco IOS XE Configuration Fundamentals Configuration Guide, Release 2</td>
</tr>
</tbody>
</table>

Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.</td>
</tr>
<tr>
<td></td>
<td>--</td>
</tr>
</tbody>
</table>

MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To locate and download MIBs for selected platforms, Cisco IOS XE software 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></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RFCs

<table>
<thead>
<tr>
<th>RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 2865</td>
<td>Remote Authentication Dial-in User Service</td>
</tr>
<tr>
<td>RFC 3576</td>
<td>Dynamic Authorization Extensions to RADIUS</td>
</tr>
</tbody>
</table>
Technical Assistance

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

Feature Information for RADIUS Packet of Disconnect

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

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

Table 20: Feature Information for RADIUS Packet of Disconnect

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
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<tbody>
<tr>
<td>RADIUS Packet of Disconnect</td>
<td>Cisco IOS XE Release 2.1</td>
<td>The RADIUS Packet of Disconnect feature is used to terminate a connected voice call.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In Cisco IOS XE Release 2.1, this feature was introduced on the on Cisco ASR 1000 Series Aggregation Services Routers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The following commands were introduced or modified: aaa pod server, debug aaa pod</td>
</tr>
</tbody>
</table>

Glossary

**AAA** --authentication, authorization, and accounting. A framework of security services that provide the method for identifying users (authentication), for remote access control (authorization), and for collecting and sending security server information used for billing, auditing, and reporting (accounting).
**L2TP** -- Layer 2 Tunnel Protocol. A Layer 2 tunneling protocol that enables an ISP or other access service to create a virtual tunnel to link customer remote sites or remote users with corporate home networks. In particular, a network access server (NAS) at the ISP point of presence (POP) exchanges PPP messages with the remote users and communicates by L2F or L2TP requests and responses with the customer tunnel server to set up tunnels.

**PE** -- Provider Edge. Networking devices that are located on the edge of a service provider network.

**RADIUS** -- Remote Authentication Dial-In User Service. RADIUS is a distributed client/server system that secures networks against unauthorized access. In the Cisco implementation, RADIUS clients run on Cisco routers and send authentication requests to a central RADIUS server that contains all user authentication and network service access information.

**VPN** -- Virtual Private Network. A system that permits dial-in networks to exist remotely to home networks, while giving the appearance of being directly connected. VPNs use L2TP and L2F to terminate the Layer 2 and higher parts of the network connection at the LNS instead of the LAC.

**VRF** -- Virtual Route Forwarding. Initially, a router has only one global default routing/forwarding table. VRFs can be viewed as multiple disjoined routing/forwarding tables, where the routes of a user have no correlation with the routes of another user.
AAA Authorization and Authentication Cache

The AAA Authorization and Authentication Cache feature allows you to cache authorization and authentication responses for a configured set of users or service profiles, providing performance improvements and an additional level of network reliability because user and service profiles that are returned from authorization and authentication responses can be queried from multiple sources and need not depend solely on an offload server. This feature also provides a failover mechanism so that if a network RADIUS or TACACS+ server is unable to provide authorization and authentication responses network users and administrators can still access the network.

- Finding Feature Information, page 119
- Prerequisites for Implementing Authorization and Authentication Profile Caching, page 120
- Information About Implementing Authorization and Authentication Profile Caching, page 120
- How to Implement Authorization and Authentication Profile Caching, page 122
- Configuration Examples for Implementing Authorization and Authentication Profile Caching, page 128
- Additional References for RADIUS Change of Authorization, page 131
- Feature Information for Implementing Authorization and Authentication Profile Caching, page 132

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.
Prerequisites for Implementing Authorization and Authentication Profile Caching

The following prerequisites apply to implementing authorization and authentication profile caching:

- Understand how you would want to implement profile caching, that is, are profiles being cached to improve network performance or as a failover mechanism if your network authentication and authorization (RADIUS and TACACS+) servers become unavailable.
- RADIUS and TACACS+ server groups must already be configured.

Information About Implementing Authorization and Authentication Profile Caching

Network Performance Optimization Using Authorization and Authentication Profile Caching

RADIUS and TACACS+ clients run on Cisco routers and send authentication requests to a central RADIUS or TACACS+ server that contains all user authentication and network service access information. The router is required to communicate with an offload RADIUS or TACACS+ server to authenticate a given call and then apply a policy or service to that call. Unlike authentication, authorization, and accounting (AAA) accounting, AAA authentication and authorization is a blocking procedure, which means the call setup may not proceed while the call is being authenticated and authorized. Thus, the time required to process the call setup is directly impacted by the time required to process such an authentication or authorization request from the router to the offload RADIUS or TACACS+ server, and back again. Any communication problems in the transmission, offload server utilization, and numerous other factors cause significant degradation in a router’s call setup performance due simply to the AAA authentication and authorization step. The problem is further highlighted when multiple AAA authentications and authorizations are needed for a single call or session.

A solution to this problem is to minimize the impact of such authentication requests by caching the authentication and authorization responses for given users on the router, thereby removing the need to send the requests to an offload server again and again. This profile caching adds significant performance improvements to call setup times. Profile caching also provides an additional level of network reliability because user and service profiles that are returned from authentication and authorization responses can be queried from multiple sources and need not depend solely on an offload server.

To take advantage of this performance optimization, you need to configure the authentication method list so that the AAA cache profile is queried first when a user attempts to authenticate to the router. See the Method Lists in Authorization and Authentication Profile Caching section for more information.

Authorization and Authentication Profile Caching as a Failover Mechanism

If, for whatever reason, RADIUS or TACACS+ servers are unable to provide authentication and authorization responses, network users and administrators can be locked out of the network. The profile caching feature
allows usernames to be authorized without having to complete the authentication phase. For example, a user by the name of user100@example.com with a password secretpassword1 could be stored in a profile cache using the regular expression ".*@example.com". Another user by the name of user101@example.com with a password of secretpassword2 could also be stored using the same regular expression, and so on. Because the number of users in the ".*@example.com" profile could number in the thousands, it is not feasible to authenticate each user with their personal password. Therefore authentication is disabled and each user simply accesses authorization profiles from a common Access Response stored in cache.

The same reasoning applies in cases where higher end security mechanisms such as Challenge Handshake Authentication Protocol (CHAP), Microsoft Challenge Handshake Authentication Protocol (MS-CHAP), or Extensible Authentication Protocol (EAP), which all use an encrypted password between the client and AAA offload server, are used. To allow these unique, secure username and password profiles to retrieve their authorization profiles, authentication is bypassed.

To take advantage of this failover capability, you need to configure the authentication and authorization method list so that the cache server group is queried last when a user attempts to authenticate to the router. See the Method Lists in Authorization and Authentication Profile Caching section for more information.

Method Lists in Authorization and Authentication Profile Caching

A method list is a sequential list describing the authentication methods to be queried in order to authenticate a user. We support methods such as local (use the local database), none (do nothing), RADIUS server group, or TACACS+ server group. Typically, more than one method can be configured into a method list. Software uses the first listed method to authenticate users. If that method fails to respond, the software selects the next authentication method listed in the method list. This process continues until there is successful communication with a listed authentication method, or until all methods defined in the method list are exhausted.

To optimize network performance or provide failover capability using the profile caching feature you simply change the order of the authentication and authorization methods in the method list. To optimize network performance, make sure the cache server group appears first in the method list. For failover capability, the cache server group should appear last in the method list.

Authorization and Authentication Profile Caching Guidelines

Because the number of usernames and profiles that can request to be authenticated or authorized at a given router on a given point of presence (POP) can be quite extensive, it would not be feasible to cache all of them. Therefore, only usernames and profiles that are commonly used or that share a common authentication and authorization response should be configured to use caching. Commonly used usernames such as aolip and aolnet, which are used for America Online (AOL) calls, or preauthentication dialed number identification service (DNIS) numbers used to connect Public Switched Telephone Network (PSTN) calls to a network attached storage device, along with domain-based service profiles, are all examples of usernames and profiles that can benefit from authentication and authorization caching.

General Configuration Procedure for Implementing Authorization and Authentication Profile Caching

To implement authorization and authentication profile caching, you would complete the following procedure:

1. Create cache profile groups and define the rules for what information is cached in each group.
Entries that match based on exact username, regular expressions, or specify that all authentication and
authorization requests can be cached.

1. Update existing server groups to reference newly defined cache groups.
2. Update authentication or authorization method lists to use the cached information to optimize network
performance or provide a failover mechanism.

How to Implement Authorization and Authentication Profile Caching

Creating Cache Profile Groups and Defining Caching Rules

Perform this task to create a cache profile group, define the rules for what information is cached in that group,
and verify and manage cache profile entries.

SUMMARY STEPS

1. enable
2. configure terminal
3. aaa new-model
4. aaa cache profile group-name
5. profile name [no-auth]
6. Repeat Step 5 for each username you want to add to the profile group in Step 4.
7. regexp matchexpression {any|only}[no-auth]
8. Repeat Step 7 for each regular expression you want to add to the cache profile group defined in Step 4.
9. all [no-auth]
10. end
11. show aaa cache group name
12. clear aaa cache group name {profile name|all}
13. debug aaa cache group

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td><strong>configure terminal</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Router# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>aaa new-model</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config)# aaa new-model</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>aaa cache profile group-name</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config)# aaa cache profile</td>
</tr>
<tr>
<td></td>
<td>networkusers@companyname</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>profile name [no-auth]</strong></td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config-profile-map)# profile</td>
</tr>
<tr>
<td></td>
<td>networkuser1 no-auth</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>Repeat Step 5 for each username you want to add</td>
</tr>
<tr>
<td></td>
<td>to the profile group in Step 4.</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>**regexp matchexpression {any</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config-profile-map)# regexp</td>
</tr>
<tr>
<td></td>
<td>.*@example.com any no-auth</td>
</tr>
<tr>
<td><strong>Step 8</strong></td>
<td>Repeat Step 7 for each regular expression you</td>
</tr>
<tr>
<td></td>
<td>want to add to the cache profile group defined</td>
</tr>
<tr>
<td></td>
<td>in Step 4.</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 9</strong></td>
<td>all [no-auth]</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config-profile-map)# all no-auth</td>
</tr>
<tr>
<td></td>
<td>(Optional) Specifies that all authentication and authorization requests are cached.</td>
</tr>
<tr>
<td></td>
<td>• Use the all command for specific service authorization requests, but it should be avoided when dealing with authentication requests.</td>
</tr>
<tr>
<td><strong>Step 10</strong></td>
<td>end</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config-profile-map)# end</td>
</tr>
<tr>
<td></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Step 11</strong></td>
<td>show aaa cache group name</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# show aaa cache group networkusers@companyname</td>
</tr>
<tr>
<td></td>
<td>(Optional) Displays all cache entries for a specified group.</td>
</tr>
<tr>
<td><strong>Step 12</strong></td>
<td>clear aaa cache group name {profile name</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# clear aaa cache group networkusers@companyname profile networkuser1</td>
</tr>
<tr>
<td></td>
<td>(Optional) Clears an individual entry or all entries in the cache.</td>
</tr>
<tr>
<td><strong>Step 13</strong></td>
<td>debug aaa cache group</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# debug aaa cache group</td>
</tr>
<tr>
<td></td>
<td>(Optional) Displays debug information about cached entries.</td>
</tr>
</tbody>
</table>

**Defining RADIUS and TACACS Server Groups That Use Cache Profile Group Information**

Perform this task to define how RADIUS and TACACS+ server groups use the information stored in each cache profile group.

**Before You Begin**

RADIUS and TACACS+ server groups must be created.
SUMMARY STEPS

1. enable
2. configure terminal
3. aaa new-model
4. aaa group server radius group-name or aaaa group server tacacs+ group-name
5. cache authorization profile name
6. cache authentication profile name
7. cache expiry hours {enforce failover}
8. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
Example:  
Router> enable |
| **Step 2** configure terminal | Enters global configuration mode.  
Example:  
Router# configure terminal |
| **Step 3** aaa new-model | Enables the AAA access control model.  
Example:  
Router(config)# aaa new-model |
| **Step 4** aaa group server radius group-name or aaaa group server tacacs+ group-name | Enters RADIUS server group configuration mode.  
Example:  
Router(config)# aaa group server radius networkusers@companyname |
| **Step 5** cache authorization profile name | Activates the authorization caching rules in the profile  
Example:  
Router(config-sg-radius)# cache authorization profile networkusers@companyname |

Authentication Authorization and Accounting Configuration Guide Cisco IOS XE Release 3S
### Purpose

**Command or Action**

**Step 6**
- `cache authentication profile name`
  - **Example:**
    
    ```
    Router(config-sq-radius)# cache authentication profile networkusers@companyname
    ```

  **Purpose:**
  Activates the authentication caching rules in the profile networkusers for this RADIUS or TACACS+ server group.

**Step 7**
- `cache expiry hours {enforce failover}`
  - **Example:**
    
    ```
    Router(config-sq-radius)# cache expiry 240 failover
    ```

  **Purpose:**
  (Optional) Sets the amount of time before a cache profile entry expires (becomes stale).
  - Use the `enforce` keyword to specify that once a cache profile entry expires it is not used again.
  - Use the `failover` keyword to specify that an expired cache profile entry can be used if all other methods to authenticate and authorize the user fail.

**Step 8**
- `end`
  - **Example:**
    
    ```
    Router(config-ag-radius)# end
    ```

  **Purpose:**
  Returns to privileged EXEC mode.

### Updating Authorization and Authentication Method Lists to Specify How Cache Information is Used

Perform this task to update authorization and authentication method lists to use the authorization and authentication cache information.

#### Before You Begin

Method lists must already be defined.

#### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `aaa new-model`
4. `aaa authorization {network | exec | commands level | reverse-access | configuration} {default | list-name} [method1 [method2...]]`
5. `aaa authentication ppp {default | list-name} method1 [method2...]
6. `aaa authentication login {default | list-name} method1 [method2...]
7. `end`
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** | enable | Enables privileged EXEC mode.  
- Enter your password if prompted. |
| **Example:** | | Router> enable |
| **Step 2** | configure terminal | Enters global configuration mode. |
| **Example:** | | Router# configure terminal |
| **Step 3** | aaa new-model | Enables the AAA access control model. |
| **Example:** | | Router(config)# aaa new-model |
| **Step 4** | aaa authorization {network | exec | commands level | reverse-access | configuration} {default | list-name} [method1 [method2...]] | Enables AAA authorization and creates method lists, which define the authorization methods used when a user accesses a specified function. |
| **Example:** | | Router(config)# aaa authorization network default cache networkusers@companyname group networkusers@companyname |
| **Step 5** | aaa authentication ppp {default | list-name} method1 [method2...] | Specifies one or more authentication methods for use on serial interfaces that are running PPP. |
| **Example:** | | Router(config)# aaa authentication ppp default cache networkusers@companyname group networkusers@companyname |
| **Step 6** | aaa authentication login {default | list-name} method1 [method2...] | Sets the authentication at login. |
| **Example:** | | Router(config)# aaa authentication login default cache adminusers group adminusers |
| **Step 7** | end | Returns to privileged EXEC mode. |
| **Example:** | | Router(config)# end |
Configuration Examples for Implementing Authorization and Authentication Profile Caching

Implementing Authorization and Authentication Profile Caching for Network Optimization Example

The following configuration example shows how to:

- Define a cache profile group adminusers that contains all administrator names on the network and sets it as the default list that is used for all login and exec sessions.
- Activate the new caching rules for a RADIUS server group.
- Add the new cache profile group in the authentication and authorization method list and change the method order so that the cache profile group is queried first.

```
configure terminal
aaa new-model
! Define aaa cache profile groups and the rules for what information is saved to cache.
aaa cache profile admin_users
    profile adminuser1
    profile adminuser2
    profile adminuser3
    profile adminuser4
    profile adminuser5
exit
! Define server groups that use the cache information in each profile group.
aaa group server radius admins@companyname.com
    cache authorization profile admin_users
    cache authentication profile admin_users
! Update authentication and authorization method lists to specify how profile groups and server groups are used.
    aaa authentication login default cache admins@companyname.com group admins@companyname.com
    aaa authorization exec default cache admins@companyname.com group admins@companyname.com
end
```
Implementing Authorization and Authentication Profile Caching as a Failover Mechanism Example

The following configuration example shows how to:

- Create a cache profile group admin_users that contains all of the administrators on the network so that if the RADIUS or TACACS+ server should become unavailable the administrators can still access the network.

- Create a cache profile group abc_users that contains all of the ABC company users on the network so that if the RADIUS or TACACS+ server should become unavailable these users will be authorized to use the network.

- Activate the new caching rules for each profile group on a RADIUS server.
• Add the new cache profile group in the authentication and authorization method list and change the method order so that the cache profile group is queried last.

configure terminal
  aaa new-model
  ! Define aaa cache profile groups and the rules for what information is saved to cache.
  aaa cache profile admin_users
  profile admin1
  profile admin2
  profile admin3
  exit
  aaa cache profile abcusers
  profile .*@example.com only no-auth
  exit
  ! Define server groups that use the cache information in each cache profile group.
  aaa group server tacacs+ admins@companyname.com
  server 10.1.1.1
  server 10.20.1.1
  cache authentication profile admin_users
  cache authorization profile admin_users
  exit
  aaa group server radius abcusers@example.com
  server 172.16.1.1
  server 172.20.1.1
  cache authentication profile abcusers
  cache authorization profile abcusers
  exit
  ! Update authentication and authorization method lists to specify how cache is used.
  aaa authentication login default cache admin@companyname.com group admins@companyname.com
  aaa authorization exec default cache admin@companyname.com group admins@companyname.com
  aaa authentication ppp default group abcusers@example.com cache abcusers@example.com
  aaa authorization network default group abcusers@example.com cache abcusers@example.com
  end
## Additional References for RADIUS Change of Authorization

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Command List, All Releases</td>
</tr>
<tr>
<td>Security commands</td>
<td>• Security Command Reference: Commands A to C</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands D to L</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands M to R</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands S to Z</td>
</tr>
<tr>
<td>Configuring AAA</td>
<td>Authentication, Authorization, and Accounting Configuration Guide</td>
</tr>
</tbody>
</table>

### Standards and RFCs

<table>
<thead>
<tr>
<th>Standard/RFC</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>RFC 2903</td>
<td>Generic AAA Architecture</td>
</tr>
<tr>
<td>RFC 5176</td>
<td>Dynamic Authorization Extensions to Remote Authentication Dial In User Service(RADIUS)</td>
</tr>
</tbody>
</table>
Technical Assistance

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

Feature Information for Implementing Authorization and Authentication Profile Caching

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
### Table 21: Feature Information for Implementing Authentication and Authorization Profile Caching

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Release</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA Authorization and Authentication Cache</td>
<td>Cisco IOS XE Release 2.3</td>
<td>This feature optimizes network performance and provides a failover mechanism in the event a network RADIUS or TACACS+ server becomes unavailable for any reason. In Cisco IOS XE Release 2.3, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: <code>aaa authentication login</code>, <code>aaa authentication ppp</code>, <code>aaa authorization</code>, <code>aaa cache profile</code>, <code>all (profile map configuration)</code>, <code>cache authentication profile (server group configuration)</code>, <code>cache authorization profile (server group configuration)</code>, <code>cache expiry (server group configuration)</code>, <code>clear aaa cache group</code>, <code>debug aaa cache group</code>, <code>profile (profile map configuration)</code>, <code>regexp (profile map configuration)</code>, <code>show aaa cache group</code>.</td>
</tr>
</tbody>
</table>
Configuring Authorization

AAA authorization enables you to limit the services available to a user. When AAA authorization is enabled, the network access server uses information retrieved from the user's profile, which is located either in the local user database or on the security server, to configure the user's session. Once this is done, the user will be granted access to a requested service only if the information in the user profile allows it.

- Finding Feature Information, page 135
- AAA Authorization Prerequisites, page 135
- Information About Configuring Authorization, page 136
- How to Configure Authorization, page 139
- Authorization Configuration Examples, page 142
- Additional References, page 145
- Feature Information for Configuring Authorization, page 146

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

AAA Authorization Prerequisites

Before configuring authorization using named method lists, you must first perform the following tasks:

- Enable AAA on your network access server.
• Configure AAA authentication. Authorization generally takes place after authentication and relies on authentication to work properly. For more information about AAA authentication, refer to the "Configuring Authentication" module.

• Define the characteristics of your RADIUS or TACACS+ security server if you are issuing RADIUS or TACACS+ authorization. For more information about configuring your Cisco network access server to communicate with your RADIUS security server, refer to the chapter "Configuring RADIUS". For more information about configuring your Cisco network access server to communicate with your TACACS+ security server, refer to the "Configuring TACACS+" module.

• Define the rights associated with specific users by using the username command if you are issuing local authorization. For more information about the username command, refer to the Cisco IOS Security Command Reference.

Information About Configuring Authorization

Named Method Lists for Authorization

Method lists for authorization define the ways that authorization will be performed and the sequence in which these methods will be performed. A method list is simply a named list describing the authorization methods to be queried (such as RADIUS or TACACS+), in sequence. Method lists enable you to designate one or more security protocols to be used for authorization, thus ensuring a backup system in case the initial method fails. Cisco IOS XE software uses the first method listed to authorize users for specific network services; if that method fails to respond, the Cisco IOS XE software selects the next method listed in the list. This process continues until there is successful communication with a listed authorization method, or all methods defined are exhausted.

Note

The Cisco IOS XE software attempts authorization with the next listed method only when there is no response from the previous method. If authorization fails at any point in this cycle—meaning that the security server or local username database responds by denying the user services—the authorization process stops and no other authorization methods are attempted.

Method lists are specific to the authorization type requested:

• Commands--Applies to the EXEC mode commands a user issues. Command authorization attempts authorization for all EXEC mode commands, including global configuration commands, associated with a specific privilege level.

• EXEC--Applies to the attributes associated with a user EXEC terminal session.

• Network--Applies to network connections. This can include a PPP, SLIP, or ARAP connection.

• Reverse Access--Applies to reverse Telnet sessions.

When you create a named method list, you are defining a particular list of authorization methods for the indicated authorization type.

Once defined, method lists must be applied to specific lines or interfaces before any of the defined methods will be performed. The only exception is the default method list (which is named "default"). If the aaa authorization command for a particular authorization type is issued without a named method list specified,
the default method list is automatically applied to all interfaces or lines except those that have a named method list explicitly defined. (A defined method list overrides the default method list.) If no default method list is defined, local authorization takes place by default.

**AAA Authorization Methods**

AAA supports five different methods of authorization:

- **TACACS+**—The network access server exchanges authorization information with the TACACS+ security daemon. TACACS+ authorization defines specific rights for users by associating attribute-value pairs, which are stored in a database on the TACACS+ security server, with the appropriate user.

- **If-Authenticated**—The user is allowed to access the requested function provided the user has been authenticated successfully.

- **None**—The network access server does not request authorization information; authorization is not performed over this line/interface.

- **Local**—The router or access server consults its local database, as defined by the `username` command, for example, to authorize specific rights for users. Only a limited set of functions can be controlled via the local database.

- **RADIUS**—The network access server requests authorization information from the RADIUS security server. RADIUS authorization defines specific rights for users by associating attributes, which are stored in a database on the RADIUS server, with the appropriate user.

**Note**

With CSCuc32663, passwords and authorization logs are masked before being sent to the TACACS+, LDAP, or RADIUS security servers. Use the `aaa authorization commands visible-keys` command to send unmasked information to the TACACS+, LDAP, or RADIUS security servers.

**Authorization Methods**

To have the network access server request authorization information via a TACACS+ security server, use the `aaa authorization` command with the `group tacacs+ method` keyword. For more specific information about configuring authorization using a TACACS+ security server, refer to the chapter "Configuring TACACS+." For an example of how to enable a TACACS+ server to authorize the use of network services, including PPP and ARA, see the TACACS Authorization Examples.

To allow users to have access to the functions they request as long as they have been authenticated, use the `aaa authorization` command with the `if-authenticated method` keyword. If you select this method, all requested functions are automatically granted to authenticated users.

There may be times when you do not want to run authorization from a particular interface or line. To stop authorization activities on designated lines or interfaces, use the `none method` keyword. If you select this method, authorization is disabled for all actions.

To select local authorization, which means that the router or access server consults its local user database to determine the functions a user is permitted to use, use the `aaa authorization` command with the `local method` keyword. The functions associated with local authorization are defined by using the `username` global configuration command. For a list of permitted functions, refer to the chapter "Configuring Authentication."
To have the network access server request authorization via a RADIUS security server, use the `radius method` keyword. For more specific information about configuring authorization using a RADIUS security server, refer to the Configuring RADIUS chapter.

To have the network access server request authorization via a RADIUS security server, use the `aaa authorization` command with the `group radius method` keyword. For more specific information about configuring authorization using a RADIUS security server, refer to the chapter Configuring RADIUS. For an example of how to enable a RADIUS server to authorize services, see the RADIUS Authorization Example.

---

**Method Lists and Server Groups**

A server group is a way to group existing RADIUS or TACACS+ server hosts for use in method lists. The figure below shows a typical AAA network configuration that includes four security servers: R1 and R2 are RADIUS servers, and T1 and T2 are TACACS+ servers. R1 and R2 make up the group of RADIUS servers. T1 and T2 make up the group of TACACS+ servers.

Using server groups, you can specify a subset of the configured server hosts and use them for a particular service. For example, server groups allow you to define R1 and R2 as separate server groups, and T1 and T2 as separate server groups. This means you can specify either R1 and T1 in the method list or R2 and T2 in the method list, which provides more flexibility in the way that you assign RADIUS and TACACS+ resources.

Server groups also can include multiple host entries for the same server, as long as each entry has a unique identifier. The combination of an IP address and a UDP port number creates a unique identifier, allowing different ports to be individually defined as RADIUS hosts providing a specific AAA service. In other words, this unique identifier enables RADIUS requests to be sent to different 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, authorization—the second host entry configured acts as fail-over backup to the first one. Using this example, if the first host entry fails to provide accounting services, the network access server will try the second host entry configured on the same device for accounting services. (The RADIUS host entries will be tried in the order they are configured.)

For more information about configuring server groups and about configuring server groups based on DNIS numbers, refer to the chapter Configuring RADIUS or the chapter Configuring TACACS+.

---

**AAA Authorization Types**

Cisco IOS XE software supports five different types of authorization:

- **Commands**—Applies to the EXEC mode commands a user issues. Command authorization attempts authorization for all EXEC mode commands, including global configuration commands, associated with a specific privilege level.
- **EXEC**—Applies to the attributes associated with a user EXEC terminal session.
- **Network**—Applies to network connections. This can include a PPP, SLIP, or ARAP connection.
- **Reverse Access**—Applies to reverse Telnet sessions.
• Configuration--Applies to downloading configurations from the AAA server.
• IP Mobile--Applies to authorization for IP mobile services.

**Authorization Types**

Named authorization method lists are specific to the indicated type of authorization.

To create a method list to enable authorization that applies specific security policies on a per-user basis, use the auth-proxy keyword. For detailed information on the authentication proxy feature, refer to the chapter “Configuring Authentication Proxy” in the “Traffic Filtering and Firewalls” part of this book.

To create a method list to enable authorization for all network-related service requests (including SLIP, PPP, PPP NCPs, and ARAP), use the network keyword.

To create a method list to enable authorization to determine if a user is allowed to run an EXEC shell, use the exec keyword.

To create a method list to enable authorization for specific, individual EXEC commands associated with a specific privilege level, use the commands keyword. (This allows you to authorize all commands associated with a specified command level from 0 to 15.)

To create a method list to enable authorization for reverse Telnet functions, use the reverse-access keyword.

For information about the types of authorization supported by the Cisco IOS XE software, refer to the AAA Authorization Types.

**Authorization Attribute-Value Pairs**

RADIUS and TACACS+ authorization both define specific rights for users by processing attributes, which are stored in a database on the security server. For both RADIUS and TACACS+, attributes are defined on the security server, associated with the user, and sent to the network access server where they are applied to the user’s connection.

For a list of supported RADIUS attributes, refer to the “RADIUS Attributes Overview and RADIUS IETF Attributes” chapter. For a list of supported TACACS+ AV pairs, refer to the “Configuring TACACS+” chapter.

**How to Configure Authorization**

For authorization configuration examples using the commands in this chapter, refer to the Authorization Configuration Examples.

**Configuring AAA Authorization Using Named Method Lists**

To configure AAA authorization using named method lists, use the following commands beginning in global configuration mode:
SUMMARY STEPS

1. Router(config)# aaa authorization {auth-proxy | network | exec | commands level | reverse-access | configuration | ipmobile} {default | list-name} [method1 [method2...]]

2. Do one of the following:
   - Router(config)# line [aux | console | tty | vty] line-number [ending-line-number]
   - Router(config)# interface interface-type interface-number

3. Do one of the following:
   - Router(config-line)# authorization {arap | commands level | exec | reverse-access} {default | list-name}
   - Router(config-line)# ppp authorization {default | list-name}

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>Creates an authorization method list for a particular authorization type and enable authorization.</td>
</tr>
<tr>
<td>Router(config)# aaa authorization {auth-proxy</td>
<td>network</td>
</tr>
<tr>
<td>Step 2</td>
<td>Enters the line configuration mode for the lines to which you want to apply the authorization method list. Alternately, enters the interface configuration mode for the interfaces to which you want to apply the authorization method list.</td>
</tr>
<tr>
<td>Do one of the following:</td>
<td></td>
</tr>
<tr>
<td>• Router(config)# line [aux</td>
<td>console</td>
</tr>
<tr>
<td>• Router(config)# interface interface-type interface-number</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>Applies the authorization list to a line or set of lines. Alternately, applies the authorization list to an interface or set of interfaces.</td>
</tr>
<tr>
<td>Do one of the following:</td>
<td></td>
</tr>
<tr>
<td>• Router(config-line)# authorization {arap</td>
<td>commands level</td>
</tr>
<tr>
<td>• Router(config-line)# ppp authorization {default</td>
<td>list-name}</td>
</tr>
</tbody>
</table>
Disabling Authorization for Global Configuration Commands

The `aaa authorization` command with the keyword `commands` attempts authorization for all EXEC mode commands, including global configuration commands, associated with a specific privilege level. Because there are configuration commands that are identical to some EXEC-level commands, there can be some confusion in the authorization process. Using `no aaa authorization config-commands` stops the network access server from attempting configuration command authorization.

To disable AAA authorization for all global configuration commands, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Device(config)# no aaa authorization config-commands</code></td>
<td>Disables authorization for all global configuration commands.</td>
</tr>
</tbody>
</table>

To disable AAA authorization on the console, use the following command in global configuration mode:

```
Device(config)# no aaa authorization console
```

AAA authorization is disabled on the console by default. If AAA authorization is enabled on the console, disable it by configuring the `no aaa authorization console` command during the AAA configuration stage. AAA should be disabled on the console for user authentication.

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Device(config)# no aaa authorization console</code></td>
<td>Disables authorization on the console.</td>
</tr>
</tbody>
</table>

Configuring Authorization for Reverse Telnet

Telnet is a standard terminal emulation protocol used for remote terminal connection. Normally, you log in to a network access server (typically through a dialup connection) and then use Telnet to access other network devices from that network access server. There are times, however, when it is necessary to establish a reverse Telnet session. In reverse Telnet sessions, the Telnet connection is established in the opposite direction—from inside a network to a network access server on the network periphery to gain access to modems or other devices connected to that network access server. Reverse Telnet is used to provide users with dialout capability by allowing them to Telnet to modem ports attached to a network access server.

It is important to control access to ports accessible through reverse Telnet. Failure to do so could, for example, allow unauthorized users free access to modems where they can trap and divert incoming calls or make outgoing calls to unauthorized destinations.

Authentication during reverse Telnet is performed through the standard AAA login procedure for Telnet. Typically the user has to provide a username and password to establish either a Telnet or reverse Telnet session. Reverse Telnet authorization provides an additional (optional) level of security by requiring authorization in addition to authentication. When enabled, reverse Telnet authorization can use RADIUS or
TACACS+ to authorize whether or not this user is allowed reverse Telnet access to specific asynchronous ports, after the user successfully authenticates through the standard Telnet login procedure.

Reverse Telnet authorization offers the following benefits:

- An additional level of protection by ensuring that users engaged in reverse Telnet activities are indeed authorized to access a specific asynchronous port using reverse Telnet.
- An alternative method (other than access lists) to manage reverse Telnet authorization.

To configure a network access server to request authorization information from a TACACS+ or RADIUS server before allowing a user to establish a reverse Telnet session, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# aaa authorization reverse-access method1 [method2 ...]</td>
<td>Configures the network access server to request authorization information before allowing a user to establish a reverse Telnet session.</td>
</tr>
</tbody>
</table>

This feature enables the network access server to request reverse Telnet authorization information from the security server, whether RADIUS or TACACS+. You must configure the specific reverse Telnet privileges for the user on the security server itself.

Authorization Configuration Examples

TACACS Authorization Examples

The following examples show how to use a TACACS+ server to authorize the use of network services, including PPP and ARA. If the TACACS+ server is not available or an error occurs during the authorization process, the fallback method (none) is to grant all authorization requests:

```conf
aaa authorization network default group tacacs+ none
```

The following example shows how to allow network authorization using TACACS+:

```conf
aaa authorization network default group tacacs+
```

The following example shows how to provide the same authorization, but it also creates address pools called "mci" and "att":

```conf
aaa authorization network default group tacacs+
  ip address-pool local
  ip local-pool mci 172.16.0.1 172.16.0.255
  ip local-pool att 172.17.0.1 172.17.0.255
```

These address pools can then be selected by the TACACS daemon. A sample configuration of the daemon follows:

```conf
user = mci_customer1 {
  login = cleartext "some password"
  service = ppp protocol = ip {
    addr-pool=mci
  }
}
```
RADIUS Authorization Example

The following example shows how to configure the router to authorize using RADIUS:

```
user = att_customer1 {
    login = cleartext "some other password"
    service = ppp protocol = ip {
        addr-pool=att
    }
}
```

RADIUS Authorization Example

The following examples show how to configure the router to authorize using RADIUS:

```
aaa new-model
aaa authorization exec default group radius if-authenticated
aaa authorization network default group radius
radius-server host ip
radius-server key
```

The lines in this sample RADIUS authorization configuration are defined as follows:

- The `aaa authorization exec default group radius if-authenticated` command configures the network access server to contact the RADIUS server to determine if users are permitted to start an EXEC shell when they log in. If an error occurs when the network access server contacts the RADIUS server, the fallback method is to permit the CLI to start, provided the user has been properly authenticated.

The RADIUS information returned may be used to specify an autocommand or a connection access list be applied to this connection.

- The `aaa authorization network default group radius` command configures network authorization via RADIUS. This can be used to govern address assignment, the application of access lists, and various other per-user quantities.

| Note | Because no fallback method is specified in this example, authorization will fail if, for any reason, there is no response from the RADIUS server. |

Reverse Telnet Authorization Examples

The following examples show how to cause the network access server to request authorization information from a TACACS+ security server before allowing a user to establish a reverse Telnet session:

```
aaa new-model
aaa authentication login default group tacacs+
aaa authorization reverse-access default group tacacs+
!
tacacs-server host 172.31.255.0
tacacs-server timeout 90
tacacs-server key goaway
```

The lines in this sample TACACS+ reverse Telnet authorization configuration are defined as follows:

- The `aaa new-model` command enables AAA.

- The `aaa authentication login default group tacacs+` command specifies TACACS+ as the default method for user authentication during login.

- The `aaa authorization reverse-access default group tacacs+` command specifies TACACS+ as the method for user authorization when trying to establish a reverse Telnet session.
• The `tacacs-server host` command identifies the TACACS+ server.

• The `tacacs-server timeout` command sets the interval of time that the network access server waits for the TACACS+ server to reply.

• The `tacacs-server key` command defines the encryption key used for all TACACS+ communications between the network access server and the TACACS+ daemon.

The following example shows how to configure a generic TACACS+ server to grant a user, pat, reverse Telnet access to port tty2 on the network access server named "maple" and to port tty5 on the network access server named "oak":

```bash
user = pat
  login = cleartext lab
  service = raccess {
    port#1 = maple/tty2
    port#2 = oak/tty5
```

**Note**

In this example, "maple" and "oak" are the configured host names of network access servers, not DNS names or alias.

The following example shows how to configure the TACACS+ server (CiscoSecure) to grant a user named pat reverse Telnet access:

```bash
user = pat
  profile_id = 90
  profile_cycle = 1
  member = Tacacs_Users
  service=shell {
    default cmd=permit
  }
  service=raccess {
    allow "c2511e0" "tty1" ".*"
    refuse ".*" ".*" ".*"
    password = clear "goaway"
```

**Note**

CiscoSecure only supports reverse Telnet using the command line interface in versions 2.1(x) through version 2.2(1).

An empty "service=raccess {}" clause permits a user to have unconditional access to network access server ports for reverse Telnet. If no "service=raccess" clause exists, the user is denied access to any port for reverse Telnet.

For more information about configuring TACACS+, refer to the "Configuring TACACS" chapter. For more information about configuring CiscoSecure, refer to the *CiscoSecure Access Control Server User Guide*, version 2.1(2) or greater.

The following example shows how to cause the network access server to request authorization from a RADIUS security server before allowing a user to establish a reverse Telnet session:

```bash
aaa new-model
aaa authentication login default group radius
aaa authorization reverse-access default group radius
radius-server host 172.31.255.0
radius-server key go away
auth-port 1645 acct-port 1646
```
The lines in this sample RADIUS reverse Telnet authorization configuration are defined as follows:

- The `aaa new-model` command enables AAA.
- The `aaa authentication login default group radius` command specifies RADIUS as the default method for user authentication during login.
- The `aaa authorization reverse-access default group radius` command specifies RADIUS as the method for user authorization when trying to establish a reverse Telnet session.
- The `radius-server host` command identifies the RADIUS server.
- The `radius-server key` command defines the encryption key used for all RADIUS communications between the network access server and the RADIUS daemon.

The following example shows how to send a request to the RADIUS server to grant a user named "pat" reverse Telnet access at port tty2 on the network access server named "maple":

Username = "pat"
Password = "goaway"
User-Service-Type = Shell-User
cisco-avpair = "raccess:port#1=maple/tty2"

The syntax "raccess:port=any/any" permits a user to have unconditional access to network access server ports for reverse Telnet. If no "raccess:port={nasname }/{tty number }" clause exists in the user profile, the user is denied access to reverse Telnet on all ports.

For more information about configuring RADIUS, refer to the chapter "Configuring RADIUS."

### Additional References

#### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Master Command List, All Releases</td>
</tr>
<tr>
<td>Security commands</td>
<td>• Security Command Reference: Commands A to C</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands D to L</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands M to R</td>
</tr>
<tr>
<td></td>
<td>• Security Command Reference: Commands S to Z</td>
</tr>
</tbody>
</table>
Technical Assistance

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

Feature Information for Configuring Authorization

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support.

To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 22: Feature Information for Configuring Authorization

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Named Method Lists for AAA Authorization and Accounting</td>
<td>Cisco IOS XE Release 2.1</td>
<td>Method lists for authorization define the ways that authorization will be performed and the sequence in which these methods will be performed. A method list is simply a named list describing the authorization methods to be queried (such as RADIUS or TACACS+), in sequence. In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.</td>
</tr>
</tbody>
</table>
Configuring Accounting

The AAA accounting feature allows the services that users are accessing and the amount of network resources that users are consuming to be tracked. When AAA accounting is enabled, the network access server reports user activity to the TACACS+ or RADIUS security server (depending on which security method is implemented) in the form of accounting records. Each accounting record contains accounting attribute-value (AV) pairs and is stored on the security server. This data can then be analyzed for network management, client billing, and auditing.

- Finding Feature Information, page 147
- Prerequisites for Configuring Accounting, page 147
- Restrictions for Configuring Accounting, page 148
- Information About Configuring Accounting, page 148
- How to Configure AAA Accounting, page 162
- Configuration Examples for AAA Accounting, page 171
- Additional References, page 174
- Feature Information for Configuring Accounting, page 176

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Configuring Accounting

The following tasks must be performed before configuring accounting using named method lists:
• Enable AAA on the network access server.
• Define the characteristics of the RADIUS or TACACS+ security server if RADIUS or TACACS+ authorization is issued. For more information about configuring the Cisco network access server to communicate with the RADIUS security server, see the chapter Configuring RADIUS. For more information about configuring the Cisco network access server to communicate with the TACACS+ security server, see the chapter Configuring TACACS+.

Restrictions for Configuring Accounting

The AAA Accounting feature has the following restrictions:
• Accounting information can be sent simultaneously to a maximum of four AAA servers.
• Service Selection Gateway (SSG) restriction--For SSG systems, the `aaa accounting network broadcast` command broadcasts only `start-stop` accounting records. If interim accounting records are configured using the `ssg accounting interval` command, the interim accounting records are sent only to the configured default RADIUS server.

Information About Configuring Accounting

Named Method Lists for Accounting

Like authentication and authorization method lists, method lists for accounting define the way accounting is performed and the sequence in which these methods are performed.

Named accounting method lists allow a particular security protocol to be designated and used on specific lines or interfaces for accounting services. The only exception is the default method list (which, by coincidence, is named "default"). The default method list is automatically applied to all interfaces except those that have a named method list explicitly defined. A defined method list overrides the default method list.

A method list is a named list describing the accounting methods to be queried (such as RADIUS or TACACS+), in sequence. Method lists allow one or more security protocols to be designated and used for accounting, thus ensuring a backup system for accounting if the initial method fails. Cisco IOS XE software uses the first method listed to support accounting; if that method fails to respond, the Cisco IOS XE software selects the next accounting method listed in the method list. This process continues until there is successful communication with a listed accounting method, or all methods defined are exhausted.

Note

The Cisco IOS XE software attempts accounting with the next listed accounting method only when there is no response from the previous method. If accounting fails at any point in this cycle--meaning that the security server responds by denying the user access--the accounting process stops and no other accounting methods are attempted.

Accounting method lists are specific to the type of accounting being requested. AAA supports six different types of accounting:
• Network--Provides information for all PPP, SLIP, or ARAP sessions, including packet and byte counts.
EXEC--Provides information about user EXEC terminal sessions of the network access server.

Command--Provides information about the EXEC mode commands that a user issues. Command accounting generates accounting records for all EXEC mode commands, including global configuration commands, associated with a specific privilege level.

Connection--Provides information about all outbound connections made from the network access server, such as Telnet, local-area transport (LAT), TN3270, packet assembler/disassembler (PAD), and rlogin.

System--Provides information about system-level events.

Resource--Provides "start" and "stop" records for calls that have passed user authentication, and provides "stop" records for calls that fail to authenticate.

System accounting does not use named accounting lists; only the default list for system accounting can be defined.

When a named method list is created, a particular list of accounting methods for the indicated accounting type are defined.

Accounting method lists must be applied to specific lines or interfaces before any of the defined methods are performed. The only exception is the default method list (which is named "default"). If the `aaa accounting` command for a particular accounting type is issued without a named method list specified, the default method list is automatically applied to all interfaces or lines except those that have a named method list explicitly defined. (A defined method list overrides the default method list.) If no default method list is defined, then no accounting takes place.

This section includes the following subsections:

**Method Lists and Server Groups**

A server group is a way to group existing RADIUS or TACACS+ server hosts for use in method lists. The figure below shows a typical AAA network configuration that includes four security servers: R1 and R2 are RADIUS servers, and T1 and T2 are TACACS+ servers. R1 and R2 comprise the group of RADIUS servers. T1 and T2 comprise the group of TACACS+ servers.

In Cisco IOS XE software, RADIUS and TACACS+ server configurations are global. A subset of the configured server hosts can be specified using server groups. These server groups can be used for a particular service. For example, server groups allow R1 and R2 to be defined as separate server groups (SG1 and SG2), and T1 and T2 as separate server groups (SG3 and SG4). This means either R1 and T1 (SG1 and SG3) can be specified in the method list or R2 and T2 (SG2 and SG4) in the method list, which provides more flexibility in the way that RADIUS and TACACS+ resources are assigned.

Server groups also can include multiple host entries for the same server, as long as each entry has a unique identifier. The combination of an IP address and a UDP port number creates a unique identifier, allowing different ports to be individually defined as RADIUS hosts providing a specific AAA service. In other words, this unique identifier enables RADIUS requests to be sent to different 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 failover backup to the first one. Using this example, 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.)
For more information about configuring server groups and about configuring server groups based on DNIS numbers, see Configuring RADIUS module or Configuring TACACS+ module in the *Cisco IOS XE Security Configuration Guide: Securing User Services Release 2.*

**AAA Accounting Methods**

Cisco IOS XE supports the following two methods for accounting:

- **TACACS+**—The network access server reports user activity to the TACACS+ security server in the form of accounting records. Each accounting record contains accounting attribute-value (AV) pairs and is stored on the security server.

- **RADIUS**—The network access server 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.

**Note**

With CSCuc32663, passwords and accounting logs are masked before being sent to the TACACS+ or RADIUS security servers. Use the `aaa accounting commands visible-keys` command to send unmasked information to the TACACS+ or RADIUS security servers.

**Accounting Record Types**

For minimal accounting, use the `stop-only` keyword, which instructs the specified method (RADIUS or TACACS+) to send a stop record accounting notice at the end of the requested user process. For more accounting information, use the `start-stop` keyword to send a start accounting notice at the beginning of the requested event and a stop accounting notice at the end of the event. To stop all accounting activities on this line or interface, use the `none` keyword.

**Accounting Methods**

The table below lists the supported accounting keywords.

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>group radius</td>
<td>Uses the list of all RADIUS servers for accounting.</td>
</tr>
<tr>
<td>group tacacs+</td>
<td>Uses the list of all TACACS+ servers for accounting.</td>
</tr>
<tr>
<td>group group-name</td>
<td>Uses a subset of RADIUS or TACACS+ servers for accounting as defined by the server group group-name.</td>
</tr>
</tbody>
</table>

The method argument refers to the actual method the authentication algorithm tries. Additional methods of authentication are used only if the previous method returns an error, not if it fails. To specify that the authentication should succeed even if all other methods return an error, specify additional methods in the
command. For example, to create a method list named acct_tac1 that specifies RADIUS as the backup method of authentication in the event that TACACS+ authentication returns an error, enter the following command:

```plaintext
aaa accounting network acct_tac1 stop-only group tacacs+ group radius
```

To create a default list that is used when a named list is not specified in the `aaa accounting` command, use the `default` keyword followed by the methods that are wanted to be used in default situations. The default method list is automatically applied to all interfaces.

For example, to specify RADIUS as the default method for user authentication during login, enter the following command:

```plaintext
aaa accounting network default stop-only group radius
```

AAA accounting supports the following methods:

- **group tacacs** -- To have the network access server send accounting information to a TACACS+ security server, use the `group tacacs+ method` keyword.
- **group radius** -- To have the network access server send accounting information to a RADIUS security server, use the `group radius method` keyword.

---

**Note**

Accounting method lists for SLIP follow whatever is configured for PPP on the relevant interface. If no lists are defined and applied to a particular interface (or no PPP settings are configured), the default setting for accounting applies.

- **group group-name** -- To specify a subset of RADIUS or TACACS+ servers to use as the accounting method, use the `aaa accounting` command with the `group group-name` method. To specify and define the group name and the members of the group, use the `aaa group server` command. For example, use the `aaa group server` command to first define the members of `group loginrad`:

```plaintext
aaa group server radius loginrad
server 172.16.2.3
server 172.16.2.17
server 172.16.2.32
```

This command specifies RADIUS servers 172.16.2.3, 172.16.2.17, and 172.16.2.32 as members of the group `loginrad`.

To specify `group loginrad` as the method of network accounting when no other method list has been defined, enter the following command:

```plaintext
aaa accounting network default start-stop group loginrad
```

Before a group name can be used as the accounting method, communication with the RADIUS or TACACS+ security server must be enabled.

## AAA Accounting Types

Named accounting method lists are specific to the indicated type of accounting.

- **network** -- To create a method list to enable authorization for all network-related service requests (including SLIP, PPP, PPP NCPs, and ARAP protocols), use the `network` keyword. For example, to create a method list that provides accounting information for ARAP (network) sessions, use the `arap` keyword.
• **exec** --To create a method list that provides accounting records about user EXEC terminal sessions on the network access server, including username, date, start and stop times, use the `exec` keyword.

• **commands** --To create a method list that provides accounting information about specific, individual EXEC commands associated with a specific privilege level, use the `commands` keyword.

• **connection** --To create a method list that provides accounting information about all outbound connections made from the network access server, use the `connection` keyword.

• **resource** --To creates a method list to provide accounting records for calls that have passed user authentication or calls that failed to be authenticated.

---

**Note**

System accounting does not support named method lists.

---

**Network Accounting**

Network accounting provides information for all PPP, SLIP, or ARAP sessions, including packet and byte counts.

The following example shows the information contained in a RADIUS network accounting record for a PPP user who comes in through an EXEC session:

```
Wed Jun 27 04:44:45 2001
NAS-IP-Address = "172.16.25.15"
NAS-Port = 5
User-Name = "username1"
Client-Port-DNIS = "4327528"
Caller-ID = "562"
Acct-Status-Type = Start
Acct-Authentic = RADIUS
Service-Type = Exec-User
Acct-Session-Id = "0000000D"
Acct-Delay-Time = 0
User-Id = "username1"
NAS-Identifier = "172.16.25.15"

Wed Jun 27 04:45:00 2001
NAS-IP-Address = "172.16.25.15"
NAS-Port = 5
User-Name = "username1"
Client-Port-DNIS = "4327528"
Caller-ID = "562"
Acct-Status-Type = Start
Acct-Authentic = RADIUS
Service-Type = Framed
Acct-Session-Id = "0000000E"
Framed-IP-Address = "10.1.1.2"
Framed-Protocol = PPP
Acct-Delay-Time = 0
User-Id = "username1"
NAS-Identifier = "172.16.25.15"

Wed Jun 27 04:47:46 2001
NAS-IP-Address = "172.16.25.15"
NAS-Port = 5
User-Name = "username1"
Client-Port-DNIS = "4327528"
Caller-ID = "562"
Acct-Status-Type = Stop
Acct-Authentic = RADIUS
```
The following example shows the information contained in a TACACS+ network accounting record for a PPP user who first started an EXEC session:

```plaintext
Wed Jun 27 04:00:35 2001 172.16.25.15 username1 tty4 562/4327528 start task_id=28 service=shell
Wed Jun 27 04:00:46 2001 172.16.25.15 username1 tty4 562/4327528 start task_id=30 addr=10.1.1.1 service=ppp
task_id=30 addr=10.1.1.1 service=ppp protocol=ip addr=10.1.1.1
Wed Jun 27 04:01:31 2001 172.16.25.15 username1 tty4 408/4327528 update
Wed Jun 27 04:01:32 2001 172.16.25.15 username1 tty4 562/4327528 stop task_id=30 addr=10.1.1.1
Wed Jun 27 04:01:32 2001 172.16.25.15 username1 tty4 562/4327528 stop task_id=28
```

The precise format of accounting packets records may vary depending on the security server daemon.

The following example shows the information contained in a RADIUS network accounting record for a PPP user who comes in through autoselect:

```plaintext
Wed Jun 27 04:00:35 2001 172.16.25.15 username1 tty4 562/4327528 start task_id=28 service=shell
Wed Jun 27 04:00:46 2001 172.16.25.15 username1 tty4 562/4327528 start task_id=30 addr=10.1.1.1 service=ppp
task_id=30 addr=10.1.1.1 service=ppp protocol=ip addr=10.1.1.1
Wed Jun 27 04:01:31 2001 172.16.25.15 username1 tty4 408/4327528 update
Wed Jun 27 04:01:32 2001 172.16.25.15 username1 tty4 562/4327528 stop task_id=30 addr=10.1.1.1
Wed Jun 27 04:01:32 2001 172.16.25.15 username1 tty4 562/4327528 stop task_id=28
```
AAA Accounting Types

EXEC Accounting

EXEC accounting provides information about user EXEC terminal sessions (user shells) on the network access server, including username, date, start and stop times, the access server IP address, and (for dial-in users) the telephone number the call originated from.

The following example shows the information contained in a RADIUS EXEC accounting record for a dial-in user:

```
Wed Jun 27 04:26:23 2001 172.16.25.15 username1 Async5 562/4327528 start task_id=35
  service=ppp
Wed Jun 27 04:27:25 2001 172.16.25.15 username1 Async5 562/4327528 update
  task_id=35 service=ppp protocol=ip addr=10.1.1.2
  paks_in=42 paks_out=28 elapsed_time=62
```
The following example shows the information contained in a TACACS+ EXEC accounting record for a dial-in user:

Wed Jun 27 03:46:21 2001 172.16.25.15 username1 tty3 5622329430/4327528
start task_id=2 service=shell
Wed Jun 27 04:08:55 2001 172.16.25.15 username1 tty3 5622329430/4327528
stop task_id=2 service=shell elapsed_time=1354

The following example shows the information contained in a RADIUS EXEC accounting record for a Telnet user:

NAS-IP-Address = "172.16.25.15"
NAS-Port = 26
User-Name = "username1"
Caller-ID = "10.68.202.158"
Acct-Status-Type = Start
Acct-Authentic = RADIUS
Service-Type = Exec-User
Acct-Session-Id = "00000010"
Acct-Delay-Time = 0
User-Id = "username1"
NAS-Identifier = "172.16.25.15"

NAS-IP-Address = "172.16.25.15"
NAS-Port = 26
User-Name = "username1"
Caller-ID = "10.68.202.158"
Acct-Status-Type = Stop
Acct-Authentic = RADIUS
Service-Type = Exec-User
Acct-Session-Id = "00000010"
Acct-Session-Time = 14
Acct-Delay-Time = 0
User-Id = "username1"
NAS-Identifier = "172.16.25.15"

The following example shows the information contained in a TACACS+ EXEC accounting record for a Telnet user:

start task_id=41 service=shell
stop task_id=41 service=shell elapsed_time=9

**Command Accounting**

Command accounting provides information about the EXEC shell commands for a specified privilege level that are being executed on a network access server. Each command accounting record includes a list of the commands executed for that privilege level, as well as the date and time each command was executed, and the user who executed it.

The following example shows the information contained in a TACACS+ command accounting record for privilege level 1:

Wed Jun 27 03:46:47 2001 172.16.25.15 username1 tty3 5622329430/4327528
stop task_id=3 service=shell priv-lvl=1 cmd=show version <cr>
Wed Jun 27 03:46:58 2001 172.16.25.15 username1 tty3 5622329430/4327528
stop task_id=4 service=shell priv-lvl=1 cmd=show interfaces <cr>
Wed Jun 27 03:47:03 2001 172.16.25.15 username1 tty3 5622329430/4327528
stop task_id=5 service=shell priv-lvl=1 cmd=show ip route <cr>
The following example shows the information contained in a TACACS+ command accounting record for privilege level 15:

```
Wed Jun 27 03:47:17 2001 172.16.25.15 username1 tty3 5622329430/4327528
stop task_id=6 service=shell priv-lvl=15 cmd=configure terminal <cr>
Wed Jun 27 03:47:21 2001 172.16.25.15 username1 tty3 5622329430/4327528
stop task_id=7 service=shell priv-lvl=15 cmd=interface GigabitEthernet0/0/0 <cr>
Wed Jun 27 03:47:29 2001 172.16.25.15 username1 tty3 56223294304327528 stop
<cr>
```

Note: The Cisco Systems implementation of RADIUS does not support command accounting.

Connection Accounting

Connection accounting provides information about all outbound connections made from the network access server, such as Telnet, LAT, TN3270, PAD, and rlogin.

The following example shows the information contained in a RADIUS connection accounting record for an outbound Telnet connection:

```
Wed Jun 27 04:28:00 2001
NAS-IP-Address = "172.16.25.15"
NAS-Port = 2
User-Name = "username1"
Client-Port-DNIS = "4327528"
Caller-ID = "5622329477"
Acct-Status-Type = Start
Acct-Authentic = RADIUS
Service-Type = Login
Acct-Session-Id = "00000008"
Login-Service = Telnet
Login-IP-Host = "10.68.202.158"
Acct-Delay-Time = 0
User-IId = "username1"
NAS-Identifier = "172.16.25.15"

NAS-IP-Address = "172.16.25.15"
NAS-Port = 2
User-Name = "username1"
Client-Port-DNIS = "4327528"
Caller-ID = "5622329477"
Acct-Status-Type = Stop
Acct-Authentic = RADIUS
Service-Type = Login
Acct-Session-Id = "00000008"
Login-Service = Telnet
Login-IP-Host = "10.68.202.158"
Acct-Input-Octets = 10774
Acct-Output-Octets = 112
Acct-Input-Packets = 91
Acct-Output-Packets = 99
Acct-Session-Time = 39
Acct-Delay-Time = 0
User-IId = "username1"
NAS-Identifier = "172.16.25.15"
```
The following examples show the information contained in a TACACS+ connection accounting record for an outbound Telnet connection:

```
Wed Jun 27 03:47:43 2001 172.16.25.15 username1 tty3 5622329430/4327528
  start  task_id=10  service=connection  protocol=telnet  addr=10.68.202.158  cmd=telnet
  username1-sun
Wed Jun 27 03:48:38 2001 172.16.25.15 username1 tty3 5622329430/4327528
  stop  task_id=10  service=connection  protocol=telnet  addr=10.68.202.158  cmd=telnet
  username1-sun  bytes_in=4467  bytes_out=96  paks_in=61  paks_out=72  elapsed_time=55
```

The following examples show the information contained in a RADIUS connection accounting record for an outbound rlogin connection:

```
Wed Jun 27 04:29:48 2001 NAS-IP-Address = "172.16.25.15"
  NAS-Port = 2
  User-Name = "username1"
  Client-Port-DNIS = "4327528"
  Caller-ID = "5622329477"
  Acct-Status-Type = Start
  Acct-Authentic = RADIUS
  Service-Type = Login
  Acct-Session-Id = "0000000A"
  Login-Service = Rlogin
  Login-IP-Host = "10.68.202.158"
  Acct-Delay-Time = 0
  User-Id = "username1"
  NAS-Identifier = "172.16.25.15"

Wed Jun 27 04:30:09 2001 NAS-IP-Address = "172.16.25.15"
  NAS-Port = 2
  User-Name = "username1"
  Client-Port-DNIS = "4327528"
  Caller-ID = "5622329477"
  Acct-Status-Type = Stop
  Acct-Authentic = RADIUS
  Service-Type = Login
  Acct-Session-Id = "0000000A"
  Login-Service = Rlogin
  Login-IP-Host = "10.68.202.158"
  Acct-Input-Octets = 18686
  Acct-Output-Octets = 86
  Acct-Input-Packets = 90
  Acct-Output-Packets = 68
  Acct-Session-Time = 22
  Acct-Delay-Time = 0
  User-Id = "username1"
  NAS-Identifier = "172.16.25.15"
```

The following examples show the information contained in a TACACS+ connection accounting record for an outbound rlogin connection:

```
Wed Jun 27 03:48:46 2001 172.16.25.15 username1 tty3 5622329430/4327528
  start  task_id=12  service=connection  protocol=rlogin  addr=10.68.202.158  cmd=rlogin
  username1-sun /user username1
Wed Jun 27 03:51:37 2001 172.16.25.15 username1 tty3 5622329430/4327528
  stop  task_id=12  service=connection  protocol=rlogin  addr=10.68.202.158  cmd=rlogin
  username1-sun /user username1  bytes_in=659926  bytes_out=138  paks_in=2378  paks_out=1251  elapsed_time=171
```

The following examples show the information contained in a TACACS+ connection accounting record for an outbound LAT connection:

```
Wed Jun 27 03:53:06 2001 172.16.25.15 username1 tty3 5622329430/4327528
  start  task_id=18  service=connection  protocol=lat  addr=VAX  cmd=lat
  VAX
Wed Jun 27 03:53:18 2001 172.16.25.15 username1 tty3 5622329430/4327528
  stop  task_id=18  service=connection  protocol=lat  addr=VAX  cmd=lat
  VAX
```

System Accounting

System accounting provides information about all system-level events (for example, when the system reboots or when accounting is turned on or off).

The following accounting record shows a typical TACACS+ system accounting record server indicating that AAA accounting has been turned off:

```
service=system event=sys_acct reason=reconfigure
```

Note The precise format of accounting packets records may vary depending on the TACACS+ daemon.

The following accounting record shows a TACACS+ system accounting record indicating that AAA accounting has been turned on:

```
Wed Jun 27 03:55:22 2001 172.16.25.15 unknown unknown unknown stop task_id=23
service=system event=sys_acct reason=reconfig
```

Additional tasks for measuring system resources are covered in the Cisco IOS XE software configuration guides. For example, IP accounting tasks are described in the Configuring IP Services chapter in the Cisco IOS XE Application Services Configuration Guide, Release 2.

Resource Accounting

The Cisco implementation of AAA accounting provides "start" and "stop" record support for calls that have passed user authentication. The additional feature of generating "stop" records for calls that fail to authenticate as part of user authentication is also supported. Such records are necessary for users employing accounting records to manage and monitor their networks.

This section includes the following subsections:

AAA Resource Failure Stop Accounting

Before AAA resource failure stop accounting, there was no method of providing accounting records for calls that failed to reach the user authentication stage of a call setup sequence. Such records are necessary for users employing accounting records to manage and monitor their networks and their wholesale customers.

This functionality generates a "stop" accounting record for any calls that do not reach user authentication; "stop" records are generated from the moment of call setup. All calls that pass user authentication behave as they did before; that is, no additional accounting records are seen.
The figure below illustrates a call setup sequence with normal call flow (no disconnect) and without AAA resource failure stop accounting enabled.

**Figure 4: Modem Dial-In Call Setup Sequence with Normal Flow and Without Resource Failure Stop Accounting Enabled**

The figure below illustrates a call setup sequence with normal call flow (no disconnect) and with AAA resource failure stop accounting enabled.

**Figure 5: Modem Dial-In Call Setup Sequence with Normal Flow and With Resource Failure Stop Accounting Enabled**

The figure below illustrates a call setup sequence with call disconnect occurring before user authentication and with AAA resource failure stop accounting enabled.

**Figure 6: Modem Dial-In Call Setup Sequence with Call Disconnect Occurring Before User Authentication and With Resource Failure Stop Accounting Enabled**
The figure below illustrates a call setup sequence with call disconnect occurring before user authentication and without AAA resource failure stop accounting enabled.

**Figure 7: Modem Dial-In Call Setup Sequence with Call Disconnect Occurring Before User Authentication and Without Resource Failure Stop Accounting Enabled**

AAA Resource Accounting for Start-Stop Records

AAA resource accounting for start-stop records supports the ability to send a "start" record at each call setup, followed by a corresponding "stop" record at the call disconnect. This functionality can be used to manage and monitor wholesale customers from one source of data reporting, such as accounting records.

With this feature, a call setup and call disconnect "start-stop" accounting record tracks the progress of the resource connection to the device. A separate user authentication "start-stop" accounting record tracks the user management progress. These two sets of accounting records are interlinked by using a unique session ID for the call.

The figure below illustrates a call setup sequence with AAA resource start-stop accounting enabled.

**Figure 8: Modem Dial-In Call Setup Sequence with Resource Start-Stop Accounting Enabled**

### AAA Accounting Enhancements

#### AAA Broadcast Accounting

AAA broadcast accounting allows accounting information to be sent to multiple AAA servers at the same time; that is, accounting information can be broadcast to one or more AAA servers simultaneously. This functionality allows service providers to send accounting information to their own private AAA servers and to the AAA servers of their end customers. It also provides redundant billing information for voice applications.

Broadcasting is allowed among groups of RADIUS or TACACS+ servers, and each server group can define its backup servers for failover independently of other groups.
Thus, service providers and their end customers can use different protocols (RADIUS or TACACS+) for the accounting server. Service providers and their end customers can also specify their backup servers independently. As for voice applications, redundant accounting information can be managed independently through a separate group with its own failover sequence.

**AAA Session MIB**

The AAA session MIB feature allows customers to monitor and terminate their authenticated client connections using Simple Network Management Protocol (SNMP). The data of the client is presented so that it correlates directly to the AAA accounting information reported by either the RADIUS or the TACACS+ server. AAA session MIB provides the following information:

- Statistics for each AAA function (when used in conjunction with the show radius statistics command)
- Status of servers providing AAA functions
- Identities of external AAA servers
- Real-time information (such as idle times), providing additional criteria for use by SNMP networks for assessing whether to terminate an active call

The table below shows the SNMP user-end data objects that can be used to monitor and terminate authenticated client connections with the AAA session MIB feature.

**Table 24: SNMP End-User Data Objects**

<table>
<thead>
<tr>
<th>Field</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>SessionId</td>
<td>The session identification used by the AAA accounting protocol (same value as reported by RADIUS attribute 44 (Acct-Session-ID)).</td>
</tr>
<tr>
<td>UserId</td>
<td>The user login ID or zero-length string if a login is unavailable.</td>
</tr>
<tr>
<td>IpAddr</td>
<td>The IP address of the session or 0.0.0.0 if an IP address is not applicable or unavailable.</td>
</tr>
<tr>
<td>IdleTime</td>
<td>The elapsed time in seconds that the session has been idle.</td>
</tr>
<tr>
<td>Disconnect</td>
<td>The session termination object used to disconnect the given client.</td>
</tr>
<tr>
<td>CallId</td>
<td>The entry index corresponding to this accounting session that the Call Tracker record stored.</td>
</tr>
</tbody>
</table>

The table below describes the AAA summary information provided by the AAA session MIB feature using SNMP on a per-system basis.
Table 25: SNMP AAA Session Summary

<table>
<thead>
<tr>
<th>Field</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ActiveTableEntries</td>
<td>Number of sessions currently active.</td>
</tr>
<tr>
<td>ActiveTableHighWaterMark</td>
<td>Maximum number of sessions present since last system reinstallation.</td>
</tr>
<tr>
<td>TotalSessions</td>
<td>Total number of sessions since the last system reinstallation.</td>
</tr>
<tr>
<td>DisconnectedSessions</td>
<td>Total number of sessions that have been disconnected since the last system reinstallation.</td>
</tr>
</tbody>
</table>

**Accounting Attribute-Value Pairs**

The network access server monitors the accounting functions defined in either TACACS+ attribute-value (AV) pairs or RADIUS attributes, depending on which security method is implemented.

**How to Configure AAA Accounting**

**Configuring AAA Accounting Using Named Method Lists**

To configure AAA accounting using named method lists, use the following commands beginning in global configuration mode:

**SUMMARY STEPS**

1. Router(config)# aaa accounting {system | network | exec | connection | commands level} {default | list-name} {start-stop | stop-only | none} [method1 [method2...]]

2. Do one of the following:
   - Router(config)# line [aux | console | tty | vty] line-number [ending-line-number]
   - 
   - 
   -

3. Do one of the following:
   - Router(config-line)# accounting {arap | commands level | connection | exec} {default | list-name}
     - 
     - 
     -
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>**Router(config)# aaa accounting {system</td>
<td>network</td>
</tr>
<tr>
<td>Step 2</td>
<td>Do one of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• **Router(config)# line [aux</td>
<td>console</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>• <strong>Router(config)# interface interface-type interface-number</strong></td>
<td>Enters interface configuration mode for the interfaces to which the accounting method list is applied.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Router(config)# interface interface-type interface-number</strong></td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>Do one of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• **Router(config)# accounting {arap</td>
<td>commands level</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>• **Router(config-if)# ppp accounting {default</td>
<td>list-name}**</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>**Router(config-if)# ppp accounting {default</td>
<td>list-name}**</td>
</tr>
</tbody>
</table>

### What to Do Next

#### Note

System accounting does not use named method lists. For system accounting, define only the default method list.

---

### Suppressing Generation of Accounting Records for Null Username Sessions

When AAA accounting is activated, the Cisco IOS XE software issues accounting records for all users on the system, including users whose username string, because of protocol translation, is NULL. An example of this is users who come in on lines where the `aaa authentication login method-list none` command is applied. To
prevent accounting records from being generated for sessions that do not have usernames associated with them, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config)# aaa accounting suppress null-username</code></td>
<td>Prevents accounting records from being generated for users whose username string is NULL.</td>
</tr>
</tbody>
</table>

**Generating Interim Accounting Records**

To enable periodic interim accounting records to be sent to the accounting server, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config)# aaa accounting update {newinfo} {periodic} number</code></td>
<td>Enables periodic interim accounting records to be sent to the accounting server.</td>
</tr>
</tbody>
</table>

When the `aaa accounting update` command is activated, the Cisco IOS XE software issues interim accounting records for all users on the system. If the `newinfo` keyword is used, interim accounting records are sent to the accounting server every time there is new accounting information to report. An example of this would be when Internet Protocol Control Protocol (IPCP) completes IP address negotiation with the remote peer. The interim accounting record includes the negotiated IP address used by the remote peer.

When `aaa accounting update` command is used with the keyword `periodic`, interim accounting records are sent periodically as defined by the argument number. The interim accounting record contains all of the accounting information recorded for that user up to the time the interim accounting record is sent.

Caution: Using the `aaa accounting update periodic` command can cause heavy congestion when many users are logged in to the network.

**Configuring an Alternate Method to Enable Periodic Accounting Records**

You can use the following alternative method to enable periodic interim accounting records to be sent to the accounting server.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `aaa accounting network default`
4. `action-type {none | start-stop [periodic {disable | interval minutes}] | stop-only}`
5. `exit`
DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
</tr>
<tr>
<td>aaa accounting network default</td>
<td>Configures the default accounting for all network-related service requests and enters accounting method list configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa accounting network default</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
</tr>
<tr>
<td>action-type {none</td>
<td>start-stop [periodic {disable</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(cfg-acct-mlist)# action-type start-stop</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>periodic interval 5</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td></td>
</tr>
<tr>
<td>exit</td>
<td>Returns to global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(cfg-acct-mlist)# exit</td>
<td></td>
</tr>
</tbody>
</table>

Generating Interim Service Accounting Records

Perform this task to enable the generation of interim service accounting records at periodic intervals for subscribers.
### Before You Begin

RADIUS Attribute 85 in the user service profile always takes precedence over the configured interim-interval value. RADIUS Attribute 85 must be in the user service profile. See the RADIUS Attributes Overview and RADIUS IETF Attributes feature document for more information.

**Note**

If RADIUS Attribute 85 is not in the user service profile, then the interim-interval value configured in Generating Interim Accounting Records is used for service interim accounting records.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **subscriber service accounting interim-interval** *minutes*

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router&gt; enable</td>
</tr>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# configure terminal</td>
</tr>
<tr>
<td>Step 3 subscriber service accounting interim-interval</td>
<td>Enables the generation of interim service accounting records at periodic intervals for subscribers. The <em>minutes</em> argument indicates the number of periodic intervals to send accounting update records from 1 to 71582 minutes.</td>
</tr>
<tr>
<td>minutes*</td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td>Router(config)# subscriber service accounting interim-interval 10</td>
</tr>
</tbody>
</table>

### Generating Accounting Records for a Failed Login or Session

When AAA accounting is activated, the Cisco IOS XE software does not generate accounting records for system users who fail login authentication, or who succeed in login authentication but fail PPP negotiation for some reason.
To specify that accounting stop records be generated for users who fail to authenticate at login or during session negotiation, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>aaa accounting send stop-record authentication failure</code></td>
<td>Generates “stop” records for users who fail to authenticate at login or during session negotiation using PPP.</td>
</tr>
</tbody>
</table>

### Specifying Accounting NETWORK-Stop Records Before EXEC-Stop Records

For PPP users who start EXEC terminal sessions, it can be specified that NETWORK records be generated before EXEC-stop records. In some cases, such as billing customers for specific services, it can be desirable to keep network start and stop records together, essentially “nesting” them within the framework of the EXEC start and stop messages. For example, a user dialing in using PPP can create the following records: EXEC-start, NETWORK-start, EXEC-stop, NETWORK-stop. By nesting the network accounting records, NETWORK-stop records follow NETWORK-start messages: EXEC-start, NETWORK-start, NETWORK-stop, EXEC-stop.

To nest accounting records for user sessions, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>aaa accounting nested</code></td>
<td>Nests network accounting records.</td>
</tr>
</tbody>
</table>

### Suppressing System Accounting Records over Switchover

To suppress the system accounting-on and accounting-off messages during switchover, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>aaa accounting redundancy suppress system-records</code></td>
<td>Suppresses the system accounting messages during switchover.</td>
</tr>
</tbody>
</table>
Configuring AAA Resource Failure Stop Accounting

To enable resource failure stop accounting, use the following command in global configuration:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config)# aaa accounting resource method-list stop-failure group server-group</code></td>
<td>Generates a &quot;stop&quot; record for any calls that do not reach user authentication.</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Before configuring the AAA Resource Failure Stop Accounting feature, the tasks described in the Prerequisites for Configuring Accounting, on page 147 section must be performed, and SNMP must be enabled on the network access server. For more information about enabling SNMP on a Cisco ASR 1000 Series Aggregation Services Router, see the Configuring SNMP Support chapter in the Cisco IOS XE Network Management Configuration Guide.</td>
</tr>
</tbody>
</table>

Configuring AAA Resource Accounting for Start-Stop Records

To enable full resource accounting for start-stop records, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Router(config)# aaa accounting resource method-list start-stop group server-group</code></td>
<td>Supports the ability to send a &quot;start&quot; record at each call setup, followed with a corresponding &quot;stop&quot; record at the call disconnect.</td>
</tr>
<tr>
<td><strong>Note</strong></td>
<td>Before configuring this feature, the tasks described in the section Prerequisites for Configuring Accounting, on page 147 must be performed, and SNMP must be enabled on the network access server. For more information about enabling SNMP on a Cisco ASR 1000 Series Aggregation Services Router, see the chapter Configuring SNMP Support in the Cisco IOS XE Network Management Configuration Guide, Release 2.</td>
</tr>
</tbody>
</table>
Configuring AAA Broadcast Accounting

To configure AAA broadcast accounting, use the `aaa accounting` command in global configuration mode. This command has been modified to allow the `broadcast` keyword.

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# aaa accounting {system</td>
<td>network</td>
</tr>
</tbody>
</table>

Configuring per-DNIS AAA Broadcast Accounting

To configure AAA broadcast accounting per DNIS, use the `aaa dnis map accounting network` command in global configuration mode. This command has been modified to allow the `broadcast` keyword and multiple server groups.

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# aaa dnis map dnis-number accounting network [start-stop</td>
<td>stop-only</td>
</tr>
</tbody>
</table>

Configuring the AAA Session MIB

The following tasks must be performed before configuring the AAA session MIB feature:

- Configure SNMP. For information on SNMP, see the Configuring SNMP Support chapter in the Cisco IOS XE Network Management Configuration Guide.
- Configure AAA.
- Define the RADIUS or TACACS+ server characteristics.

Note: Overusing SNMP can affect the overall system performance; therefore, normal network management performance must be considered when this feature is used.
To configure the AAA session MIB, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# aaa session-mib disconnect</td>
<td>Monitors and terminates authenticated client connections using SNMP.</td>
</tr>
<tr>
<td></td>
<td>To terminate the call, use the disconnect keyword.</td>
</tr>
</tbody>
</table>

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

To establish a console session with a router if the AAA server is unreachable, use the following command in global configuration mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router(config)# no aaa accounting system guarantee-first</td>
<td>The <strong>aaa accounting system guarantee-first</strong> command guarantees system accounting as the first record, which is the default condition.</td>
</tr>
<tr>
<td></td>
<td>In some situations, users may be prevented from starting a session on the console or terminal connection until after the system reloads, which can take more than three minutes. To resolve this problem, use the <strong>no aaa accounting system guarantee-first</strong> command.</td>
</tr>
</tbody>
</table>

### Monitoring Accounting

No specific `show` command exists for either RADIUS or TACACS+ accounting. To obtain accounting records displaying information about users logged in, use the following command in privileged EXEC mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router# show accounting</td>
<td>Allows display of the active accountable events on the network and helps collect information in the event of a data loss on the accounting server.</td>
</tr>
</tbody>
</table>

### Troubleshooting Accounting

To troubleshoot accounting information, use the following command in privileged EXEC mode:

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router# debug aaa accounting</td>
<td>Displays information on accountable events as they occur.</td>
</tr>
</tbody>
</table>
Configuration Examples for AAA Accounting

Configuring a Named Method List Example

The following example shows how to configure a Cisco AS5200 (enabled for AAA and communication with a RADIUS security server) in order for AAA services to be provided by the RADIUS server. If the RADIUS server fails to respond, then the local database is queried for authentication and authorization information, and accounting services are handled by a TACACS+ server.

```plaintext
aaa new-model
aaa authentication login admins local
aaa authentication ppp dialins group radius local
aaa authorization network network1 group radius local
aaa accounting network network2 start-stop group radius group tacacs+
username root password ALongPassword
tacacs-server host 172.31.255.0
tacacs-server key goaway
radius-server host 172.16.2.7
radius-server key myRaDiUSpassWoRd
interface group-async 1
group-range 1 16
encapsulation ppp
ppp authentication chap dialins
ppp authorization network1
ppp accounting network2
line 1 16
autoselect ppp
autoselect during-login
login authentication admins
modem dialin
```

The lines in this sample RADIUS AAA configuration are defined as follows:

- **The `aaa new-model` command** enables AAA network security services.
- **The `aaa authentication login admins local` command** defines a method list, "admins", for login authentication.
- **The `aaa authentication ppp dialins group radius local` command** defines the authentication method list "dialins", which specifies that first RADIUS authentication and then (if the RADIUS server does not respond) local authentication is used on serial lines using PPP.
- **The `aaa authorization network network1 group radius local` command** defines the network authorization method list named "network1", which specifies that RADIUS authorization is used on serial lines using PPP. If the RADIUS server fails to respond, then local network authorization is performed.
- **The `aaa accounting network network2 start-stop group radius group tacacs+` command** defines the network accounting method list named "network2", which specifies that RADIUS accounting services (in this case, start and stop records for specific events) are used on serial lines using PPP. If the RADIUS server fails to respond, accounting services are handled by a TACACS+ server.
- **The `username` command** defines the username and password to be used for the PPP Password Authentication Protocol (PAP) caller identification.
- **The `tacacs-server host` command** defines the name of the TACACS+ server host.
• The `tacacs-server key` command defines the shared secret text string between the network access server and the TACACS+ server host.

• The `radius-server host` command defines the name of the RADIUS server host.

• The `radius-server key` command defines the shared secret text string between the network access server and the RADIUS server host.

• The `interface group-async` command selects and defines an asynchronous interface group.

• The `group-range` command defines the member asynchronous interfaces in the interface group.

• The `encapsulation ppp` command sets PPP as the encapsulation method used on the specified interfaces.

• The `ppp authentication chap dialins` command selects Challenge Handshake Authentication Protocol (CHAP) as the method of PPP authentication and applies the “dialins” method list to the specified interfaces.

• The `ppp authorization network1` command applies the blue1 network authorization method list to the specified interfaces.

• The `ppp accounting network2` command applies the red1 network accounting method list to the specified interfaces.

• The `line` command switches the configuration mode from global configuration to line configuration and identifies the specific lines being configured.

• The `autoselect ppp` command configures the Cisco IOS XE software to allow a PPP session to start up automatically on these selected lines.

• The `autoselect during-login` command is used to display the username and password prompt without pressing the Return key. After the user logs in, the autoselect function (in this case, PPP) begins.

• The `login authentication admins` command applies the admins method list for login authentication.

• The `modem dialin` command configures modems attached to the selected lines to accept only incoming calls.

The `show accounting` command yields the following output for the preceding configuration:

Active Accounted actions on tty1, User username2 Priv 1
Task ID 5, Network Accounting record, 00:00:52 Elapsed
task_id=5 service=ppp protocol=ip address=10.0.0.98

The table below describes the fields contained in the preceding output.

**Table 26: show accounting Field Descriptions**

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Accounted actions on</td>
<td>Terminal line or interface name user with which the user logged in.</td>
</tr>
<tr>
<td>User</td>
<td>User’s ID.</td>
</tr>
<tr>
<td>Priv</td>
<td>User’s privilege level.</td>
</tr>
<tr>
<td>Task ID</td>
<td>Unique identifier for each accounting session.</td>
</tr>
</tbody>
</table>
Configuring AAA Resource Accounting Example

The following example shows how to configure the resource failure stop accounting and resource accounting for start-stop records functions:

!Enable AAA on your network access server.
aaa new-model
!Enable authentication at login and list the AOL string name to use for login authentication.
  aaa authentication login AOL group radius local
!Enable authentication for ppp and list the default method to use for PPP authentication.
  aaa authentication ppp default group radius local
!Enable authorization for all exec sessions and list the AOL string name to use for authorization.
  aaa authorization exec AOL group radius if-authenticated
!Enable authorization for all network-related service requests and list the default method to use for all network-related authorizations.
  aaa authorization network default group radius if-authenticated
!Enable accounting for all exec sessions and list the default method to use for all start-stop accounting services.
  aaa accounting exec default start-stop group radius
!Enable accounting for all network-related service requests and list the default method to use for all start-stop accounting services.
  aaa accounting network default start-stop group radius
!Enable failure stop accounting.
  aaa accounting resource default stop-failure group radius
!Enable resource accounting for start-stop records.
  aaa accounting resource default start-stop group radius

Configuring AAA Broadcast Accounting Example

The following example shows how to turn on broadcast accounting using the global `aaa accounting` command:

aaa group server radius isp
  server 10.0.0.1
  server 10.0.0.2
aaa group server tacacs+ isp_customer
  server 172.0.0.1
aaa accounting network default start-stop broadcast group isp group isp_customer
  radius-server host 10.0.0.1
  radius-server host 10.0.0.2
  radius-server key key1
tacacs-server host 172.0.0.1 key key2

The `broadcast` keyword causes "start" and "stop" accounting records for network connections to be sent simultaneously to server 10.0.0.1 in the group isp and to server 172.0.0.1 in the group isp_customer. If server 10.0.0.1 is unavailable, failover to server 10.0.0.2 occurs. If server 172.0.0.1 is unavailable, no failover occurs because backup servers are not configured for the group isp_customer.
Configuring per-DNIS AAA Broadcast Accounting Example

The following example shows how to turn on per-DNIS broadcast accounting using the global `aaa dnis map accounting network` command:

```plaintext
aaa group server radius isp
  server 10.0.0.1
  server 10.0.0.2
aaa group server tacacs+ isp_customer
  server 172.0.0.1
aaa dnis map enable
aaa dnis map 7777 accounting network start-stop broadcast group isp group isp_customer
  radius-server host 10.0.0.1
  radius-server host 10.0.0.2
  radius-server key key_1
  tacacs-server host 172.0.0.1 key key_2
```

The broadcast keyword causes "start" and "stop" accounting records for network connection calls having DNIS number 7777 to be sent simultaneously to server 10.0.0.1 in the group isp and to server 172.0.0.1 in the group isp_customer. If server 10.0.0.1 is unavailable, failover to server 10.0.0.2 occurs. If server 172.0.0.1 is unavailable, no failover occurs because backup servers are not configured for the group isp_customer.

AAA Session MIB Example

The following example shows how to set up the AAA session MIB feature to disconnect authenticated client connections for PPP users:

```plaintext
aaa new-model
aaa authentication ppp default group radius
aaa authorization network default group radius
aaa accounting network default start-stop group radius
aaa session-mib disconnect
```

Additional References

The following sections provide references related to the Configuring Accounting feature.

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuring SNMP</td>
<td><em>Cisco IOS XE Network Management Configuration Guide</em></td>
</tr>
<tr>
<td>SNMP commands</td>
<td><em>Cisco IOS Network Management Command Reference</em></td>
</tr>
<tr>
<td>Security commands</td>
<td><em>Cisco IOS Security Command Reference</em></td>
</tr>
<tr>
<td>Configuring Radius</td>
<td>Configuring RADIUS</td>
</tr>
<tr>
<td>Configuring TACACS+</td>
<td>Configuring TACACS+</td>
</tr>
</tbody>
</table>
## Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.</td>
<td>--</td>
</tr>
</tbody>
</table>

## MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CISCO-AAA-SESSION-MIB</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS XE software 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></td>
</tr>
</tbody>
</table>

## RFCs

<table>
<thead>
<tr>
<th>RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.</td>
<td>--</td>
</tr>
</tbody>
</table>
Technical Assistance

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

Feature Information for Configuring Accounting

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

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

Table 27: Feature Information for Configuring Accounting

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA Broadcast Accounting</td>
<td>Cisco IOS XE Release 2.1</td>
<td>AAA broadcast accounting allows accounting information to be sent to multiple AAA servers at the same time; that is, accounting information can be broadcast to one or more AAA servers simultaneously. In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: aaa accounting.</td>
</tr>
<tr>
<td>Feature Name</td>
<td>Releases</td>
<td>Feature Information</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>AAA Session MIB</td>
<td>Cisco IOS XE Release 2.1</td>
<td>The AAA session MIB feature allows customers to monitor and terminate their authenticated client connections using Simple Network Management Protocol (SNMP). In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: <code>aaa session-mib disconnect</code>.</td>
</tr>
<tr>
<td>Connection Accounting</td>
<td>Cisco IOS XE Release 2.1</td>
<td>Connection accounting provides information about all outbound connections made from the network access server, such as Telnet, local-area transport (LAT), TN3270, packet assembler/disassembler (PAD), and rlogin. In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.</td>
</tr>
<tr>
<td>AAA Interim Accounting</td>
<td>Cisco IOS XE Release 2.4</td>
<td>AAA interim accounting allows accounting records to be sent to the accounting server every time there is new accounting information to report, or on a periodic basis. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: <code>aaa accounting update</code> and <code>subscriber service accounting interim-interval</code>.</td>
</tr>
</tbody>
</table>
AAA-SERVER-MIB Set Operation

The AAA-SERVER-MIB Set Operation feature allows you to extend and expand your ability to configure authentication, authorization, and accounting (AAA) servers using the CISCO-AAA-SERVER-MIB. Using this feature, you can do the following:

• Create and add new AAA servers.
• Modify the “KEY” under the CISCO-AAA-SERVER-MIB.
• Delete the AAA server configuration.

Finding Feature Information, page 179
Prerequisites for AAA-SERVER-MIB Set Operation, page 180
Restrictions for AAA-SERVER-MIB Set Operation, page 180
Information About AAA-SERVER-MIB Set Operation, page 180
How to Configure AAA-SERVER-MIB Set Operation, page 180
Configuration Examples for AAA-SERVER-MIB Set Operation, page 181
Additional References, page 183
Feature Information for AAA-SERVER-MIB Set Operation, page 184

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.
Prerequisites for AAA-SERVER-MIB Set Operation

AAA must have been enabled on the router, that is, the `aaa new-model` command must have been configured. If this configuration has not been accomplished, the set operation fails.

Restrictions for AAA-SERVER-MIB Set Operation

Currently, the CISCO SNMP set operation is supported only for the RADIUS protocol. Therefore, only RADIUS servers in global configuration mode can be added, modified, or deleted.

Information About AAA-SERVER-MIB Set Operation

CISCO-AAA-SERVER-MIB

The CISCO-AAA-SERVER-MIB provides that statistics reflect both the state of the AAA server operation with the server itself and of AAA communications with external servers. The CISCO-AAA-SERVER-MIB provides the following information:

- Statistics for each AAA operation
- Status of servers that are providing AAA functions
- Identities of external AAA servers

CISCO-AAA-SERVER-MIB Set Operation

In Cisco IOS XE Release 2.1, the CISCO-AAA-SERVER-MIB supports both the get and set operations. With the set operation, you can do the following:

- Create or add a new AAA server.
- Modify the KEY under the CISCO-AAA-SERVER-MIB. This "secret key" is used for secure connectivity to the AAA server, which is present with the network access server (NAS) and the AAA server.
- Delete the AAA server configuration.

How to Configure AAA-SERVER-MIB Set Operation

No special configuration is required for this feature. The Simple Network Management Protocol (SNMP) framework can be used to manage MIBs. See the section Additional References for a reference to configuring SNMP.
Verifying RADIUS Server Configuration and Server Statistics

RADIUS server configuration and server statistics can be verified by performing the following steps.

SUMMARY STEPS

1. enable
2. show running-config | include radius-server host
3. show aaa servers

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Step 2</td>
<td>show running-config</td>
<td>include radius-server host</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router# show running-config</td>
<td>include radius-server host</td>
</tr>
<tr>
<td>Step 3</td>
<td>show aaa servers</td>
<td>Displays information about the number of requests sent to and received from authentication, authorization, and accounting (AAA) servers.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router# show aaa servers</td>
<td></td>
</tr>
</tbody>
</table>

Configuration Examples for AAA-SERVER-MIB Set Operation

RADIUS Server Configuration and Server Statistics Example

The following output example shows the RADIUS server configuration and server statistics before and after the set operation.

Before the Set Operation

Router# show running-config | include radius-server host
! The following line is for server 1.
radius-server host 172.19.192.238 auth-port 2095 acct-port 2096 key cisco2
Server Statistics

Router# show aaa servers
RADIUS: id 2, priority 1, host 172.19.192.238, auth-port 2095, acct-port 2096
State: current UP, duration 25s, previous duration 0s
  Dead: total time 0s, count 7
  Authen: request 8, timeouts 8
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 2
  Author: request 0, timeouts 0
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 0
  Account: request 0, timeouts 0
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 0
  Elapsed time since counters last cleared: 5m
RADIUS: id 3, priority 2, host 172.19.192.238, auth-port 1645, acct-port 1646
State: current UP, duration 5s, previous duration 0s
  Dead: total time 0s, count 2
  Authen: request 8, timeouts 8
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 4
  Author: request 0, timeouts 0
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 0
  Account: request 0, timeouts 0
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 0
  Elapsed time since counters last cleared: 3m

SNMP Get Operation to Check the Configuration and Statistics of the RADIUS Servers

aaa-server5:/users/smetri> getmany 10.0.1.42 casConfigTable
casAddress.2.2 = 172.19.192.238
casAddress.2.3 = 172.19.192.238
casAuthenPort.2.2 = 2095
casAuthenPort.2.3 = 1645
casAcctPort.2.2 = 2096
casAcctPort.2.3 = 1646
casKey.2.2 =
casKey.2.3 =
! The following line shows priority for server 1.
casPriority.2.2 = 1
! The following line shows priority for server 2.
casPriority.2.3 = 2
casConfigRowStatus.2.2 = active(1)
casConfigRowStatus.2.3 = active(1)

SNMP Set Operation

The key of the existing RADIUS server is being changed. The index “1” is being used. That index acts as a wildcard for addition, deletion, or modification of any entries.

Change the key for server 1:

aaa-server5:/users/smetri> setany -v2c 10.0.1.42 public casAddress.2.1 -i 172.19.192.238 casAuthenPort.2.1 -i 2095 casAcctPort.2.1 -i 2096 casKey.2.1 -o king
casAddress.2.1 = 172.19.192.238
casAuthenPort.2.1 = 2095
casAcctPort.2.1 = 2096
casKey.2.1 = king

Authentication Authorization and Accounting Configuration Guide Cisco IOS XE Release 3S
After the Set Operation

After the above SNMP set operation, the configurations on the router change. The following output shows the output after the set operation.

Router# show running-config | include radius-server host
radius-server host 172.19.192.238 auth-port 1645 acct-port 1646
! The following line shows a change in the key value to “king.”
radius-server host 172.19.192.238 auth-port 2095 acct-port 2096 key king

Router# show aaa servers
RADIUS: id 3, priority 1, host 172.19.192.238, auth-port 1645, acct-port 1646
  State: current UP, duration 189s, previous duration 0s
  Dead: total time 0s, count 2
  Authen: request 8, timeouts 8
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 4
  Author: request 0, timeouts 0
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 0
  Account: request 0, timeouts 0
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 0
  Elapsed time since counters last cleared: 6m

! The following line shows a new server with new statistics.
RADIUS: id 4, priority 2, host 172.19.192.238, auth-port 2095, acct-port 2096
  State: current UP, duration 209s, previous duration 0s
  Dead: total time 0s, count 7
  Authen: request 0, timeouts 0
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 0
  Author: request 0, timeouts 0
    Response: unexpected 0, server error 0, incorrect 0, time 0ms
    Transaction: success 0, failure 0
  Account: request 0, timeouts 0
    Response: unexpected 0, server error 0, incorrect 0, time 0ms

Additional References

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands</td>
<td>Cisco IOS Master Command List, All Releases</td>
</tr>
<tr>
<td>Authentication commands</td>
<td>Cisco IOS Security Command Reference</td>
</tr>
<tr>
<td>IEEE 802.1x—Flexible Authentication</td>
<td>Securing User Services Configuration Library</td>
</tr>
</tbody>
</table>
MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CISCO-AUTH-FRAMEWORK-MIB</td>
<td>To locate and download MIBs for selected</td>
</tr>
<tr>
<td></td>
<td>platforms, Cisco IOS software releases, and</td>
</tr>
<tr>
<td></td>
<td>feature sets, use Cisco MIB Locator found at</td>
</tr>
<tr>
<td></td>
<td>the following URL:</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
<tr>
<td>• CISCO-MAC-AUTH-BYPASS-MIB</td>
<td></td>
</tr>
<tr>
<td>• CISCO-PAE-MIB</td>
<td></td>
</tr>
<tr>
<td>• IEEE8021-PAE-MIB</td>
<td></td>
</tr>
</tbody>
</table>

RFCs

<table>
<thead>
<tr>
<th>RFC 3580</th>
<th>IEEE 802.1x Remote Authentication Dial In User</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Service (RADIUS)</td>
</tr>
</tbody>
</table>

Technical Assistance

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

Feature Information for AAA-SERVER-MIB Set Operation

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
Table 28: Feature Information for AAA-SERVER-MIB Set Operation

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA-SERVER-MIB Set Operation</td>
<td>Cisco IOS XE Release 2.1</td>
<td>This feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.</td>
</tr>
</tbody>
</table>
Per VRF AAA

The Per VRF AAA feature allows ISPs to partition authentication, authorization, and accounting (AAA) services on the basis of Virtual Private Network (VPN) routing and forwarding (VRF) instances, allowing their customers to control some of their own AAA services.

The list of servers in server groups is extended to include the definitions of private servers in addition to references to the hosts in the global configuration, allowing access to both customer servers and global service provider servers simultaneously.

In Cisco IOS XE Release 2.4 and later releases, a customer template can be used, which may be stored either locally or remotely, and AAA services can be performed on the information that is stored in the customer template. This feature is referred to as the Dynamic Per VRF AAA feature.

- Prerequisites for Per VRF AAA, page 187
- Restrictions for Per VRF AAA, page 187
- Information About Per VRF AAA, page 188
- How to Configure Per VRF AAA, page 194
- Configuration Examples for Per VRF AAA, page 207
- Additional References, page 215
- Feature Information for Per VRF AAA, page 216
- Glossary, page 218

Prerequisites for Per VRF AAA

Before configuring the Per VRF AAA feature, AAA must be enabled. See "How to Configure Per VRF AAA" section on page 6 for more information.

Restrictions for Per VRF AAA

- This feature is supported only for RADIUS servers.
• Operational parameters should be defined once per VRF rather than set per server group, because all functionality must be consistent between the network access server (NAS) and the AAA servers.

• The ability to configure a customer template either locally or remotely is available only for Cisco IOS XE Release 2.4 and later releases.

**Information About Per VRF AAA**

When you use the Per VRF AAA feature, AAA services can be based on VRF instances. This feature permits the Provider Edge (PE) or Virtual Home Gateway (VHG) to communicate directly with the customer’s RADIUS server, which is associated with the customer’s Virtual Private Network (VPN), without having to go through a RADIUS proxy. Thus, ISPs can scale their VPN offerings more efficiently because they no longer have to use RADIUS proxies and ISPs can also provide their customers with additional flexibility.

**How Per VRF AAA Works**

To support AAA on a per customer basis, some AAA features must be made VRF aware. That is, ISPs must be able to define operational parameters—such as AAA server groups, method lists, system accounting, and protocol-specific parameters—and bind those parameters to a particular VRF instance. Defining and binding the operational parameters can be accomplished using one or more of the following methods:

• Virtual private dialup network (VPDN) virtual template or dialer interfaces that are configured for a specific customer

• Locally defined customer templates--Per VPN with customer definitions. The customer template is stored locally on the VHG. This method can be used to associate a remote user with a specific VPN based on the domain name or dialed number identification service (DNIS) and provide the VPN-specific configuration for virtual access interface and all operational parameters for the customer AAA server.

• Remotely defined customer templates--Per VPN with customer definitions that are stored on the service provider AAA server in a RADIUS profile. This method is used to associate a remote user with a specific VPN based on the domain name or DNIS and provide the VPN-specific configuration for the virtual access interface and all operational parameters for the AAA server of the customer.

**Note**

The ability to configure locally or remotely defined customer templates is available only with Cisco IOS XE Release 2.4 and later releases.

**AAA Accounting Records**

The Cisco implementation of AAA accounting provides "start" and "stop" record support for calls that have passed user authentication. Start and stop records are necessary for users employing accounting records to manage and monitor their networks.
New Vendor-Specific Attributes

The Internet Engineering Task Force (IETF) draft standard specifies a method for communicating vendor-specific information between the network access server and the RADIUS server by using the vendor-specific attribute (VSA) attribute 26. Attribute 26 encapsulates VSAs, thereby, allowing vendors to support their own extended attributes otherwise not suitable for general use.

The Cisco RADIUS implementation supports one vendor-specific option 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 of the following 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 attribute-value (AV) pair defined in the Cisco TACACS+ specification, and "sep" is "=" for mandatory attributes and "*" for optional attributes. This format allows the full set of features available for TACACS+ authorization to be used also for RADIUS.

The table below summarizes the VSAs that are now supported with Per VRF AAA.

**Table 29: VSAs Supported with Per VRF AAA**

<table>
<thead>
<tr>
<th>VSA Name</th>
<th>Value Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note</td>
<td></td>
<td>Each VSA must have the prefix &quot;template:&quot; before the VSA name, unless a different prefix is explicitly stated.</td>
</tr>
<tr>
<td>account-delay</td>
<td>string</td>
<td>This VSA must be &quot;on.&quot; The functionality of this VSA is equal to the <code>aaa accounting delay-start</code> command for the customer template.</td>
</tr>
<tr>
<td>account-send-stop</td>
<td>string</td>
<td>This VSA must be &quot;on.&quot; The functionality of this VSA is equal to the <code>aaa accounting send stop-record authentication</code> command with the <code>failure</code> keyword.</td>
</tr>
<tr>
<td>account-send-success-remote</td>
<td>string</td>
<td>This VSA must be &quot;on.&quot; The functionality of this VSA is equal to the <code>aaa accounting send stop-record authentication</code> command with the <code>success</code> keyword.</td>
</tr>
</tbody>
</table>
### New Vendor-Specific Attributes

<table>
<thead>
<tr>
<th>VSA Name</th>
<th>Value Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>attr-44</td>
<td>string</td>
<td>This VSA must be “access-req.” The functionality of this VSA is equal to the <code>radius-server attribute 44 include-in-access-req</code> command.</td>
</tr>
<tr>
<td>ip-addr</td>
<td>string</td>
<td>This VSA specifies the IP address, followed by the mask that the router uses to indicate its own IP address and mask in negotiation with the client; for example, <code>ip-addr=192.168.202.169 255.255.255.255</code></td>
</tr>
<tr>
<td>ip-unnumbered</td>
<td>string</td>
<td>This VSA specifies the name of an interface on the router. The functionality of this VSA is equal to the <code>ip unnumbered</code> command, which specifies an interface name such as &quot;Loopback0.&quot;</td>
</tr>
<tr>
<td>ip-vrf</td>
<td>string</td>
<td>This VSA specifies which VRF will be used for the packets of the end user. This VRF name should match the name that is used on the router via the <code>ip vrf forwarding</code> command.</td>
</tr>
<tr>
<td>peer-ip-pool</td>
<td>string</td>
<td>This VSA specifies the name of an IP address pool from which an address will be allocated for the peer. This pool should be configured using the <code>ip local pool</code> command or should be automatically downloadable via RADIUS.</td>
</tr>
<tr>
<td>VSA Name</td>
<td>Value Type</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>ppp-acct-list</td>
<td>string</td>
<td>This VSA defines the accounting method list that is to be used for PPP sessions. The VSA syntax is as follows: &quot;ppp-acct-list=[start-stop</td>
</tr>
<tr>
<td>ppp-authen-list</td>
<td>string</td>
<td>This VSA defines which authentication method list is to be used for PPP sessions and, if more than one method is specified, in what order the methods should be used. The VSA syntax is as follows: &quot;ppp-authen-list=[groupX</td>
</tr>
<tr>
<td>VSA Name</td>
<td>Value Type</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ppp-authen-type</td>
<td>string</td>
<td>This VSA allows the end user to specify at least one of the following authentication types: pap, chap, eap, ms-chap, ms-chap-v2, any, or a combination of the available types that is separated by spaces. The end user will be permitted to log in using only the methods that are specified in this VSA. PPP will attempt these authentication methods in the order presented in the attribute.</td>
</tr>
<tr>
<td>ppp-author-list</td>
<td>string</td>
<td>This VSA defines the authorization method list that is to be used for PPP sessions. It indicates which methods will be used and in what order. The VSA syntax is as follows: &quot;ppp-author-list=[groupX] [local] [if-authenticated] [none],&quot; which is equal to the <code>aaa authorization network mylist</code> command functionality. The user must specify at least one, but no more than four, authorization methods. If a server group is specified, the group name must be an integer. The servers in the group should have already been identified in the access-accept via the VSA &quot;rad-serv.&quot;</td>
</tr>
</tbody>
</table>

**Note**
The RADIUS VSAs--rad-serv, rad-serv-filter, rad-serv-source-if, and rad-serv-vrf--must have the prefix “aaa:” before the VSA name.
<table>
<thead>
<tr>
<th>VSA Name</th>
<th>Value Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rad-serv</td>
<td>string</td>
<td>This VSA indicates the IP address, key, timeout, and retransmit number of a server, as well as the group of the server. The VSA syntax is as follows: &quot;rad-serv=a.b.c.d [key SomeKey] [auth-port X] [acct-port Y] [retransmit V] [timeout W].&quot; Other than the IP address, all parameters are optional and can be issued in any order. If the optional parameters are not specified, their default values will be used. The key cannot contain any spaces; for &quot;retransmit V,&quot; &quot;V&quot; can range from 1-100; for &quot;timeout W,&quot; the &quot;W&quot; can range from 1-1000.</td>
</tr>
<tr>
<td>rad-serv-filter</td>
<td>string</td>
<td>The VSA syntax is as follows: &quot;rad-serv-filter=authorization</td>
</tr>
<tr>
<td>rad-serv-source-if</td>
<td>string</td>
<td>This VSA specifies the name of the interface that is used for transmitting RADIUS packets. The specified interface must match the interface configured on the router.</td>
</tr>
<tr>
<td>rad-serv-vrf</td>
<td>string</td>
<td>This VSA specifies the name of the VRF that is used for transmitting RADIUS packets. The VRF name should match the name that was specified via the ip vrf forwarding command.</td>
</tr>
</tbody>
</table>
VRF Aware Framed-Routes

In Cisco IOS XE Release 2.3 and later, the Cisco ASR 1000 Series Aggregation Services Routers support VRF aware framed-routes. No configuration is required to enable support for this feature. Framed-routes are automatically detected and if the framed-route is part of a VRF associated with an interface, the rout is applied accordingly.

How to Configure Per VRF AAA

Configuring Per VRF AAA

Configuring AAA

To enable AAA you need to complete the following steps.

SUMMARY STEPS

1. enable
2. configure terminal
3. aaa new-model

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3 aaa new-model</td>
<td>Enables AAA globally.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa new-model</td>
<td></td>
</tr>
</tbody>
</table>
# Configuring Server Groups

To configure server groups you need to complete the following steps.

## SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `aaa new-model`
4. `aaa group server radius groupname`
5. `server-private ip-address [auth-port port-number | acct-port port-number] [non-standard] [timeout seconds] [retransmit retries] [key string]`
6. `exit`

## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
  - Enter your password if prompted.  
  **Example:**  
  `Router> enable` |
| **Step 2** `configure terminal` | Enters global configuration mode.  
  **Example:**  
  `Router# configure terminal` |
| **Step 3** `aaa new-model` | Enables AAA globally.  
  **Example:**  
  `Router(config)# aaa new-model` |
| **Step 4** `aaa group server radius groupname` | Groups different RADIUS server hosts into distinct lists and distinct methods. Enters server-group configuration mode.  
  **Example:**  
  `Router(config)# aaa group server radius v2.44.com` |
| **Step 5** `server-private ip-address [auth-port port-number | acct-port port-number] [non-standard] [timeout seconds] [retransmit retries] [key string]` | Configures the IP address of the private RADIUS server for the group server.  
  **Note** If private server parameters are not specified, global configurations will be used. If global configurations are not specified, default values will be used.  
  **Example:**  
  `Router(config-sg-radius)# server-private 10.10.130.2 auth-port 1600 key ww` |
### Configuring Authentication Authorization and Accounting for Per VRF AAA

To configure authentication, authorization, and accounting for Per VRF AAA, you need to complete the following steps.

#### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **aaa new-model**
4. **aaa authentication ppp {default | list-name} method1 [method2...]**
5. **aaa authorization {network | exec | commands level | reverse-access | configuration} {default | list-name} method1 [method2...]**
6. **aaa accounting system default [vrf vrf-name] {start-stop | stop-only | none} [broadcast] group groupname**
7. **aaa accounting delay-start [vrf vrf-name]**
8. **aaa accounting send stop-record authentication {failure | success remote-server} [vrf vrf-name]**

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>enable</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td><code>Router&gt; enable</code></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>configure terminal</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td><code>Router# configure terminal</code></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Step 3</strong> aaa new-model</td>
<td>Enables AAA globally.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa new-model</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> aaa authentication ppp {default</td>
<td>list-name} method1 [method2...]</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa authentication ppp method_list_v2.44.com group v2.44.com</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> aaa authorization {network</td>
<td>exec</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa authorization network method_list_v2.44.com group v2.44.com</td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong> aaa accounting system default {start-stop</td>
<td>stop-only</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa accounting system default vrf v2.44.com start-stop group v2.44.com</td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong> aaa accounting delay-start [vrf vrf-name]</td>
<td>Displays generation of the start accounting records until the user IP address is established.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa accounting delay-start vrf v2.44.com</td>
<td></td>
</tr>
<tr>
<td><strong>Step 8</strong> aaa accounting send stop-record authentication {failure</td>
<td>success remote-server} [vrf vrf-name]</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa accounting send stop-record authentication failure vrf v2.44.com</td>
<td>When using the <em>failure</em> keyword a &quot;stop&quot; record will be sent for calls that are rejected during authentication.</td>
</tr>
<tr>
<td>When using the <em>success</em> keyword a &quot;stop&quot; record will be sent for calls that meet one of the following criteria:</td>
<td></td>
</tr>
<tr>
<td>• Calls that are authenticated by a remote AAA server when the call is terminated.</td>
<td></td>
</tr>
<tr>
<td>• Calls that are not authenticated by a remote AAA server and the start record has been sent.</td>
<td></td>
</tr>
</tbody>
</table>
### Configuring RADIUS-Specific Commands for Per VRF AAA

To configure RADIUS-specific commands for Per VRF AAA you need to complete the following steps.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ip radius source-interface subinterface-name [vrf vrf-name]`
4. `radius-server attribute 44 include-in-access-req [vrf vrf-name]`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> <code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> <code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong> Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> <code>ip radius source-interface subinterface-name [vrf vrf-name]</code></td>
<td>Forces RADIUS to use the IP address of a specified interface for all outgoing RADIUS packets and enables the specification on a per-VRF basis.</td>
</tr>
<tr>
<td><strong>Example:</strong> Router(config)# ip radius source-interface loopback55</td>
<td></td>
</tr>
</tbody>
</table>
### Configuring Interface-Specific Commands for Per VRF AAA

To configure interface-specific commands for Per VRF AAA, you need to complete the following steps.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `interface type number [name-tag]`
4. `ip vrf forwarding vrf-name`
5. `ppp authentication {protocol1 [protocol2 ...]} listname`
6. `ppp authorization list-name`
7. `ppp accounting default`
8. `exit`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
  Example: Router> enable  
  • Enter your password if prompted. |
| **Step 2** configure terminal | Enters global configuration mode.  
  Example: Router# configure terminal |
| **Step 3** interface type number [name-tag] | Configures an interface type and enters interface configuration mode.  
  Example: Router(config)# interface loopback11 |
### Command or Action

<table>
<thead>
<tr>
<th>Step 4</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ip vrf forwarding vrf-name</td>
<td>Associates a VRF with an interface.</td>
<td></td>
</tr>
</tbody>
</table>

#### Example:
```
Router(config-if)# ip vrf forwarding v2.44.com
```

<table>
<thead>
<tr>
<th>Step 5</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ppp authentication {protocol1 [protocol2...]} listname</td>
<td>Enables Challenge Handshake Authentication Protocol (CHAP) or Password Authentication Protocol (PAP) or both and specifies the order in which CHAP and PAP authentication are selected on the interface.</td>
<td></td>
</tr>
</tbody>
</table>

#### Example:
```
Router(config-if)# ppp authentication chap callin V2_44_com
```

<table>
<thead>
<tr>
<th>Step 6</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ppp authorization list-name</td>
<td>Enables AAA authorization on the selected interface.</td>
<td></td>
</tr>
</tbody>
</table>

#### Example:
```
Router(config-if)# ppp authorization V2_44_com
```

<table>
<thead>
<tr>
<th>Step 7</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ppp accounting default</td>
<td>Enables AAA accounting services on the selected interface.</td>
<td></td>
</tr>
</tbody>
</table>

#### Example:
```
Router(config-if)# ppp accounting default
```

<table>
<thead>
<tr>
<th>Step 8</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>exit</td>
<td>Exits interface configuration mode.</td>
<td></td>
</tr>
</tbody>
</table>

#### Example:
```
Router(config)# exit
```

---

### Configuring Per VRF AAA Using Local Customer Templates

#### Configuring AAA
Perform the tasks as outlined in the Configuring Per VRF AAA.

#### Configuring Server Groups
Perform the tasks as outlined in the Configuring Server Groups.

#### Configuring Authentication Authorization and Accounting for Per VRF AAA
Perform the tasks as outlined in the Configuring Authentication Authorization and Accounting for Per VRF AAA.
Configuring Authorization for Per VRF AAA with Local Customer Templates

To configure authorization for Per VRF AAA with local templates, you need to complete the following steps.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. aaa authorization template
4. aaa authorization network default local

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td></td>
<td>Router&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router# configure terminal</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 3</td>
<td>aaa authorization template</td>
<td>Enables the use of local or remote templates.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# aaa authorization template</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 4</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 4</td>
<td>aaa authorization network default local</td>
<td>Specifies local as the default method for authorization.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router(config)# aaa authorization network default local</td>
<td></td>
</tr>
</tbody>
</table>

**Configuring Local Customer Templates**

To configure local customer templates, you need to complete the following steps.
SUMMARY STEPS

1. enable
2. configure terminal
3. vpdn search-order domain
4. template name [default | exit | multilink | no | peer | ppp]
5. peer default ip address pool pool-name
6. ppp authentication {protocol1 [protocol2...]} [if-needed] [list-name | default] [callin] [one-time]
7. ppp authorization [default | list-name]
8. aaa accounting [auth-proxy | system | network | exec | connection | commands level} {default | list-name} [vrf vrf-name] [start-stop | stop-only | none] [broadcast] group groupname
9. exit

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router&gt; enable</td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3</td>
<td>vpdn search-order domain</td>
<td>Looks up the profiles based on domain.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router (config)# vpdn search-order domain</td>
<td></td>
</tr>
<tr>
<td>Step 4</td>
<td>template name [default</td>
<td>exit</td>
</tr>
<tr>
<td>Example:</td>
<td>Router (config)# template v2.44.com</td>
<td>Enters template configuration mode.</td>
</tr>
<tr>
<td>Note</td>
<td>Steps 5, 6, and 7 are optional. Enter multilink, peer, and ppp keywords appropriate to customer application requirements.</td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>peer default ip address pool pool-name</td>
<td>(Optional) Specifies that the customer profile to which this template is attached will use a local IP address pool with the specified name.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config-template)# peer default ip address pool v2_44_com_pool</td>
<td></td>
</tr>
</tbody>
</table>
### Command or Action

**Step 6**

`ppp authentication [protocol1 [protocol2...]] [if-needed] [list-name] [default] [callin] [one-time]`  
(Optional) Sets the PPP link authentication method.

Example:

```
Router(config-template)# ppp authentication chap
```

**Step 7**

`ppp authorization [default] [list-name]`  
(Optional) Sets the PPP link authorization method.

Example:

```
Router(config-template)# ppp authorization v2_44_com
```

**Step 8**

`aaa accounting {auth-proxy | system | network | exec | connection | commands level} {default | list-name} [vrf vrf-name] {start-stop | stop-only | none} [broadcast] [group groupname]`  
(Optional) Enables AAA operational parameters for the specified customer profile.

Example:

```
Router(config-template)# aaa accounting v2_44_com
```

**Step 9**

`exit`  
Exits from template configuration mode; returns to global configuration mode.

```
Router(config-template)# exit
```

---

**Configuring Per VRF AAA Using Remote Customer Templates**

**Configuring AAA**

Perform the tasks as outlined in the Configuring Per VRF AAA.

**Configuring Server Groups**

Perform the tasks as outlined in the Configuring Server Groups.

**Configuring Authentication for Per VRF AAA with Remote Customer Profiles**

To configure authentication for Per VRF AAA with remote customer profiles, you need to perform the following steps.
SUMMARY STEPS

1. enable
2. configure terminal
3. aaa authentication ppp {default | list-name} method1 [method2...]
4. aaa authorization {network | exec | commands level | reverse-access | configuration} {default | list-name} [[method1 [method2...]

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td>Router&gt; enable</td>
</tr>
<tr>
<td></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# configure terminal</td>
</tr>
<tr>
<td></td>
<td>Enters global configuration mode.</td>
</tr>
</tbody>
</table>
| **Step 3** | aaa authentication ppp {default | list-name} method1 [method2...]
| Example: | Router(config)# ppp authentication ppp default group radius |
| | Specifies one or more authentication, authorization, and accounting (AAA) authentication methods for use on serial interfaces that are running PPP. |
| **Step 4** | aaa authorization {network | exec | commands level | reverse-access | configuration} {default | list-name} [[method1 [method2...]
| Example: | Router(config)# aaa authorization network default group sp |
| | Sets parameters that restrict user access to a network. |

Configuring Authorization for Per VRF AAA with Remote Customer Profiles

To configuring authorization for Per VRF AAA with remote customer profiles, you need to perform the following step.
### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `aaa authorization template`
4. `aaa authorization {network | exec | commands level | reverse-access | configuration} {default | list-name} [[method1 [method2...]]`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enable privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Enter your password if prompted.</td>
</tr>
<tr>
<td><code>Router&gt; enable</code></td>
<td></td>
</tr>
</tbody>
</table>

| **Step 2** | Enters global configuration mode. |
| `configure terminal` | Enters global configuration mode. |
| **Example:** | |
| `Router# configure terminal` | |

| **Step 3** | Enables use of local or remote templates. |
| `aaa authorization template` | Enables use of local or remote templates. |
| **Example:** | |
| `Router(config)# aaa authorization template` | |

| **Step 4** | Specifies the server group that is named as the default method for authorization. |
| `aaa authorization {network | exec | commands level | reverse-access | configuration} {default | list-name} [[method1 [method2...]]` | Specifies the server group that is named as the default method for authorization. |
| **Example:** | |
| `Router(config)# aaa authorization network default sp` | |

**Configuring the RADIUS Profile on the SP RADIUS Server**

Configure the RADIUS profile on the Service Provider (SP) RADIUS server. See the Per VRF AAA Using a Remote RADIUS Customer Template Example for an example of how to update the RADIUS profile.

**Verifying VRF Routing Configurations**

To verify VRF routing configurations, you need to complete the following steps:
### SUMMARY STEPS

1. enable
2. configure terminal
3. show ip route vrf vrf-name

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1**
  - enable
  - **Example:**
    - Router> enable
    - Enters privileged EXEC mode.
    - Enter your password if prompted. |
| **Step 2**
  - configure terminal
  - **Example:**
    - Router# configure terminal
    - Enters global configuration mode. |
| **Step 3**
  - show ip route vrf vrf-name
  - **Example:**
    - Router(config)# show ip route vrf northvrf
    - Displays the IP routing table associated with a VRF. |
Troubleshooting Per VRF AAA Configurations

To troubleshoot the Per VRF AAA feature, use at least one of the following commands in EXEC mode:

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router# debug aaa accounting</td>
<td>Displays information on accountable events as they occur.</td>
</tr>
<tr>
<td>Router# debug aaa authentication</td>
<td>Displays information on AAA authentication.</td>
</tr>
<tr>
<td>Router# debug aaa authorization</td>
<td>Displays information on AAA authorization.</td>
</tr>
<tr>
<td>Router# debug ppp negotiation</td>
<td>Displays information on traffic and exchanges in an internetwork implementing PPP.</td>
</tr>
<tr>
<td>Router# debug radius</td>
<td>Displays information associated with RADIUS.</td>
</tr>
<tr>
<td>Router# debug vpdn event</td>
<td>Displays Layer 2 Transport Protocol (L2TP) errors and events that are a part of normal tunnel establishment or shutdown for VPNS.</td>
</tr>
<tr>
<td>Router# debug vpdn error</td>
<td>Displays debug traces for VPN.</td>
</tr>
</tbody>
</table>

Configuration Examples for Per VRF AAA

Per VRF Configuration Examples

Per VRF AAA Example

The following example shows how to configure the Per VRF AAA feature using a AAA server group with associated private servers:

```
aaa new-model
aaa authentication ppp method_list_v1.55.com group v1.55.com
aaa authorization network method_list_v1.55.com group v1.55.com
aaa accounting network method_list_v1.55.com start-stop group v1.55.com
aaa accounting system default vrf v1.55.com start-stop group v1.55.com
aaa accounting delay-start vrf v1.55.com
aaa accounting send stop-record authentication failure vrf v1.55.com
aaa group server radius v1.55.com
    server-private 10.10.132.4 auth-port 1645 acct-port 1646 key ww
    ip vrf forwarding v1.55.com
    ip radius source-interface loopback55
radius-server attribute 44 include-in-access-req vrf v1.55.com
```
Per VRF AAA Using a Locally Defined Customer Template Example

The following example shows how to configure the Per VRF AAA feature using a locally defined customer template with a AAA server group that has associated private servers:

```
aaa new-model
aaa authentication ppp method list_v1.55.com group v1.55.com
aaa authorization network method list_v1.55.com group v1.55.com
aaa authorization network default local
aaa authorization template
aaa accounting network method list_v1.55.com start-stop group v1.55.com
aaa accounting system default vrf v1.55.com start-stop group v1.55.com
aaa group server radius V1_55_com
  server-private 10.10.132.4 auth-port 1645 acct-port 1646 key ww
  ip vrf forwarding V1.55.com
template V1.55.com
  peer default ip address pool V1_55_com_pool
  ppp authentication chap callin V1_55_com
  ppp authorization V1_55_com
  aaa accounting delay-start
  aaa accounting send stop-record authentication failure
  radius-server attribute 44 include-in-access-req
  ip vrf forwarding v1.55.com
  ip radius source-interface Loopback55
```

Per VRF AAA Using a Remote RADIUS Customer Template Example

The following examples shows how to configure the Per VRF AAA feature using a remotely defined customer template on the SP RADIUS server with a AAA server group that has associated private servers:

```
aaa new-model
aaa authentication ppp default group radius
aaa authorization template
aaa authorization template
aaa accounting network default group sp
aaa group server radius sp
  server 10.3.3.3
radius-server host 10.3.3.3 auth-port 1645 acct-port 1646 key sp_key
The following RADIUS server profile is configured on the SP RADIUS server:

cisco-avpair = "aaa:rad-serv#1=10.10.132.4 key ww"
cisco-avpair = "aaa:rad-serv-vrf#1=V1.55.com"
cisco-avpair = "aaa:rad-serv-source-if#1=Loopback 55"
cisco-avpair = "template:ppp-authen-list=group 1"
cisco-avpair = "template:ppp-author-list=group 1"
cisco-avpair = "template:ppp-acct-list= start-stop group 1"
cisco-avpair = "template:account-delay-on"
cisco-avpair = "template:account-send-stop-on"
cisco-avpair = "template:rad-attr44=access-req"
cisco-avpair = "template:peer-ip-pool=V1.55-pool"
cisco-avpair = "template:ip-vrf=V1.55.com"
cisco-avpair = "template:ip-unnumbered=Loopback 55"
framed-protocol = ppp
service-type = framed
```
Customer Template Examples

Locally Configured Customer Template with RADIUS Attribute Screening and Broadcast Accounting Example

The following example shows how to create a locally configured template for a single customer, configuring additional features including RADIUS attribute screening and broadcast accounting:

```
aaa authentication ppp default local group radius
aaa authentication ppp V1_55_com group V1_55_com
aaa authorization template
daaa authorization network default local group radius
daaa authorization network V1_55_com group V1_55_com
daaa accounting network V1_55_com start-stop broadcast group V1_55_com group SP_AAA_server
daaa group server radius SP_AAA_server
    server 10.10.100.7 auth-port 1645 acct-port 1646
    aaa group server radius V1_55_com
    server-private 10.10.132.4 auth-port 1645 acct-port 1646
    authorization accept min-author
    accounting accept usage-only
    ip vrf forwarding V1.55.com
    ip vrf V1.55.com
    rd 1:55
    route-target export 1:55
    route-target import 1:55
template V1.55.com
    peer default ip address pool V1.55-pool
    ppp authentication chap callin V1_55_com
    ppp authorization V1_55_com
    ppp accounting V1_55_com
    aaa accounting delay-start
    aaa accounting send stop-record authentication failure
    radius-server attribute 44 include-in-access-req
    vpdn-group V1.55
    accept-dialin
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
    ip radius source-interface Loopback55
    protocol l2tp
    virtual-template 13
    terminate-from hostname lac-lb-V1.55
    source-ip 10.10.104.12
    lcp renegotiation always
    l2tp tunnel password 7 060506324F41
    interface Virtual-Template13
    ip vrf forwarding V1.55.com
    ip unnumbered Loopback55
```
Remotely Configured Customer Template with RADIUS Attribute Screening and Broadcast Accounting Example

The following example shows how to create a remotely configured template for a single customer, configuring additional features including RADIUS attribute screening and broadcast accounting:

```plaintext
aaa authentication ppp default local group radius
aaa authorization template
aaa authorization network default local group radius
ip vrf V1.55.com
rd 1:55
route-target export 1:55
route-target import 1:55
vpdn-group V1.55
accept-dialin
protocol l2tp
virtual-template 13
terminate-from hostname lac-lb-V1.55
source-ip 10.10.104.12
lcp renegotiation always
l2tp tunnel password 7 060506324F41
interface Virtual-Template13
no ip address
ppp authentication chap callin
ppp multilink
ip local pool V1.55-pool 10.1.55.10 10.1.55.19 group V1.55-group
radius-server attribute list min-author
attribute 6-7,22,27-28,242
radius-server attribute list usage-only
attribute 1,40,42-43,46

The customertemplate is stored as a RADIUS server profile for v1.55.com.

cisco-avpair = "aaa:rad-serv#:1=10.10.132.4 key ww"
cisco-avpair = "aaa:rad-serv-vrf#:1=V1.55.com"
cisco-avpair = "aaa:rad-serv-source-if#:1=Loopback 55"
cisco-avpair = "aaa:rad-serv#:2=10.10.100.7 key ww"
cisco-avpair = "aaa:rad-serv-source-if#:2=Loopback 0"
cisco-avpair = "template:ppp-authen-list=group 1"
cisco-avpair = "template:ppp-author-list=group 1"
cisco-avpair = "template:ppp-acct-list= start-stop group 1 group 2 broadcast"
cisco-avpair = "template:account-delay-on"
cisco-avpair = "template:account-send-stop-on"
cisco-avpair = "template:rad-attr44=access-req"
cisco-avpair = "aaa:rad-serv-filter#1=authorization accept min-author"
cisco-avpair = "aaa:rad-serv-filter#1=accounting accept usage-only"
cisco-avpair = "template:peer-ip-pool=V1.55-pool"
cisco-avpair = "template:ip-vrf=V1.55.com"
cisco-avpair = "template:ip-unnumbered-Loopback 55"
framed-protocol = ppp
service-type = framed
```

AAA Accounting Stop Record Examples

The following AAA accounting stop record examples show how to configure the `aaa accounting send stop-record authentication` command to control the generation of "stop" records when the `aaa accounting` command is issued with the `start-stop` or `stop-only` keyword.

**Note** The `success` and `remote-server` keywords are available in Cisco IOS XE Release 2.4 and later releases.
AAA Accounting Stop Record and Rejected Call Example

The following example shows the “stop” record being sent for a rejected call during authentication when the `aaa accounting send stop-record authentication` command is issued with the `success` keyword.

```
Router# show running-config | include aaa

*aaa new-model
*aaa accounting stop-record authentication success remote-server
*aaa accounting network default start-stop group radius

* Jul 7 03:39:40.199: AAA/BIND(00000026): Bind i/f Virtual-Template2
* Jul 7 03:39:40.199: AAA/AUTHOR/LCP: Authorization succeeds trivially
* Jul 7 03:39:42.199: RADIUS/ENCODE(00000026): Orig. component type = PPoE
* Jul 7 03:39:42.199: RADIUS: AAA Unsupported [156] 7
* Jul 7 03:39:42.199: RADIUS: Stop-Record: 30 2F 30 2F 30
  (0/0/0)
* Jul 7 03:39:42.199: RADIUS(00000026): Config NAS IP: 10.0.0.0
  RADIUS(00000026): acct_session_id: 55
  RADIUS(00000026): sending
  RADIUS(00000026): RADIUS(00000026): RADIUS: Best Local IP-Address 10.0.1.123 for
  RADIUS-Server 172.19.192.238
  * Jul 7 03:39:42.199: RADIUS(00000026): Send Access-Request to
  172.19.192.238:2195 id 1645/14, len 94
* Jul 7 03:39:42.199: RADIUS: authenticator A6 D1 6B A4 76 9D CF - 33 SD
  16 BE AC 7E 5F A6
  PPP [1]
  * Jul 7 03:39:42.199: RADIUS: User-Name [1] 16 "user@example.com"
  * Jul 7 03:39:42.199: RADIUS: CHAP-Password [3] 19 *
  * Jul 7 03:39:42.199: RADIUS: NAS-Port-Type [61] 6
  Virtual [5]
  0
  * Jul 7 03:39:42.199: RADIUS: NAS-Port-Id [87] 9 "0/0/0/0"
  * Jul 7 03:39:42.199: RADIUS: Service-Type [6] 6
  Framed [2]
  10.0.1.123
  * Jul 7 03:39:42.271: RADIUS: Received from id 1645/14 172.19.192.238:2195,
  Access-Accept, len 194
  * Jul 7 03:39:42.271: RADIUS: authenticator 30 AD FF 8E 59 OC E4 6C - BA 11
  23 63 81 DE 6F D7
  PPP [1]
  * Jul 7 03:39:42.275: RADIUS: Service-Type [6] 6
  Framed [2]
  * Jul 7 03:39:42.275: RADIUS: Vendor, Cisco [26] 26
  * Jul 7 03:39:42.275: RADIUS: Cisco AVpair [1] 20 "vpdn:tunnel-
  id=lac"
  * Jul 7 03:39:42.275: RADIUS: Vendor, Cisco [26] 29
  * Jul 7 03:39:42.275: RADIUS: Cisco AVpair [1] 23 "vpdn:tunnel-
  type=l2tp"
  * Jul 7 03:39:42.275: RADIUS: Vendor, Cisco [26] 30
  * Jul 7 03:39:42.275: RADIUS: Cisco AVpair [1] 24 "vpdn:gw-
  password=cisco"
  * Jul 7 03:39:42.275: RADIUS: Vendor, Cisco [26] 31
  * Jul 7 03:39:42.275: RADIUS: Cisco AVpair [1] 25 "vpdn:nas-
  password=cisco"
  * Jul 7 03:39:42.275: RADIUS: Vendor, Cisco [26] 34
  * Jul 7 03:39:42.275: RADIUS: Cisco AVpair [1] 28 "vpdn:ip-
  addresses=10.0.0.2"
  * Jul 7 03:39:42.275: RADIUS: Service-Type [6] 6
  Framed [2]
```
PPP [1]

*Jul 7 03:39:42.275: RADIUS(00000026): Received from id 1645/14
*Jul 7 03:39:42.275: PPP/AAA: Check Attr: Framed-Protocol
*Jul 7 03:39:42.275: PPP/AAA: Check Attr: service-type
*Jul 7 03:39:42.275: PPP/AAA: Check Attr: tunnel-id
*Jul 7 03:39:42.275: PPP/AAA: Check Attr: gw-password
*Jul 7 03:39:42.275: PPP/AAA: Check Attr: nas-password
*Jul 7 03:39:42.275: PPP/AAA: Check Attr: ip-addresses
*Jul 7 03:39:42.275: PPP/AAA: Check Attr: service-type
*Jul 7 03:39:42.275: PPP/AAA: Check Attr: Framed-Protocol
*Jul 7 03:39:42.279: AAA/BIND(00000027): Bind i/f
*Jul 7 03:39:42.279: Tnl 21407 L2TP: O SCCRQ
*Jul 7 03:39:42.279: Tnl 21407 L2TP: O SCCRQ, flg TLS, ver 2, len 134, tnl
 0, ns 0, nr 0
  C8 02 00 86 00 00 00 00 00 00 00 00 80 08 00 00
  00 00 00 01 80 08 00 00 00 02 01 00 00 08 00 00
  00 06 11 30 80 09 00 00 00 07 6C 61 63 00 19 00
  00 00 08 43 69 73 63 6F 20 53 79 73 74 65 6D 73
  2C 20 49 6E 63 2E 80 ...
*Jul 7 03:39:49.279: Tnl 21407 L2TP: O StopCCN
*Jul 7 03:39:49.279: Tnl 21407 L2TP: O StopCCN, flg TLS, ver 2, len 66, tnl
 0, ns 1, nr 0
  C8 02 00 42 00 00 00 00 00 01 00 00 80 08 00 00
  00 00 00 04 80 1E 00 00 00 01 00 02 00 06 54 6F
  6F 20 6D 61 6E 79 20 72 65 74 72 61 6E 73 6D 69
  74 73 00 08 00 09 00 09 69 00 01 80 08 00 00 09
  53 9F
*Jul 7 03:39:49.279: RADIUS/ENCODE(00000026):Orig. component type = PPoE
*Jul 7 03:39:49.279: RADIUS(00000026): Config NAS IP: 10.0.0.0
*Jul 7 03:39:49.279: RADIUS(00000026): sending
*Jul 7 03:39:49.279: RADIUS(00000026): Send Accounting-Request to 172.19.192.238 id 1646/32, len 179
*Jul 7 03:39:49.279: RADIUS: authenticator 0A 85 2F F0 65 6F 25 E1 - 97 54 CC BF EA F7 62 89
*Jul 7 03:39:49.279: RADIUS: Acct-Session-Id [44] 10 "00000037"
PPP [1]

*Jul 7 03:39:49.279: RADIUS: Tunnel-Medium-Type [65] 6
00:IPv4 [3]
*Jul 7 03:39:49.279: RADIUS: Tunnel-Client-Endpo[66] 10 "10.0.0.1"
*Jul 7 03:39:49.279: RADIUS: Tunnel-Server-Endpo[67] 10 "10.0.0.2"
*Jul 7 03:39:49.283: RADIUS: Tunnel-Type [64] 6
00:L2TP [3]
*Jul 7 03:39:49.283: RADIUS: Acct-Tunnel-Connecti[68] 3 "0"
*Jul 7 03:39:49.283: RADIUS: Tunnel-Client-Auth-I[90] 5 "lac"
*Jul 7 03:39:49.283: RADIUS: User-Name [1] 16 "user@example.com"
RADIUS [1]

0
0
0
0
0
*Jul 7 03:39:49.283: RADIUS: Acct-Terminate-Cause[49] 6 nas-
error [9]
*Jul 7 03:39:49.283: RADIUS: Acct-Status-Type [40] 6
Stop [2]
*Jul 7 03:39:49.283: RADIUS: NAS-Port-Type [61] 6
Virtual [5]
0
*Jul 7 03:39:49.283: RADIUS: NAS-Port-Id [87] 9 "0/0/0/0"
Framed [2]
AAA Accounting Stop Record and Successful Call Example

The following example shows "start" and "stop" records being sent for a successful call when the `aaa accounting send stop-record authentication failure` command is issued with the `failure` keyword.

```
Router# show running-config | include aaa
.
.

aaa authentication ppp default group radius
aaa authorization network default local
aaa accounting send stop-record authentication failure
.
.
```

AAA Accounting Stop Record Examples

Authentication Authorization and Accounting Configuration Guide Cisco IOS XE Release 3S
*Jul 7 03:28:33.571: Tnl 5192 L2TP: I SCCRP from LNS-tunnel
*Jul 7 03:28:33.571: Tnl 5192 L2TP: O SCCCN to LNS-tunnel tnlid 6897
*Jul 7 03:28:33.571: Tnl 5192 L2TP: O SCCCN, flg TLS, ver 2, len 42, tnl 6897, na 1, nr 1
C8 02 00 2A 1A F1 00 00 00 01 00 01 80 08 00 00
00 00 00 03 80 16 00 00 00 0D 32 24 17 BC 6A 19
B1 79 F3 F9 A9 D7 7D 9A DB
*Jul 7 03:28:33.571: uid:14 Tnl/Sn 5192/11 L2TP: O ICRQ to LNS-tunnel 6897/0
*Jul 7 03:28:33.571: uid:14 Tnl/Sn 5192/11 L2TP: O ICRQ, flg TLS, ver 2, len 63, tnl 6897, lsid 11, rsid 0, ns 2, nr 1
C8 02 00 3F 1A F1 00 00 00 02 00 01 80 08 00 00
00 00 00 0B 80 0A 00 00 00 0F C8 14 B4 03 80 08
00 00 0E 00 0B 80 0A 00 00 00 12 00 00 00
00 0F 00 09 00 64 0F 10 09 02 02 00 01 00 00
*Jul 7 03:28:33.575: uid:14 Tnl/Sn 5192/11 L2TP: Parse AVP 0, len 8, flag 0x8000 (M)
*Jul 7 03:28:33.575: uid:14 Tnl/Sn 5192/11 L2TP: Parse ICRP
*Jul 7 03:28:33.575: uid:14 Tnl/Sn 5192/11 L2TP: Parse AVP 14, len 8, flag 0x8000 (M)
*Jul 7 03:28:33.575: uid:14 Tnl/Sn 5192/11 L2TP: Assigned Call ID 5
*Jul 7 03:28:33.575: uid:14 Tnl/Sn 5192/11 L2TP: No missing AVPs in ICRP
*Jul 7 03:28:33.579: uid:14 Tnl/Sn 5192/11 L2TP: Parse AVP 0, len 8, flag 0x8000 (M)
*Jul 7 03:28:33.579: uid:14 Tnl/Sn 5192/11 L2TP: Parse ICRP
*Jul 7 03:28:33.579: uid:14 Tnl/Sn 5192/11 L2TP: Parse AVP 14, len 8, flag 0x8000 (M)
*Jul 7 03:28:33.579: uid:14 Tnl/Sn 5192/11 L2TP: Assigned Call ID 5
*Jul 7 03:28:33.579: uid:14 Tnl/Sn 5192/11 L2TP: No missing AVPs in ICRP
*Jul 7 03:28:33.579: RADIUS/ENCODE(00000018):Orig. component type = PPoE
*Jul 7 03:28:33.579: RADIUS(00000018): Config NAS IP: 10.0.0.0
*Jul 7 03:28:33.579: RADIUS(00000018): sending
*Jul 7 03:28:33.579: RADIUS: authenticator 3C 81 D6 C5 2B 6D 21 8E - 19 FF 43 B5 41 86 A8 A5
*Jul 7 03:28:33.579: RADIUS: Acct-Session-Id [44] 10 "00000023"
*Jul 7 03:28:33.579: RADIUS: Tunnel-Medium-Type [65] 6
*Jul 7 03:28:33.579: RADIUS: Tunnel-Type [64] 6
*Jul 7 03:28:33.579: RADIUS: User-Name [1] 16 "user@example.com"
Additional References

The following sections provide references related to Per VRF AAA.

### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS Security Commands</td>
<td><em>Cisco IOS Security Command Reference</em></td>
</tr>
<tr>
<td>Cisco IOS Switching Services Commands</td>
<td><em>Cisco IOS IP Switching Command Reference</em></td>
</tr>
<tr>
<td>Configuring Multiprotocol Label Switching</td>
<td><em>Cisco IOS XE Multiprotocol Label Switching Configuration Guide</em>, Release 2</td>
</tr>
<tr>
<td>Configuring virtual templates</td>
<td>Virtual Templates and Profiles section of the <em>Cisco IOS XE Dial Technologies Configuration Guide</em>, Release 2</td>
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### Standards

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<th>Standards</th>
<th>Title</th>
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<tr>
<td>No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.</td>
<td>--</td>
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MIBs

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<th>MIBs</th>
<th>MIBs Link</th>
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<tbody>
<tr>
<td>No new or modified MIBs are supported by this feature, and support</td>
<td>To locate and download MIBs for selected platforms, Cisco IOS XE software</td>
</tr>
<tr>
<td>for existing MIBs has not been modified by this feature.</td>
<td>releases, and feature sets, use Cisco MIB Locator found at the following URL:</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
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</table>

RFCs

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<td>No new or modified RFCs are supported by this feature.</td>
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</tr>
</tbody>
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Technical Assistance

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

Feature Information for Per VRF AAA

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
### Table 30: Feature Information for Per VRF AAA

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| Per VRF AAA                   | Cisco IOS XE Release 2.1 | The Per VRF AAA feature allows authentication, authorization, and accounting (AAA) on the basis of Virtual Private Network (VPN) routing and forwarding (VRF) instances.  
In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.  
The following commands were introduced or modified: `aaa accounting`, `aaa accounting delay-start`, `ip radius source-interface`, `server-private (RADIUS)`, `ip vrf forwarding (server-group)`, `radius-server domain-stripping`, `aaa authorization template`. |
| RADIUS Per-VRF Server Group   | Cisco IOS XE Release 2.1 | Using the Radius Per-VRF Server Group feature, Internet Service Providers (ISPs) can partition RADIUS server groups based on Virtual Route Forwarding (VRF). This means that you can define RADIUS server groups that belong to a VRF. This feature is supported by "aaa: rad-serv-vrf" VSA.  
In Cisco IOS XE Release 2.1, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.  
The following commands were introduced or modified: `ip vrf forwarding`. |
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute Filtering Per-Domain and VRF Aware Framed-Routes</td>
<td>Cisco IOS XE Release 2.3</td>
<td>The Attribute Filtering Per-Domain and VRF Aware Framed-Routes feature allows for attribute filtering per-domain and VRF aware Framed-Routes. It introduces support for the &quot;aaa:rad-serv-filter&quot; VSA. In Cisco IOS XE Release 2.3, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.</td>
</tr>
<tr>
<td>AAA CLI Stop Record Enhancement</td>
<td>Cisco IOS XE Release 2.4</td>
<td>The AAA CLI Stop Record Enhancement feature enables sending an accounting stop record only when an access accept is received from the AAA server. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers. The following commands were introduced or modified: <code>aaa accounting send stop-record authentication</code>.</td>
</tr>
<tr>
<td>Dynamic Per VRF AAA</td>
<td>Cisco IOS XE Release 2.4</td>
<td>The Dynamic Per VRF AAA feature allows you to use a customer template, which may be stored either locally or remotely, and AAA services can be performed on the information that is stored in the customer template. In Cisco IOS XE Release 2.4, this feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.</td>
</tr>
</tbody>
</table>

**Glossary**

AAA—authentication, authorization, and accounting. A framework of security services that provide the method for identifying users (authentication), for remote access control (authorization), and for collecting and sending security server information used for billing, auditing, and reporting (accounting).
L2TP--Layer 2 Tunnel Protocol. A Layer 2 tunneling protocol that enables an ISP or other access service to create a virtual tunnel to link customer remote sites or remote users with corporate home networks. In particular, a network access server (NAS) at the ISP point of presence (POP) exchanges PPP messages with the remote users and communicates by L2F or L2TP requests and responses with the customer tunnel server to set up tunnels.

PE--Provider Edge. Networking devices that are located on the edge of a service provider network.

RADIUS--Remote Authentication Dial-In User Service. RADIUS is a distributed client/server system that secures networks against unauthorized access. In the Cisco implementation, RADIUS clients run on Cisco routers and send authentication requests to a central RADIUS server that contains all user authentication and network service access information.

VPN--Virtual Private Network. A system that permits dial-in networks to exist remotely to home networks, while giving the appearance of being directly connected. VPNs use L2TP and L2F to terminate the Layer 2 and higher parts of the network connection at the LNS instead of the LAC.

VRF--Virtual Route Forwarding. Initially, a router has only one global default routing/forwarding table. VRFs can be viewed as multiple disjoined routing/forwarding tables, where the routes of a user have no correlation with the routes of another user.
AAA Support for IPv6

Authentication, authorization, and accounting (AAA) support for IPv6 is in compliance with RFC 3162. This module provides information about how to configure AAA options for IPv6.

- Finding Feature Information, page 221
- Information About AAA Support for IPv6, page 221
- How to Configure AAA Support for IPv6, page 226
- Configuration Examples for AAA Support for IPv6, page 227
- Additional References, page 227
- Feature Information for RADIUS over IPv6, page 229

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About AAA Support for IPv6

AAA over IPv6

Vendor-specific attributes (VSAs) are used to support Authentication, Authorization and Accounting (AAA) over IPv6. Cisco VSAs are inacl, outacl, prefix, and route.

You can configure prefix pools and pool names by using the AAA protocol. Customers can deploy an IPv6 RADIUS server or a TACACS+ server to communicate with Cisco devices.
RADIUS over IPv6

The following RADIUS attributes, as described in RFC 3162, are supported for IPv6:

- Framed-Interface-Id
- Framed-IPv6-Pool
- Framed-IPv6-Prefix
- Framed-IPv6-Route
- Login-IPv6-Host

The following RADIUS attributes are also supported for IPv6:

- Delegated-IPv6-Prefix (RFC 4818)
- Delegated-IPv6-Prefix-Pool
- DNS-Server-IPv6-Address
- IPv6 ACL
- IPv6_DNS_Servers
- IPv6 Pool
- IPv6 Prefix#
- IPv6 Route

The attributes listed above can be configured on a RADIUS server and downloaded to access servers, where they can be applied to access connections.

Prerequisites for Using AAA Attributes for IPv6

AAA attributes for IPv6 are compliant with RFC 3162 and require a RADIUS server capable of supporting RFC 3162.

RADIUS Per-User Attributes for Virtual Access in IPv6 Environments

The following IPv6 RADIUS attributes are supported for virtual access and can be used as attribute-value (AV) pairs:

- Delegated-IPv6-Prefix
- Delegated-IPv6-Prefix-Pool
- DNS-Server-IPv6-Address
- Framed-Interface-Id
- Framed-IPv6-Pool
- Framed-IPv6-Prefix
- Framed-IPv6-Route
Delegated-IPv6-Prefix

The Delegated-IPv6-Prefix attribute indicates an IPv6 prefix to be delegated to a user for use in a network. This attribute is used during DHCP prefix delegation between a RADIUS server and a delegating device. A Network Access Server (NAS) that hosts a DHCP Version 6 (DHCPv6) server can act as a delegating device.

The following example shows how to use the Delegated-IPv6-Prefix attribute:

```
ipv6:delegated-prefix=2001:DB8::/64
```

Note

The Cisco VSA format is not supported for this attribute. If you try to add this attribute in the Cisco VSA format into a user profile, the RADIUS server response fails. Use only the IETF attribute format for this attribute.

Delegated-IPv6-Prefix-Pool

The Delegated-IPv6-Prefix-Pool attribute indicates the name of a prefix pool from which a prefix is selected and delegated to a device.

Prefix delegation is a DHCPv6 option for delegating IPv6 prefixes. Prefix delegation involves a delegating device that selects a prefix and assigns it on a temporary basis to a requesting device. A delegating device uses many strategies to choose a prefix. One method is to choose a prefix from a prefix pool with a name that is defined locally on a device.

The Delegated-IPv6-Prefix-Pool attribute indicates the name of an assigned prefix pool. A RADIUS server uses this attribute to communicate the name of a prefix pool to a NAS hosting a DHCPv6 server and acting as a delegating device.

You may use DHCPv6 prefix delegation along with ICMPv6 stateless address autoconfiguration (SLAAC) on a network. In this case, both the Delegated-IPv6-Prefix-Pool attribute and the Framed-IPv6-Pool attribute may be included within the same packet. To avoid ambiguity, the Delegated-IPv6-Prefix-Pool attribute should be restricted to the authorization and accounting of prefix pools used in DHCPv6 delegation, and the Framed-IPv6-Pool attribute should be used for the authorization and accounting of prefix pools used in SLAAC.

The following example shows how an address prefix is selected from a pool named pool1. The prefix pool pool1 is downloaded to a delegating device from a RADIUS server by using the Delegated-IPv6-Prefix-Pool attribute. The device then selects the address prefix 2001:DB8::/64 from this prefix pool.

```
Cisco:Cisco-AVpair = "ipv6:delegated-ipv6-pool = pool1"
!
ipv6 dhcp pool pool1
address prefix 2001:DB8::/64
!"
DNS-Server-IPv6-Address

The DNS-Server-IPv6-Address attribute indicates the IPv6 address of a Domain Name System (DNS) server. A DHCPv6 server can configure a host with the IPv6 address of a DNS server. The IPv6 address of the DNS server can also be conveyed to the host using router advertisement messages from ICMPv6 devices.

A NAS may host a DHCPv6 server to handle DHCPv6 requests from hosts. The NAS may also act as a device that provides router advertisement messages. Therefore, this attribute is used to provide the NAS with the IPv6 address of the DNS server.

If a NAS has to announce more than one recursive DNS server to a host, this attribute can be included multiple times in Access-Accept packets sent from the NAS to the host.

The following example shows how you can define the IPv6 address of a DNS server by using the DNS-Server-IPv6-Address attribute:

Cisco: Cisco-AVPair = "ipv6:ipv6-dns-servers-addr=2001:DB8::"

Framed-Interface-Id

The Framed-Interface-Id attribute indicates an IPv6 interface identifier to be configured for a user. This attribute is used during IPv6 Control Protocol (IPv6CP) negotiations of the Interface-Identifier option. If negotiations are successful, the NAS uses this attribute to communicate a preferred IPv6 interface identifier to the RADIUS server by using Access-Request packets. This attribute may also be used in Access-Accept packets.

Framed-IPv6-Pool

The Framed-IPv6-Pool attribute indicates the name of a pool that is used to assign an IPv6 prefix to a user. This pool should be either defined locally on a device or defined on a RADIUS server from where pools can be downloaded.

Framed-IPv6-Prefix

The Framed-IPv6-Prefix attribute indicates an IPv6 prefix (and a corresponding route) to be configured for a user. So this attribute performs the same function as a Cisco VSA and is used for virtual access only. A NAS uses this attribute to communicate a preferred IPv6 prefix to a RADIUS server by using Access-Request packets. This attribute may also be used in Access-Accept packets and can appear multiple times in these packets. The NAS creates a corresponding route for the prefix.

This attribute is used by a user to specify which prefixes to advertise in router advertisement messages of the Neighbor Discovery Protocol.

This attribute can also be used for DHCPv6 prefix delegation, and a separate profile must be created for a user on the RADIUS server. The username associated with this separate profile has the suffix "-dhcpv6".

The Framed-IPv6-Prefix attribute is treated differently in this separate profile and the regular profile of a user. If a NAS needs to send a prefix through router advertisement messages, the prefix is placed in the Framed-IPv6-Prefix attribute of the regular profile of the user. If a NAS needs to delegate a prefix to the network of a remote user, the prefix is placed in the Framed-IPv6-Prefix attribute of the separate profile of the user.

Note

The RADIUS IETF attribute format and the Cisco VSA format are supported for this attribute.
**Framed-IPv6-Route**

The Framed-IPv6-Route attribute indicates the routing information to be configured for a user on a NAS. This attribute performs the same function as a Cisco VSA. The value of the attribute is a string and is specified by using the `ipv6 route` command.

**IPv6 ACL**

The IPv6 ACL attribute is used to specify a complete IPv6 access list. The unique name of an access list is generated automatically. An access list is removed when the respective user logs out. The previous access list on the interface is then reapplied.

The inacl and outacl attributes enable you to specify an existing access list configured on a device. The following example shows how to define an access list identified with number 1:

```
cisco-avpair = "ipv6:inacl#1=permit 2001:DB8:cc00:1::/48",
cisco-avpair = "ipv6:outacl#1=deny 2001:DB8::/10",
```

**IPv6_DNS_Servers**

The IPv6_DNS_Servers attribute is used to send up to two DNS server addresses to the DHCPv6 server. The DNS server addresses are saved in the interface DHCPv6 subblock and override other configurations in the DHCPv6 pool. This attribute is also included in attributes returned for AAA start and stop notifications.

**IPv6 Pool**

The IPv6 Pool attribute extends the IPv4 address pool attribute to support the IPv6 protocol for RADIUS authentication. This attribute specifies the name of a local pool on a NAS from which a prefix is chosen and used whenever PPP is configured and the protocol is specified as IPv6. The address pool works with local pooling and specifies the name of a local pool that is preconfigured on the NAS.

**IPv6 Prefix#**

The IPv6 Prefix# attribute indicates which prefixes to advertise in router advertisement messages of the Neighbor Discovery Protocol. When this attribute is used, a corresponding route (marked as a per-user static route) is installed in the routing information base (RIB) tables for a given prefix.

The following example shows how to specify which prefixes to advertise:

```
cisco-avpair = "ipv6:prefix#1=2001:DB8::/64",
cisco-avpair = "ipv6:prefix#2=2001:DB8::/64",
```

**IPv6 Route**

The IPv6 Route attribute is used to specify a static route for a user. A static route is appropriate when Cisco software cannot dynamically build a route to the destination. See the `ipv6 route` command for more information about building static routes.

The following example shows how to use the IPv6 Route attribute to define a static route:

```
cisco-avpair = "ipv6:route#1=2001:DB8:cc00:1::/48",
cisco-avpair = "ipv6:route#2=2001:DB8:cc00:2::/48",
```
Login-IPv6-Host

The Login-IPv6-Host attribute indicates IPv6 addresses of hosts with which to connect a user when the Login-Service attribute is included. A NAS uses the Login-IPv6-Host attribute in Access-Request packets to communicate to a RADIUS server that it prefers to use certain hosts.

How to Configure AAA Support for IPv6

Configuring DHCPv6 AAA Options

Perform the following task to configure the option of acquiring prefixes from the AAA server:

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `ipv6 dhcp pool pool-name`
4. `prefix-delegation aaa [method-list method-list] [lifetime]`
5. `end`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><em>Example:</em> Device&gt; enable</td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><em>Example:</em> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> ipv6 dhcp pool pool-name</td>
<td>Configures a DHCPv6 configuration information pool and enters IPv6 DHCP pool configuration mode.</td>
</tr>
<tr>
<td><em>Example:</em> Device(config)# ipv6 dhcp pool pool1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> prefix-delegation aaa [method-list method-list] [lifetime]</td>
<td>Specifies that prefixes are to be acquired from AAA servers.</td>
</tr>
<tr>
<td><em>Example:</em> Device(config-dhcpv6)# prefix-delegation aaa method-list list1</td>
<td></td>
</tr>
</tbody>
</table>
aaa support for IPv6

configuration examples for AAA support for IPv6

example: DHCPv6 AAA options configuration

The following example shows how to configure the DHCPv6 option of acquiring prefixes from the AAA server:

Device> enable
Device# configure terminal
Device(config)# ipv6 dhcp pool pool1
Device(config-dhcpv6)# prefix-delegation aaa method-list list1
Device(config-dhcpv6)# end

example: RADIUS configuration

The following sample RADIUS configurations show the definition of AV pairs to establish static routes:

campus1 Auth-Type = Local, Password = "mypassword"
User-Service-Type = Framed-User,
Framed-Protocol = PPP,
cisco-avpair = "ipv6:inacl#1=permit 2001:DB8:1::/64 any",
cisco-avpair = "ipv6:route=2001:DB8:2::/64",
cisco-avpair = "ipv6:route=2001:DB8:3::/64",
cisco-avpair = "ipv6:prefix=2001:DB8:2::/64 0 0 onlink autoconfig",
cisco-avpair = "ipv6:prefix=2001:DB8:3::/64 0 0 onlink autoconfig",
cisco-avpair = "ip:route=10.0.0.0 255.0.0.0",

additional references

The following sections provide references related to the Authorization feature.

related documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
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<tr>
<td>Authorization Commands</td>
<td>Cisco IOS Security Command Reference</td>
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<tr>
<td>RADIUS</td>
<td>Configuring RADIUS feature module.</td>
</tr>
<tr>
<td>LDAP</td>
<td>Configuring RADIUS feature Module.</td>
</tr>
<tr>
<td>Related Topic</td>
<td>Document Title</td>
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<td>---------------------------------------</td>
<td>-----------------------------------------------------</td>
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<tr>
<td>RADIUS attributes</td>
<td>RADIUS Attributes Overview and RADIUS IETF Attributes feature module.</td>
</tr>
<tr>
<td>TACACS+</td>
<td>Configuring TACACS+ feature module.</td>
</tr>
<tr>
<td>TACACS+ Attribute-Value Pairs</td>
<td>TACACS+ Attribute-Value Pairs feature module.</td>
</tr>
<tr>
<td>Authentication</td>
<td>Configuring Authentication feature module.</td>
</tr>
<tr>
<td>Authentication Proxy</td>
<td>Configuring Authentication Proxy feature module.</td>
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### Standards

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<thead>
<tr>
<th>Standard</th>
<th>Title</th>
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<td>--</td>
</tr>
</tbody>
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### MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>None.</td>
<td>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></td>
</tr>
</tbody>
</table>

### RFCs

<table>
<thead>
<tr>
<th>RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or modified RFCs are supported by this feature.</td>
<td>--</td>
</tr>
</tbody>
</table>
Technical Assistance

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

Feature Information for RADIUS over IPv6

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

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

Table 31: Feature Information for RADIUS over IPv6

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>RADIUS over IPv6</td>
<td>15.1(1)SY</td>
<td>RADIUS attributes defined in RFC 3162 are supported.</td>
</tr>
</tbody>
</table>
TACACS+ over IPv6

An IPv6 server can be configured to be used with TACACS+.

- Finding Feature Information, page 231
- Information About TACACS+ over IPv6, page 231
- How to Configure TACACS+ over IPv6, page 232
- Configuration Examples for TACACS+ over IPv6, page 235
- Additional References, page 236
- Feature Information for TACACS+ over IPv6, page 237

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.

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Information About TACACS+ over IPv6

The Terminal Access Controller Access-Control System (TACACS+) security protocol provides centralized validation of users. TACACS+ services are maintained in a database on a TACACS+ daemon typically running on a UNIX or Windows NT workstation. You must have access to and must configure a TACACS+ server before the configured TACACS+ features on your devices are available.

TACACS+ provides for separate authentication, authorization, and accounting facilities. TACACS+ allows for a single access control server (the TACACS+ daemon) to provide each service (authentication, authorization, and accounting) independently. Each service is associated with its own database to take advantage of other services available on that server or on the network, depending on the capabilities of the daemon.
AAA over IPv6

Vendor-specific attributes (VSAs) are used to support Authentication, Authorization and Accounting (AAA) over IPv6. Cisco VSAs are inacl, outacl, prefix, and route.

You can configure prefix pools and pool names by using the AAA protocol. Customers can deploy an IPv6 RADIUS server or a TACACS+ server to communicate with Cisco devices.

TACACS+ Over an IPv6 Transport

An IPv6 server can be configured to use TACACS+. Both IPv6 and IPv4 servers can be configured to use TACACS+ using a name instead of an IPv4 or IPv6 address.

How to Configure TACACS+ over IPv6

Configuring the TACACS+ Server over IPv6

SUMMARY STEPS

1. enable
2. configure terminal
3. tacacs server name
4. address ipv6 ipv6-address
5. key [0 | 7] key-string
6. port [number
7. send-nat-address
8. single-connection
9. timeout seconds

DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Step 2</td>
<td>configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td></td>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td><strong>tacacs server</strong> <em>name</em>  &lt;br&gt; <strong>Example:</strong>  &lt;br&gt; Router(config)# tacacs server server1</td>
<td>Configures the TACACS+ server for IPv6 and enters TACACS+ server configuration mode.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td><strong>address ipv6</strong> <em>ipv6-address</em>  &lt;br&gt; <strong>Example:</strong>  &lt;br&gt; Router(config-server-tacacs)# address ipv6 2001:DB8:3333:4::5</td>
<td>Configures the IPv6 address of the TACACS+ server.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td><strong>key</strong> [0</td>
<td>7] <em>key-string</em>  &lt;br&gt; <strong>Example:</strong>  &lt;br&gt; Router(config-server-tacacs)# key 0 key1</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td><strong>port</strong> <em>number</em>  &lt;br&gt; <strong>Example:</strong>  &lt;br&gt; Router(config-server-tacacs)# port 12</td>
<td>Specifies the TCP port to be used for TACACS+ connections.</td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td><strong>send-nat-address</strong>  &lt;br&gt; <strong>Example:</strong>  &lt;br&gt; Router(config-server-tacacs)# send-nat-address</td>
<td>Sends a client’s post-NAT address to the TACACS+ server.</td>
</tr>
<tr>
<td><strong>Step 8</strong></td>
<td><strong>single-connection</strong>  &lt;br&gt; <strong>Example:</strong>  &lt;br&gt; Router(config-server-tacacs)# single-connection</td>
<td>Enables all TACACS packets to be sent to the same server using a single TCP connection.</td>
</tr>
<tr>
<td><strong>Step 9</strong></td>
<td><strong>timeout</strong> <em>seconds</em>  &lt;br&gt; <strong>Example:</strong>  &lt;br&gt; Router(config-server-tacacs)# timeout 10</td>
<td>Configures the time to wait for a reply from the specified TACACS server.</td>
</tr>
</tbody>
</table>
Specifying the Source Address in TACACS+ Packets

SUMMARY STEPS

1. enable
2. configure terminal
3. ipv6 tacacs source-interface type number

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

| **Step 2** configure terminal | Enters global configuration mode. |
| **Example:**                  |         |
| Router# configure terminal    |         |

| **Step 3** ipv6 tacacs source-interface type number | Specifies an interface to use for the source address in TACACS+ packets. |
| **Example:**                              |         |
| Router(config)# ipv6 tacacs source-interface |         |
| GigabitEthernet 0/0/0                    |         |

Configuring TACACS+ Server Group Options

SUMMARY STEPS

1. enable
2. configure terminal
3. aaa group server tacacs+ group-name
4. server name server-name
5. server-private {ip-address | name | ipv6-address} [nat] [single-connection] [port port-number] [timeout seconds] [key [0 | 7] string]
## DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>enable</td>
<td>- Enter your password if prompted.</td>
</tr>
<tr>
<td>Example:</td>
<td>Router&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>configure terminal</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Router# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Groups different TACACS+ server hosts into distinct lists and distinct methods.</td>
</tr>
<tr>
<td>aaa group server tacacs+ group-name</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config)# aaa group server tacacs+ group1</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Specifies an IPv6 TACACS+ server.</td>
</tr>
<tr>
<td>server name server-name</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config-sg-tacacs+)# server name server1</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Configures the IPv6 address of the private TACACS+ server for the group server.</td>
</tr>
<tr>
<td>server-private {ip-address</td>
<td>name</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config-sg-tacacs+)# server-private 2001:DB8:3333:4::5 port 19 key key1</td>
</tr>
</tbody>
</table>

### Configuration Examples for TACACS+ over IPv6

**Example: Configuring TACACS+ Server over IPv6**

```
Device# show tacacs

Tacacs+ Server: server1
Server Address: FE80::200:F8FF:FE21:67CF
Socket opens: 0
Socket closes: 0
Socket aborts: 0
Socket errors: 0
Socket Timeouts: 0
Failed Connect Attempts: 0
```

---

*Authentication Authorization and Accounting Configuration Guide Cisco IOS XE Release 3S*
Additional References

The following sections provide references related to the MSCHAP Version 2 feature.

### Related Documents

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<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
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<td>Configuring PPP interfaces</td>
<td>PPP Configuration in the <em>Cisco IOS Dial Technologies Configuration Guide</em>, Release 12.4T.</td>
</tr>
<tr>
<td>Descriptions of the tasks and commands necessary to configure and maintain Cisco networking devices</td>
<td><em>Cisco IOS Dial Technologies Command Reference</em></td>
</tr>
<tr>
<td>Lists of IOS Security Commands</td>
<td><em>Cisco IOS Security Command Reference</em></td>
</tr>
</tbody>
</table>

### Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or modified standards are supported by this feature.</td>
<td>--</td>
</tr>
</tbody>
</table>

### MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>No new or modified MIBs are supported by this feature.</td>
<td>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></td>
</tr>
</tbody>
</table>
RFCS

<table>
<thead>
<tr>
<th>RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 1661</td>
<td>Point-to-Point Protocol (PPP)</td>
</tr>
<tr>
<td>RFC 2548</td>
<td>Microsoft Vendor-specific RADIUS Attributes</td>
</tr>
<tr>
<td>RFC 2759</td>
<td>Microsoft PPP CHAP Extensions, Version 2</td>
</tr>
</tbody>
</table>

Technical Assistance

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

Feature Information for TACACS+ over IPv6

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
Table 32: Feature Information for TACACS+ over IPv6

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>TACACS+ over IPv6</td>
<td>Cisco IOS XE Release 3.2S</td>
<td>TACACS+ over IPv6 is supported. The following commands were introduced or modified: aaa group server tacacs+, address ipv6 (TACACS+), ipv6 tacacs source-interface, key (TACACS+), port (TACACS+), send-nat-address, server name (IPv6 TACACS+), server-private (TACACS+), single-connection, tacacs server, timeout (TACACS+).</td>
</tr>
</tbody>
</table>
AAA Dead-Server Detection

The AAA Dead-Server Detection feature allows you to configure the criteria to be used to mark a RADIUS server as dead. If no criteria are explicitly configured, the criteria are computed dynamically on the basis of the number of outstanding transactions. Using this feature will result in less deadtime and quicker packet processing.

- Finding Feature Information, page 239
- Prerequisites for AAA Dead-Server Detection, page 239
- Restrictions for AAA Dead-Server Detection, page 240
- Information About AAA Dead-Server Detection, page 240
- How to Configure AAA Dead-Server Detection, page 240
- Configuration Examples for AAA Dead-Server Detection, page 243
- Additional References, page 243
- Feature Information for AAA Dead-Server Detection, page 245

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for AAA Dead-Server Detection

- You must have access to a RADIUS server.
- You should be familiar with configuring a RADIUS server.
- You should be familiar with configuring authentication, authorization, and accounting (AAA).
• Before a server can be marked as dead, you must first configure the `radius-server deadtime` command. If this command is not configured, even if the criteria are met for the server to be marked as dead, the server state will be the "up" state.

Restrictions for AAA Dead-Server Detection

• Original transmissions are not counted in the number of consecutive timeouts that must occur on the router before the server is marked as dead--only the number of retransmissions are counted.

Information About AAA Dead-Server Detection

Criteria for Marking a RADIUS Server As Dead

The AAA Dead-Server Detection feature allows you to determine the criteria that are used to mark a RADIUS server as dead. That is, you can configure the 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.

In addition, you can configure the 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 are included in the number. Improperly constructed packets are counted as though they are timeouts. Only retransmissions are counted, not the initial transmission. (Each timeout causes one retransmission to be sent.)

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

The RADIUS dead-server detection configuration will result in the prompt detection of RADIUS servers that have stopped responding. This configuration will also result in the avoidance of servers being improperly marked as dead when they are "swamped" (responding slowly) and the avoidance of the state of servers being rapidly changed from dead to live to dead again. This prompt detection of nonresponding RADIUS servers and the avoidance of swamped and dead-to-live-to-dead-again servers will result in less deadtime and quicker packet processing.

How to Configure AAA Dead-Server Detection

Configuring AAA Dead-Server Detection

To configure AAA Dead-Server Detection, perform the following steps.
SUMMARY STEPS

1. enable
2. configure terminal
3. aaa new-model
4. radius-server deadtime minutes
5. radius-server dead-criteria [time seconds] [tries number-of-tries]

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> aaa new-model</td>
<td>Enables the AAA access control model.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router (config)# aaa new-model</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> radius-server deadtime</td>
<td>Improves RADIUS response times when some servers might be unavailable and causes the unavailable servers to be skipped immediately.</td>
</tr>
<tr>
<td>minutes</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router (config)# radius-server deadtime 5</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong> radius-server dead-criteria</td>
<td>Forces one or both of the criteria--used to mark a RADIUS server as dead--to be the indicated constant.</td>
</tr>
<tr>
<td>[time seconds] [tries number-of-tries]</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router (config)# radius-server dead-criteria time 5 tries 4</td>
<td></td>
</tr>
</tbody>
</table>

Troubleshooting Tips

After you have configured AAA Dead-Server Detection, you should verify your configuration using the `show running-config` command. This verification is especially important if you have used the `no` form of the `radius-server dead-criteria` command. The output of the `show running-config` command must show the
same values in the "Dead Criteria Details" field that you configured using the `radius-server dead-criteria` command.

### Verifying AAA Dead-Server Detection

To verify your AAA Dead-Server Detection configuration, perform the following steps. The `show` and `debug` commands may be used in any order.

#### SUMMARY STEPS

1. `enable`
2. `debug aaa dead-criteria transactions`
3. `show aaa dead-criteria`
4. `show aaa servers [private | public]`

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| Step 1 | `enable` | Enables privileged EXEC mode.  
  **Example:**  
  `Router> enable`  
  - Enter your password if prompted. |
| Step 2 | `debug aaa dead-criteria transactions` | Displays AAA dead-criteria transaction values.  
  **Example:**  
  `Router# debug aaa dead-criteria transactions` |
| Step 3 | `show aaa dead-criteria` | Displays dead-criteria information for a AAA server.  
  **Example:**  
  `Router# show aaa dead-criteria` |
| Step 4 | `show aaa servers [private | public]` | Displays the status and number of packets that are sent to and received from all public and private authentication, authorization, and accounting (AAA) RADIUS servers.  
  **Example:**  
  `Router# show aaa server private`  
  - The `private` keyword optionally displays the AAA servers only.  
  - The `public` keyword optionally displays the AAA servers only. |
Configuration Examples for AAA Dead-Server Detection

Configuring AAA Dead-Server Detection Example

The following example shows that the router will be considered dead after 5 seconds and four tries:

```
Router (config)# aaa new-model
Router (config)# radius-server deadtime 5
Router (config)# radius-server dead-criteria time 5 tries 4
```

debug aaa dead-criteria transactions Command Example

The following output example shows dead-criteria transaction information for a particular server group:

```
Router# debug aaa dead-criteria transactions
AAA Transaction debugs debugging is on
```

show aaa dead-criteria Command Example

The following output example shows that dead-server-detection information has been requested for a RADIUS server at the IP address 172.19.192.80:

```
Router# show aaa dead-criteria radius 172.19.192.80 radius
RADIUS Server Dead Criteria:
----------------------------------------
Server Details:
   Address : 172.19.192.80
   Auth Port : 1645
   Acct Port : 1646
Server Group : radius
Dead Criteria Details:
   Configured Retransmits : 62
   Configured Timeout : 27
   Estimated Outstanding Transactions: 5
   Dead Detect Time : 25s
   Computed Retransmit Tries: 22
Statistics Gathered Since Last Successful Transaction
----------------------------------------
Max Computed Outstanding Transactions: 5
Max Computed Dead Detect Time: 25s
Max Computed Retransmits : 22
```

Additional References

The following sections provide references related to the AAA Dead-Server Detection feature.
### Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuring RADIUS</td>
<td>Configuring RADIUS feature module.</td>
</tr>
<tr>
<td>Configuring AAA</td>
<td>Configuring Authentication</td>
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<td></td>
<td>Configuring Authorization</td>
</tr>
<tr>
<td></td>
<td>Configuring Accounting</td>
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<tr>
<td>Security commands</td>
<td><em>Cisco IOS Security Command Reference</em></td>
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### Standards

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<th>Standards</th>
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<td>No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.</td>
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<td></td>
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### MIBs

<table>
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<th>MIBs Link</th>
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<td></td>
<td></td>
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<tr>
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### RFCs

<table>
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<tr>
<th>RFCs</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>RFC 2865</td>
<td><em>Remote Authentication Dial In User Service (RADIUS)</em></td>
</tr>
</tbody>
</table>
Technical Assistance

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

Feature Information for AAA Dead-Server Detection

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

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

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
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<tbody>
<tr>
<td>AAA Dead-Server Detection</td>
<td>Cisco IOS XE Release 3.9S</td>
<td>Allows you to configure the criteria to be used to mark a RADIUS server as dead.</td>
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<tr>
<td></td>
<td></td>
<td>The following commands were introduced or modified: debug aaa dead-criteria transactions, radius-server dead-criteria, show aaa dead-criteria, show aaa servers.</td>
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</table>
Login Password Retry Lockout

The Login Password Retry Lockout feature allows system administrators to lock out a local authentication, authorization, and accounting (AAA) user account after a configured number of unsuccessful attempts by the user to log in.

- Finding Feature Information, page 247
- Prerequisites for Login Password Retry Lockout, page 247
- Restrictions for Login Password Retry Lockout, page 248
- Information About Login Password Retry Lockout, page 248
- How to Configure Login Password Retry Lockout, page 248
- Configuration Examples for Login Password Retry Lockout, page 252
- Additional References, page 253
- Feature Information for Login Password Retry Lockout, page 254
- Glossary, page 254

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Login Password Retry Lockout

- You must be running a Cisco IOS image that contains the AAA component.
Restrictions for Login Password Retry Lockout

- Authorized users can lock themselves out because there is no distinction between an attacker who is guessing passwords and an authorized user who is entering the password incorrectly multiple times.

- A denial of service (DoS) attack is possible; that is, an authorized user could be locked out by an attacker if the username of the authorized user is known to the attacker.

Information About Login Password Retry Lockout

Lock Out of a Local AAA User Account

The Login Password Retry Lockout feature allows system administrators to lock out a local AAA user account after a configured number of unsuccessful attempts by the user to log in using the username that corresponds to the AAA user account. A locked-out user cannot successfully log in again until the user account is unlocked by the administrator.

A system message is generated when a user is either locked by the system or unlocked by the system administrator. The following is an example of such a system message:

```
%AAA-5-USER_LOCKED: User user1 locked out on authentication failure.
The system administrator cannot be locked out.
```

Note

The system administrator is a special user who has been configured using the maximum privilege level (root privilege--level 15). A user who has been configured using a lesser privilege level can change the privilege level using the `enable` command. A user that can change to the root privilege (level 15) is able to act as a system administrator.

This feature is applicable to any login authentication method, such as ASCII, Challenge Handshake Authentication Protocol (CHAP), and Password Authentication Protocol (PAP).

Note

No messages are displayed to users after authentication failures that are due to the locked status (that is, there is no distinction between a normal authentication failure and an authentication failure due to the locked status of the user).

How to Configure Login Password Retry Lockout

Configuring Login Password Retry Lockout

To configure the Login Password Retry Lockout feature, perform the following steps.
### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `username name [privilege level] password encryption-type password`
4. `aaa new-model`
5. `aaa local authentication attempts max-fail number-of-unsuccessful-attempts`
6. `aaa authentication login default method`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><code>enable</code></td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Establishes a username-based authentication system.</td>
</tr>
<tr>
<td><code>username name [privilege level] password encryption-type password</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# username user1 privilege 15 password 0 cisco</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Enables the AAA access control model.</td>
</tr>
<tr>
<td><code>aaa new-model</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa new-model</td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Specifies the maximum number of unsuccessful attempts before a user is locked out.</td>
</tr>
<tr>
<td><code>aaa local authentication attempts max-fail number-of-unsuccessful-attempts</code></td>
<td></td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(config)# aaa local authentication attempts max-fail 3</td>
<td></td>
</tr>
</tbody>
</table>
Unlocking a Login Locked-Out User

To unlock a login locked-out user, perform the following steps.

**Note**
This task can be performed only by users having the root privilege (level 15).

**SUMMARY STEPS**

1. `enable`
2. `clear aaa local user lockout {username username | all}`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1**

  - `enable`
  - Example:
    - Router> enable

  Enables privileged EXEC mode.
  - Enter your password if prompted.

| **Step 2**

  - `clear aaa local user lockout {username username | all}`
  - Example:
    - Router> clear aaa local user lockout username user1

  Unlocks a locked-out user.

Clearing the Unsuccessful Login Attempts of a User

This task is useful for cases in which the user configuration was changed and the unsuccessful login attempts of a user that are already logged must be cleared.

To clear the unsuccessful login attempts of a user that have already been logged, perform the following steps.

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **aaa authentication login default method**

  Example:
  - Router(config)# aaa authentication login default local

  Sets the authentication, authorization, and accounting (AAA) authentication method at login. For example, `aaa authentication login default local` specifies the local AAA user database.
**SUMMARY STEPS**

1. enable
2. clear aaa local user fail-attempts \{username username | all\}

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2 clear aaa local user fail-attempts {username username</td>
<td>all}</td>
</tr>
<tr>
<td>Example:</td>
<td>• This command is useful for cases in which the user configuration was changed and the unsuccessful attempts that are already logged must be cleared.</td>
</tr>
<tr>
<td>Router# clear aaa local user fail-attempts username user1</td>
<td></td>
</tr>
</tbody>
</table>

**Monitoring and Maintaining Login Password Retry Lockout Status**

To monitor and maintain the status of the Login Password Retry Lockout configuration, perform the following steps.

**SUMMARY STEPS**

1. enable
2. show aaa local user lockout

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>
### Displaying the Login Password Retry Lockout Configuration Example

The following `show running-config` command output illustrates that the maximum number of failed user attempts has been set for 2 as the login password retry lockout configuration:

```
Router # show running-config
Building configuration...
Current configuration : 1214 bytes
!
version 12.3
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname LAC-2
!
boot-start-marker
boot-end-marker
!
username sysadmin
username sysadm privilege 15 password 0 cisco
username user1 password 0 cisco
aaa new-model
aaa local authentication attempts max-fail 2
!
aaa authentication login default local
aaa dnis map enable
aaa session-id common
```
Additional References

The following sections provide references related to Login Password Retry Lockout.

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS security commands</td>
<td><em>Cisco IOS Security Command Reference</em></td>
</tr>
</tbody>
</table>

Standards

<table>
<thead>
<tr>
<th>Standards</th>
<th>Title</th>
</tr>
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<tbody>
<tr>
<td>None</td>
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MIBs

<table>
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<tr>
<th>MIBs</th>
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<tr>
<td>None</td>
<td>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></td>
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</tbody>
</table>

RFCs

<table>
<thead>
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<th>RFCs</th>
<th>Title</th>
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<tr>
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</table>
Technical Assistance

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

Feature Information for Login Password Retry Lockout

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

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

Table 34: Feature Information for Login Password Retry Lockout

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Login Password Retry Lockout</td>
<td>Cisco IOS XE Release 3.9S</td>
<td>The Login Password Retry Lockout feature allows system administrators to lock out a local AAA user account after a configured number of unsuccessful attempts by the user to log in. The following commands were introduced or modified: <code>aaa local authentication attempts max-fail</code>, <code>clear aaa local user fail-attempts</code>, <code>clear aaa local user lockout</code>.</td>
</tr>
</tbody>
</table>

Glossary

- **local AAA method** -- Method by which it is possible to configure a local user database on a router and to have AAA provision authentication or authorization of users from this database.
• **local AAA user** -- User who is authenticated using the local AAA method.
MSCHAP Version 2

The MSCHAP Version 2 feature (introduced in Cisco IOS Release 12.2(2)XB5) allows Cisco routers to utilize Microsoft Challenge Handshake Authentication Protocol Version 2 (MSCHAP V2) authentication for PPP connections between a computer using a Microsoft Windows operating system and a network access server (NAS).

For Cisco IOS Release 12.4(6)T, MSCHAP V2 now supports a new feature: AAA Support for MSCHAPv2 Password Aging. Prior to Cisco IOS Release 12.4(6)T, when Password Authentication Protocol (PAP)-based clients sent username and password values to the authentication, authorization, and accounting (AAA) subsystem, AAA generated an authentication request to the RADIUS server. If the password expired, the RADIUS server replied with an authentication failure message. The reason for the authentication failure was not passed back to AAA subsystem; thus, users were denied access because of authentication failure but were not informed why they were denied access.

The Password Aging feature, available in Cisco IOS Release 12.4(6)T, notifies crypto-based clients that the password has expired and provides a generic way for the user to change the password. The Password Aging feature supports only crypto-based clients.

• Finding Feature Information, page 257
• Prerequisites for MSCHAP Version 2, page 258
• Restrictions for MSCHAP Version 2, page 258
• Information About MSCHAP Version 2, page 258
• How to Configure MSCHAP Version 2, page 259
• Configuration Examples, page 263
• Additional References, page 264
• Feature Information for MSCHAP Version 2, page 265

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for MSCHAP Version 2

- Configure an interface type and enter interface configuration mode by using the `interface` command.
- Configure the interface for PPP encapsulation by using the `encapsulation` command.
- Be sure that the client operating system supports all MSCHAP V2 capabilities.
- For Cisco IOS Release 12.4(6)T, the Password Aging feature only supports RADIUS authentication for crypto-based clients.
- To ensure that the MSCHAP Version 2 features correctly interpret the authentication failure attributes sent by the RADIUS server, you must configure the `ppp max-bad-auth` command and set the number of authentication retries at two or more.
- In order for the MSCHAP Version 2 feature to support the ability to change a password, the authentication failure attribute, which is sent by the RADIUS server, must be correctly interpreted as described in Configuring MSCHAP V2 Authentication.

In addition, the `radius server vsa send authentication` command must be configured, allowing the RADIUS client to send a vendor-specific attribute to the RADIUS server. The Change Password feature is supported only for RADIUS authentication.

- The Microsoft Windows 2000, Microsoft Windows XP, and Microsoft Windows NT operating systems have a known caveat that prevents the Change Password feature from working. You must download a patch from Microsoft at the following URL:

http://support.microsoft.com/default.aspx?scid=kb;en-us;Q326770

For more information on completing these tasks, see the section “PPP Configuration” in the Cisco IOS Dial Technologies Configuration Guide, Release 12.4T. The RADIUS server must be configured for authentication. Refer to vendor-specific documentation for information on configuring RADIUS authentication on the RADIUS server.

Restrictions for MSCHAP Version 2

- MSCHAP V2 authentication is not compatible with MSCHAP V1 authentication.
- The change password option is supported only for RADIUS authentication and is not available for local authentication.

Information About MSCHAP Version 2

MSCHAP V2 authentication is the default authentication method used by the Microsoft Windows 2000 operating system. Cisco routers that support this authentication method enable Microsoft Windows 2000 operating system users to establish remote PPP sessions without configuring an authentication method on the client.
MSCHAP V2 authentication introduced an additional feature not available with MSCHAP V1 or standard CHAP authentication: the Change Password feature. This feature allows the client to change the account password if the RADIUS server reports that the password has expired.

Note
MSCHAP V2 authentication is an updated version of MSCHAP that is similar to but incompatible with MSCHAP Version 1 (V1). MSCHAP V2 introduces mutual authentication between peers and a Change Password feature.

# How to Configure MSCHAP Version 2

## Configuring MSCHAP V2 Authentication

To configure the NAS to accept MSCHAP V2 authentication for local or RADIUS authentication and to allow proper interpretation of authentication failure attributes and vendor-specific RADIUS attributes for RADIUS authentication, use the following commands beginning in global configuration mode.

### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `radius-server vsa send authentication`
4. `interface type number`
5. `ppp max-bad-auth number`
6. `ppp authentication ms-chap-v2`
7. `end`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
</tr>
<tr>
<td><code>enable</code></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router&gt; enable</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
</tr>
<tr>
<td><code>configure terminal</code></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router# configure terminal</code></td>
<td></td>
</tr>
</tbody>
</table>
### MSCHAP Version 2

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 3</strong></td>
<td>Configures the NAS to recognize and use vendor-specific attributes.</td>
</tr>
<tr>
<td><code>radius-server vsa send authentication</code></td>
<td>Configures an interface type and enters interface configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router(config)# radius-server vsa send authentication</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Configures a point-to-point interface to reset immediately after an authentication failure or within a specified number of authentication retries.</td>
</tr>
<tr>
<td><code>interface type number</code></td>
<td>Enables MSCHAP V2 authentication on a NAS.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><code>Router(config)# interface FastEthernet 0/1</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Enables MSCHAP V2 authentication on a NAS.</td>
</tr>
<tr>
<td><code>ppp max-bad-auth number</code></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router(config-if)# ppp max-bad-auth 2</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>Enables MSCHAP V2 authentication on a NAS.</td>
</tr>
<tr>
<td><code>ppp authentication ms-chap-v2</code></td>
<td>Enables MSCHAP V2 authentication on a NAS.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router(config-if)# ppp authentication ms-chap-v2</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td>Enables MSCHAP V2 authentication on a NAS.</td>
</tr>
<tr>
<td><code>end</code></td>
<td>Enables MSCHAP V2 authentication on a NAS.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Router(config-if)# end</code></td>
<td></td>
</tr>
</tbody>
</table>

### Verifying MSCHAP V2 Configuration

To verify that the MSCHAP Version 2 feature is configured properly, perform the following steps.
**SUMMARY STEPS**

1. `show running-config interface type number`
2. `debug ppp negotiation`
3. `debug ppp authentication`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Verifies the configuration of MSCHAP V2 as the authentication method for the specified interface.</td>
</tr>
<tr>
<td><code>show running-config interface type number</code></td>
<td>Example: Router# show running-config interface Asynch65</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Verifies successful MSCHAP V2 negotiation.</td>
</tr>
<tr>
<td><code>debug ppp negotiation</code></td>
<td>Example: Router# debug ppp negotiation</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Verifies successful MSCHAP V2 authentication.</td>
</tr>
<tr>
<td><code>debug ppp authentication</code></td>
<td>Example: Router# debug ppp authentication</td>
</tr>
</tbody>
</table>

**Configuring Password Aging for Crypto-Based Clients**

The AAA security services facilitate a variety of login authentication methods. Use the `aaa authentication login` command to enable AAA authentication no matter which of the supported login authentication methods you decide to use. With the `aaa authentication login` command, you create one or more lists of authentication methods that are tried at login. These lists are applied using the `login authentication` line configuration command.

After the RADIUS server requests a new password, AAA queries the crypto client, which in turn prompts the user to enter a new password.

To configure login authentication and password aging for crypto-based clients, use the following commands beginning in global configuration mode.

**Note**

The AAA Password Expiry infrastructure notifies the Easy VPN client that the password has expired and provides a generic way for the user to change the password. Please use RADIUS-server domain-stripping feature wisely in combination with AAA password expiry support.
### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `aaa new-model`
4. `aaa authentication login {default | list-name} passwd-expiry method1 [method2...]
5. `crypto map map-name client authentication list list-name`

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1**        | Enables privileged EXEC mode.  
| `enable`          | • Enter your password if prompted.  
| Example: Router> enable |         |
| **Step 2**        | Enters global configuration mode.  
| `configure terminal` |         |
| Example: Router# configure terminal |         |
| **Step 3**        | Enables AAA globally.  
| `aaa new-model`   |         |
| Example: Router(config)# aaa new-model |         |
| **Step 4**        | Enables password aging for crypto-based clients on a local authentication list.  
| `aaa authentication login {default | list-name} passwd-expiry method1 [method2...]` |         |
| Example: Router(config)# aaa authentication login userauthen passwd-expiry group radius |         |
| **Step 5**        | Configures user authentication (a list of authentication methods) on an existing crypto map.  
| `crypto map map-name client authentication list list-name` |         |
| Example: Router(config)# crypto map clientmap client authentication list userauthen |         |
Configuration Examples

Configuring Local Authentication Example

The following example configures PPP on an asynchronous interface and enables MSCHAP V2 authentication locally:

```
interface Async65
 ip address 10.0.0.2 255.0.0.0
 encapsulation ppp
 async mode dedicated
 no peer default ip address
 ppp max-bad-auth 3
 ppp authentication ms-chap-v2
 username client password secret
```

Configuring RADIUS Authentication Example

The following example configures PPP on an asynchronous interface and enables MSCHAP V2 authentication via RADIUS:

```
interface Async65
 ip address 10.0.0.2 255.0.0.0
 encapsulation ppp
 async mode dedicated
 no peer default ip address
 ppp max-bad-auth 3
 ppp authentication ms-chap-v2
 exit
 aaa authentication ppp default group radius
 radius-server host 10.0.0.2 255.0.0.0
 radius-server key secret
 radius-server vsa send authentication
```

Configuring Password Aging with Crypto Authentication Example

The following example configures password aging by using AAA with a crypto-based client:

```
aaa authentication login userauthen passwd-expiry group radius
 !
aaa session-id common
 !
crypto isakmp policy 3
 encr 3des
 authentication pre-share
 group 2
 !
crypto isakmp client configuration group 3000client
 key cisco123
 dns 10.1.1.10
 wins 10.1.1.20
 domain cisco.com
 pool ippool
 acl 155
 !
crypto ipsec transform-set myset esp-3des esp-sha-hmac
```
crypto dynamic-map dynmap 10
    set transform-set myset
crypto map clientmap client authentication list userauthen
!
radius-server host 10.140.15.203 auth-port 1645 acct-port 1646
radius-server domain-stripping prefix-delimiter $
radius-server key cisco123
radius-server vsa send authentication
radius-server vsa send authentication 3gpp2
!
end

Additional References

The following sections provide references related to the MSCHAP Version 2 feature.

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuring PPP interfaces</td>
<td>PPP Configuration in the Cisco IOS Dial Technologies Configuration Guide, Release 12.4T.</td>
</tr>
<tr>
<td>Descriptions of the tasks and commands necessary to configure and maintain Cisco networking devices</td>
<td>Cisco IOS Dial Technologies Command Reference</td>
</tr>
<tr>
<td>Lists of IOS Security Commands</td>
<td>Cisco IOS Security Command Reference</td>
</tr>
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</table>

Standards

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<tr>
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<th>Title</th>
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<td>No new or modified standards are supported by this feature.</td>
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</tbody>
</table>
MIBs

<table>
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<th>MIB</th>
<th>MIBs Link</th>
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<tbody>
<tr>
<td>No new or modified MIBs are supported by this feature.</td>
<td>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></td>
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</table>

RFCs

<table>
<thead>
<tr>
<th>RFC</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFC 1661</td>
<td>Point-to-Point Protocol (PPP)</td>
</tr>
<tr>
<td>RFC 2548</td>
<td>Microsoft Vendor-specific RADIUS Attributes</td>
</tr>
<tr>
<td>RFC 2759</td>
<td>Microsoft PPP CHAP Extensions, Version 2</td>
</tr>
</tbody>
</table>

Technical Assistance

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

Feature Information for MSCHAP Version 2

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature. Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.
Table 35: Feature Information for MSCHAP Version 2

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSCHAP Version 2</td>
<td>Cisco IOS XE Release 3.9S</td>
<td>The MSCHAP Version 2 feature allows Cisco routers to utilize Microsoft Challenge Handshake Authentication Protocol Version 2 (MSCHAP V2) authentication for PPP connections between a computer using a Microsoft Windows operating system and a network access server (NAS). The following commands were introduced or modified: <strong>aaa authentication login</strong>, and <strong>ppp authentication ms-chap-v2</strong>.</td>
</tr>
</tbody>
</table>
AAABroadcastAccounting-MandatoryResponse Support

The AAA Broadcast Accounting--Mandatory Response Support feature provides a mechanism to support broadcast accounting under each server group through a Gateway GPRS Support Node (GGSN), which acts as a gateway between a General Packet Radio Service (GPRS) wireless data network and other networks such as the Internet or private networks.

- Finding Feature Information, page 267
- Prerequisites for AAABroadcastAccounting-MandatoryResponse Support, page 268
- Restrictions for AAABroadcastAccounting-MandatoryResponse Support, page 268
- Information About AAABroadcastAccounting-MandatoryResponse Support, page 268
- How AAABroadcastAccounting is Supported for GGSN, page 269
- Configuration Examples for AAABroadcastAccounting-MandatoryResponse Support, page 272
- Additional References, page 273
- Feature Information for AAABroadcastAccounting-MandatoryResponse Support, page 274

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 www.cisco.com/go/cfn. An account on Cisco.com is not required.
Prerequisites for AAA Broadcast Accounting-Mandatory Response Support

See the Cisco GGSN Release 8.0 Configuration Guide for more information on preparing for the GGSN configuration.

Restrictions for AAA Broadcast Accounting-Mandatory Response Support

Accounting information can be sent simultaneously to a maximum of ten AAA servers.

Information About AAA Broadcast Accounting-Mandatory Response Support

The AAA Broadcast Accounting--Mandatory Response Support feature allows up to 10 server groups (methods) to be configured in a method list. The following sections describe the types of AAA accounting used to support GGSN:

AAA Broadcast Accounting

AAA broadcast accounting allows accounting information to be sent to multiple authentication, authorization, and accounting (AAA) servers at the same time; that is, accounting information can be broadcast to one or more AAA servers simultaneously. This functionality allows service providers to send accounting information to their own private AAA servers and to the AAA servers of their end customers. It also provides redundant billing information for voice applications.

Broadcasting is allowed among groups of servers, which can be either RADIUS or TACACS+, and each server group can define its backup servers for failover independently of other groups. Failover is a process that may occur when more than one server has been defined within a server group. Failover refers to the process by which information is sent to the first server in a server group; if the first server is unavailable, the information is sent to the next server in the server group. This process continues until the information is successfully sent to one of the servers within the server group or until the list of available servers within the server group is exhausted.

Simultaneous Broadcast and Wait Accounting

With Cisco GGSN Release 8.0 and later releases, broadcast and wait accounting can be configured to work together. The wait accounting feature is configured at the Access Point Name (APN) level, while broadcast accounting is specified at the AAA method level.

Broadcast accounting sends start, stop, and interim accounting records to all the server groups that are configured in a method list. Within a server group, the accounting records are sent to the first active server. If the active server cannot be reached, the accounting records are sent to the next server within a group.
Additionally, one or more server groups within a method list can be configured as "mandatory," meaning that a server from that server group has to respond to the Accounting Start message. The APN-level wait accounting ensures that an accounting response has been received from all mandatory server groups before the packet data protocol (PDP) context is established.

The advantages of broadcast and wait accounting together include:

- Accounting records are sent to multiple servers, and once the entry is made, the user can start using different services.
- Records are sent to multiple AAA servers for redundancy purposes.
- A PDP context is established only when a valid Accounting Start record has been received by all essential servers, avoiding information loss.
- Broadcast records can be sent to as many as ten server groups within a method list.

When configuring broadcast and wait accounting together, note the following:

- Under the method list configuration, the mandatory keyword is available only if broadcast accounting is configured.
- If wait accounting is not required, broadcast accounting to all server groups is available without any mandatory groups defined.
- If you do not specify any mandatory server groups when configuring broadcast accounting, wait accounting will function as it does in Cisco GGSN Release 7.0 and earlier releases.
- Wait accounting does not apply to PPP PDP contexts.
- A PDP is successfully created only when an Accounting response is received from all the mandatory servers.
- The periodic timer starts when an Accounting Response (PDP creation) is received.

Note: More than one server group can be defined as a mandatory server group in a method list.

How AAA Broadcast Accounting is Supported for GGSN

Configuring Broadcast and Wait Accounting on the GGSN

The tasks in this section describe how to configure broadcast and wait accounting on the GGSN.
### SUMMARY STEPS

1. enable
2. configure terminal
3. aaa new-model
4. aaa accounting network \{method-list-name | default\}
5. action-type \{start-stop | stop-only | none\}
6. broadcast
7. group server-group [mandatory]
8. exit
9. gprs access-point-list list-name
10. access-point access-point-index
11. aaa-group accounting method-list name
12. gtp-response-message wait-accounting

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td>Router&gt; enable</td>
</tr>
<tr>
<td></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td></td>
<td>• Enter the password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# configure terminal</td>
</tr>
<tr>
<td></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>aaa new-model</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# aaa new-model</td>
</tr>
<tr>
<td></td>
<td>Enables new access control commands and functions (disables the old commands).</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>aaa accounting network {method-list-name</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config)# aaa accounting network net1</td>
</tr>
<tr>
<td></td>
<td>Enables authentication, authorization, and accounting (AAA) accounting of requested services for billing or security purposes when you use RADIUS and enters accounting method list mode.</td>
</tr>
<tr>
<td></td>
<td>• The method-list-name argument is the named accounting list, which has a maximum of 31 characters. Any characters longer than the maximum are rejected.</td>
</tr>
<tr>
<td></td>
<td>• The default keyword specifies the default accounting list.</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>action-type {start-stop</td>
</tr>
<tr>
<td></td>
<td>Performs a type of action on accounting records. Possible values are:</td>
</tr>
<tr>
<td>Command or Action</td>
<td>Purpose</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td>Router(cfg-acct-mlist)#action-type start-stop</td>
<td></td>
</tr>
</tbody>
</table>

- **start-stop** -- Sends a "start" accounting notice at the beginning of a process and a "stop" accounting notice at the end of a process.
- **stop-only** -- Sends a "stop" accounting notice at the end of the requested user process.
- **none** -- Disables accounting services on this line or interface.

**Step 6**  
**broadcast**  
**Example:**  
Router(cfg-acct-mlist)#broadcast  
(Optional) Enables sending accounting records to multiple AAA servers. Simultaneously sends accounting records to the first server in each group. If the first server is unavailable, failover occurs using the backup servers defined within that group.

**Step 7**  
**group server-group [mandatory]**  
**Example:**  
Router(cfg-acct-mlist)#group server1  
Specifies the server group. Optionally, specify the **mandatory** keyword to define this server group as mandatory. If a server group is mandatory, a server from the server group must respond to the Accounting Start message.  
**Note**  
Up to ten server groups can be defined within a method list.

**Step 8**  
**exit**  
**Example:**  
Router(config)# group server1  
Exits accounting method list configuration mode.

**Step 9**  
**gprs access-point-list list-name**  
**Example:**  
Router(config)# gprs access-point-list public  
Configures an access point list that you use to define public data network (PDN) access points on the GGSN and enters global configuration mode.

**Step 10**  
**access-point access-point-index**  
**Example:**  
Router(config-ap-list)# access-point 11  
Specifies an access point number and enters access point configuration mode.

**Step 11**  
**aaa-group accounting method-list name**  
**Example:**  
Router(config-access-point)#aaa-group accounting net1  
Specifies an accounting server group.

**Step 12**  
**gtp-response-message wait-accounting**  
**Example:**  
Router(config-access-point)# gtp-response-message wait-accounting  
Configures APN to wait for a RADIUS accounting response before sending a Create PDP Context response to the Serving GPRS Support Node (SGSN).
Configuration Examples for AAA Broadcast Accounting-Mandatory Response Support

AAA Broadcast Accounting-Mandatory Response Support Example

The following example globally configures the GGSN to wait for an accounting response from the RADIUS server before sending a Create PDP Context response to the SGSN. The GGSN waits for a response for PDP context requests received across all access points, except access-point 1. RADIUS response message waiting has been overridden at access-point 1 by using the no gtp response-message wait-accounting command.

```plaintext
! Enables AAA globally
! aaa new-model
! Defines AAA server group
! aaa group server radius abc
  server 10.2.3.4 auth-port 1645 acct-port 1646
  server 10.6.7.8 auth-port 1645 acct-port 1646
! Configures AAA authentication and authorization
! aaa authentication ppp abc group abc
aaa authorization network abc group abc
aaa accounting network abc
  action-type start-stop
  broadcast
  group SG1 mandatory
  group SG2
  group SG3 mandatory
! gprs access-point-list gprs
  access-point 1
    access-mode non-transparent
    access-point-name www.pdn1.com
    aaa-group authentication abc
! Disables waiting for RADIUS response
! message at APN 1
! no gtp response-message wait-accounting
exit
access-point 2
  access-mode non-transparent
  access-point-name www.pdn2.com
  aaa-group authentication abc
! Enables waiting for RADIUS response
! messages across all APNs (except APN 1)
! gprs gtp response-message wait-accounting
! Configures global RADIUS server hosts
! and specifies destination ports for
! authentication and accounting requests
radius-server host 10.2.3.4 auth-port 1645 acct-port 1646 non-standard
radius-server host 10.6.7.8 auth-port 1645 acct-port 1646 non-standard
radius-server key ggsntel
```
Additional References

The following sections provide references related to the AAA Broadcast Accounting--Mandatory Response Support feature.

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
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<tbody>
<tr>
<td>Preparation for the GGSN configuration</td>
<td>Cisco GGSN Release 8.0 Configuration Guide</td>
</tr>
<tr>
<td>AAA commands</td>
<td>Cisco IOS Security Command Reference Guide</td>
</tr>
<tr>
<td>AAA features</td>
<td>Cisco IOS Security Configuration Guide: Securing User Services</td>
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Standards

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<th>Title</th>
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MIBs

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<td>No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.</td>
<td>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></td>
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RFCs

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</table>

Authentication Authorization and Accounting Configuration Guide Cisco IOS XE Release 3S
Feature Information for AAA Broadcast Accounting-Mandatory Response Support

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

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.
Table 36: Feature Information for AAA Broadcast Accounting—Mandatory Response Support

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA Broadcast Accounting—Mandatory Response Support</td>
<td>Cisco IOS XE Release 3.9S</td>
<td>The AAA Broadcast Accounting—Mandatory Response Support feature provides a mechanism to support broadcast accounting under each server group through a Gateway GPRS Support Node (GGSN), which acts as a gateway between a General Packet Radio Service (GPRS) wireless data network and other networks such as the Internet or private networks. The following commands were introduced or modified: <code>aaa accounting network</code>, <code>aaa-group accounting</code>, <code>access-point</code>, <code>action-type</code>, <code>broadcast</code>, <code>gprs access-point-list</code>, <code>group</code>, <code>gtp-response-message wait-accounting</code></td>
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