Configuring IEEE 802.1x Port-Based Authentication

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This document describes how to configure IEEE 802.1x port-based authentication on Cisco integrated services routers (ISRs). IEEE 802.1x authentication prevents unauthorized devices (supplicants) from gaining access to the network.

Cisco ISRs can combine the functions of a router, a switch, and an access point, depending on the fixed configuration or installed modules. The switch functions are provided by either built in switch ports or a plug-in module with switch ports.

Note This document describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for Configuring IEEE 802.1x Port-Based Authentication" section on page 36.

Finding Support Information for Platforms and Cisco IOS and Catalyst OS Software Images

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

Contents

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Prerequisites for Configuring IEEE 802.1x Port-Based Authentication

The features described in this document are available only on switch ports installed in Cisco ISR routers. The IEEE 802.1x port-based authentication features are available in Cisco IOS Release 12.4(11)T on Cisco 800, 870, 1800, 2800, and 3800 series ISRs that support switch ports.

The fixed configuration Cisco 1800 series router platforms and the Cisco 870 series routers have integrated 4-port and 8-port switches.

The following cards or modules support switch ports:

- High-speed WAN interface cards (HWIC)
  - HWIC-4ESW
  - HWICD-9ESW
- EtherSwitch Network Modules
  - NM-16ESW
  - NMD-36ESW

Note Not all Cisco ISR routers support all the components listed. For information about module compatibility with a specific router platform, see *Cisco EtherSwitch Modules Comparison*.

To determine whether your router has switch ports that can be configured with the IEEE 802.1x port-based authentication feature, use the **show interfaces switchport** command.

To configure IEEE 802.1x port-based authentication, you must enable authentication, authorization, and accounting (AAA) and specify the authentication method list. A method list describes the sequence and authentication method to be queried to authenticate a user.

Restrictions for Configuring IEEE 802.1x Port-Based Authentication

These sections describe the configuration restrictions for these features:

IEEE 802.1x Authentication Configuration

These are the IEEE 802.1x authentication configuration restrictions:

- When IEEE 802.1x authentication is enabled, ports are authenticated before any other Layer 2 or Layer 3 features are enabled.
- If you try to change the mode (for example, from access to trunk) of an IEEE 802.1x-enabled port, an error message appears, and the port mode is not changed.
- If the VLAN to which an IEEE 802.1x-enabled port is assigned changes, this change is transparent and does not affect the switch port. For example, this change occurs if a port is assigned to a RADIUS server-assigned VLAN and is then assigned to a different VLAN after reauthentication.

  If the VLAN to which an IEEE 802.1x port is assigned is shut down, disabled, or removed, the port becomes unauthorized. For example, the port is unauthorized after the access VLAN to which a port is assigned shuts down or is removed.
- The IEEE 802.1x protocol is supported on Layer 2 static-access ports, voice VLAN enabled ports, and Layer 3 routed ports, but it is not supported on these port types:
  - Dynamic-access ports—If you try to enable IEEE 802.1x authentication on a dynamic-access (VLAN Query Protocol [VQP]) port, an error message appears, and IEEE 802.1x authentication is not enabled. If you try to change an IEEE 802.1x-enabled port to dynamic VLAN assignment, an error message appears, and the VLAN configuration is not changed.
  - Dynamic ports—If you try to enable IEEE 802.1x authentication on a dynamic port, an error message appears, and IEEE 802.1x authentication is not enabled. If you try to change the mode of an IEEE 802.1x-enabled port to dynamic, an error message appears, and the port mode is not changed.
  - Switched Port Analyzer (SPAN) and Remote SPAN (RSPAN) destination ports—You can enable IEEE 802.1x authentication on a port that is a SPAN or RSPAN destination port. However, IEEE 802.1x authentication is disabled until the port is removed as a SPAN or RSPAN destination port. You can enable IEEE 802.1x authentication on a SPAN or RSPAN source port.
  - Trunk port—If you try to enable IEEE 802.1x authentication on a trunk port, an error message appears, and IEEE 802.1x authentication is not enabled. If you try to change the mode of an IEEE 802.1x-enabled port to trunk, an error message appears, and the port mode is not changed.

Note A port in dynamic mode can negotiate with its neighbor to become a trunk port.

VLAN Assignment Configuration

This is the restriction for configuring VLAN assignment and the guest VLAN feature on switch ports in an ISR router:

- When IEEE 802.1x authentication is enabled on a port, you cannot configure a port VLAN that is equal to a voice VLAN.

Guest VLAN Configuration

- You can configure any VLAN except an RSPAN VLAN or a voice VLAN as an IEEE 802.1x guest VLAN. The guest VLAN feature is not supported on internal VLANs (routed ports) or trunk ports; it is supported only on access ports.
- After you configure a guest VLAN for an IEEE 802.1x port to which a DHCP client is connected, you might have to get a host IP address from a DHCP server. You can change the settings for restarting the IEEE 802.1x authentication process on the switch before the DHCP process on the client times out and tries to get a host IP address from the DHCP server. Decrease the settings for the IEEE 802.1x authentication process (using the **dot1x max-reauth-req** and **dot1x timeout tx-period** interface configuration commands). The amount of decrease depends on the connected IEEE 802.1x client type.

Upgrading from a Previous Software Release

In Cisco IOS Release 12.4(11)T, the implementation for IEEE 802.1x authentication changed from the previous releases. When IEEE 802.1x authentication is enabled, information about Port Fast is no longer added to the configuration.

Note When you enter any IEEE 802.1x-related commands on a port, this information is automatically added to the running configuration to address any backward compatibility issues:

```
dot1xpae authenticator
```

Information About IEEE 802.1x Port-Based Authentication

Note This section describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

The IEEE 802.1x standard defines a client-server-based access control and authentication protocol that prevents unauthorized clients from connecting to a LAN through publicly accessible ports unless they are properly authenticated. The authentication server authenticates each client connected to a port before making available any services offered by the device or the network.

Until the client is authenticated, IEEE 802.1x access control allows only Extensible Authentication Protocol over LAN (EAPOL), Cisco Discovery Protocol (CDP), and Spanning Tree Protocol (STP) traffic through the port to which the client is connected. After authentication is successful, normal traffic can pass through the port.

These sections describe IEEE 802.1x port-based authentication:

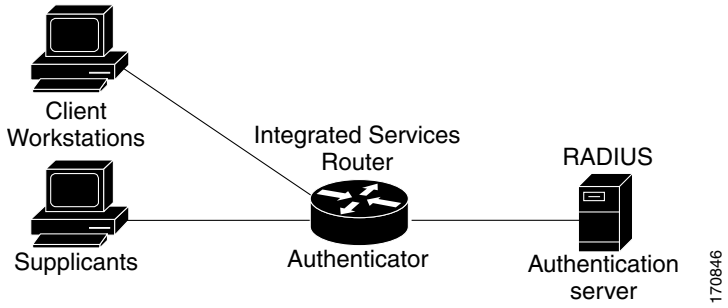
IEEE 802.1x Authenticator

The following sections describe the basic authentication process:

Device Roles

With IEEE 802.1x port-based authentication, the devices in the network have specific roles as shown in Figure 1.

Figure 1 IEEE 802.1x Device Roles



- *Supplicant*—Device (workstation) that requests access to the LAN and switch services and responds to requests from the router. The workstation must be running IEEE 802.1x-compliant client software such as that offered in the Microsoft Windows XP operating system. (The *supplicant* is sometimes called the client.)

  Note To resolve Windows XP network connectivity and IEEE 802.1x authentication issues, read the Microsoft Knowledge Base article at this URL: http://support.microsoft.com/support/kb/articles/Q303/5/97.ASP

- *Authentication server*—Device that performs the actual authentication of the supplicant. The authentication server validates the identity of the supplicant and notifies the router whether or not the supplicant is authorized to access the LAN and switch services. The Network Access Device (or ISR router in this instance) transparently passes the authentication messages between the supplicant and the authentication server, and the authentication process is carried out between the supplicant and the authentication server. The particular EAP method used will be decided between the supplicant and the authentication server (RADIUS server). The RADIUS security system with EAP

extensions is available in Cisco Secure Access Control Server Version 3.0 or later. RADIUS operates in a client and server model in which secure authentication information is exchanged between the RADIUS server and one or more RADIUS clients.

- *Authenticator* (integrated services router (ISR) or wireless access point)—Router that controls the physical access to the network based on the authentication status of the supplicant. The router acts as an intermediary between the supplicant and the authentication server, requesting identity information from the supplicant, verifying that information with the authentication server, and relaying a response to the supplicant. The router includes the RADIUS client, which is responsible for encapsulating and decapsulating the EAP frames and interacting with the authentication server.

  When the authenticator receives EAPOL frames and relays them to the authentication server, the EAPOL is stripped and the remaining EAP frame is reencapsulated in the RADIUS format. The EAP frames are not modified during encapsulation, and the authentication server must support EAP within the native frame format. When the authenticator receives frames from the authentication server, the server's frame header is removed, leaving the EAP frame, which is then encapsulated for Ethernet and sent to the client.

Authentication Initiation and Message Exchange

During IEEE 802.1x authentication, the router or the supplicant can initiate authentication. If you enable authentication on a port by using the **dot1x port-control auto** interface configuration command, the router initiates authentication when the link state changes from down to up or periodically if the port remains up and unauthenticated. The router sends an EAP-request/identity frame to the supplicant to request its identity. Upon receipt of the frame, the supplicant responds with an EAP-response/identity frame.

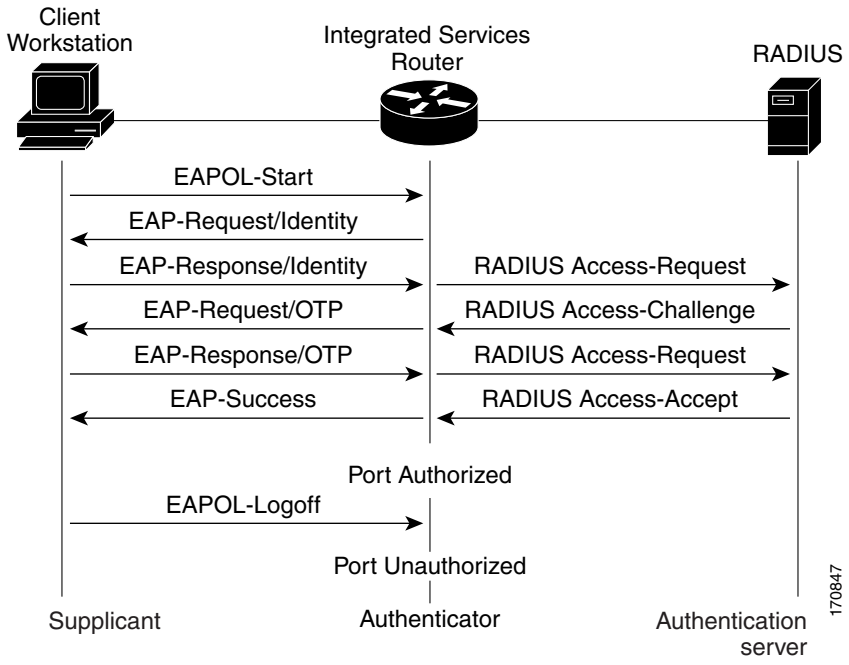
However, if during bootup, the supplicant does not receive an EAP-request/identity frame from the router, the supplicant can initiate authentication by sending an EAPOL-start frame, which prompts the router to request the supplicant's identity.

Note If IEEE 802.1x authentication is not enabled or supported on the network access device, any EAPOL frames from the supplicant are dropped. If the supplicant does not receive an EAP-request/identity frame after three attempts to start authentication, the supplicant sends frames as if the port is in the authorized state. A port in the authorized state effectively means that the supplicant has been successfully authenticated. For more information, see the "Ports in Authorized and Unauthorized States" section on page 8.

When the supplicant supplies its identity, the router begins its role as the intermediary, passing EAP frames between the supplicant and the authentication server until authentication succeeds or fails. If the authentication succeeds, the router port becomes authorized. If the authentication fails, authentication can be retried, the port might be assigned to a VLAN that provides limited services, or network access is not granted. For more information, see the "Ports in Authorized and Unauthorized States" section on page 8.

The specific exchange of EAP frames depends on the authentication method being used. Figure 2 shows a message exchange initiated by the supplicant using the One-Time-Password (OTP) authentication method with a RADIUS server.

Figure 2 Message Exchange



Authentication Process

To configure IEEE 802.1x port-based authentication, you must enable authentication, authorization, and accounting (AAA) and specify the authentication method list. A method list describes the sequence and authentication method to be queried to authenticate a user.

The AAA process begins with authentication. When IEEE 802.1x port-based authentication is enabled and the device attempting to authenticate is IEEE 802.1x-capable (meaning it supports the supplicant functionality) these events occur:

- If the supplicant identity is valid and the IEEE 802.1x authentication succeeds, the router grants the supplicant access to the network.

The router reauthenticates a supplicant when one of these situations occurs:

- Periodic reauthentication is enabled, and the reauthentication timer expires.

  You can configure the reauthentication timer to use a router-specific value or to be based on values from the RADIUS server.

  After IEEE 802.1x authentication using a RADIUS server is configured, the router uses timers based on the Session-Timeout RADIUS attribute (Attribute[27]) and the Termination-Action RADIUS attribute (Attribute [29]).

  The Session-Timeout RADIUS attribute (Attribute[27]) specifies the time after which reauthentication occurs.

  The Termination-Action RADIUS attribute (Attribute [29]) specifies the action to take during reauthentication. The actions can be *Initialize* or *ReAuthenticate*. When the *Initialize* action is set (the attribute value is *DEFAULT*), the IEEE 802.1x session ends, and connectivity is lost during reauthentication. When the *ReAuthenticate* action is set (the attribute value is RADIUS-Request), the session is not affected during reauthentication.

- You manually reauthenticate the supplicant by entering the **dot1x re-authenticate interface** *interface-id* privileged EXEC command.

Ports in Authorized and Unauthorized States

During IEEE 802.1x authentication, depending on the port state, the router can grant a supplicant access to the network. The port starts in the *unauthorized* state. While in this state, the port that is not configured as a voice VLAN port disallows all ingress traffic except for IEEE 802.1x authentication, CDP, and STP packets. When a supplicant is successfully authenticated, the port changes to the *authorized* state, allowing all traffic for the supplicant to flow normally. If the port is configured as a voice VLAN port, the port allows VoIP traffic and IEEE 802.1x protocol packets before the supplicant is successfully authenticated.

If a client that does not support IEEE 802.1x authentication connects to an unauthorized IEEE 802.1x port, the router requests the client's identity. In this situation, if the client does not respond to the request, the port remains in the unauthorized state, and the client is not granted access to the network.

In contrast, when an IEEE 802.1x-enabled supplicant connects to a port that is not running the IEEE 802.1x standard, the supplicant initiates the authentication process by sending the EAPOL-start frame. When no response is received, the supplicant sends the request for a fixed number of times. Because no response is received, the supplicant begins sending frames as if the port is in the authorized state.

You control the port authorization state by using the **dot1x port-control** interface configuration command and these keywords:

- **force-authorized**—Disables IEEE 802.1x authentication and causes the port to change to the authorized state without any authentication exchange required. The port sends and receives normal traffic without IEEE 802.1x-based authentication of the client. This is the default setting.
- **force-unauthorized**—Causes the port to remain in the unauthorized state, ignoring all attempts by the supplicant to authenticate. The router cannot provide authentication services to the supplicant through the port.
- **auto**—Enables IEEE 802.1x authentication and causes the port to begin in the unauthorized state, allowing only EAPOL frames to be sent and received through the port. The authentication process begins when the link state of the port changes from down to up or when an EAPOL-start frame is received. The router requests the identity of the supplicant and begins relaying authentication messages between the supplicant and the authentication server. Each supplicant attempting to access the network is uniquely identified by the router by using the supplicant MAC address.

If the supplicant is successfully authenticated (receives an Accept frame from the authentication server), the port state changes to authorized, and all frames from the authenticated supplicant are allowed through the port. If the authentication fails, the port remains in the unauthorized state, but authentication can be retried. If the authentication server cannot be reached, the router can resend the request. If no response is received from the server after the specified number of attempts, authentication fails, and network access is not granted.

When a supplicant logs off, it sends an EAPOL-logoff message, causing the router port to change to the unauthorized state.

If the link state of a port changes from up to down, or if an EAPOL-logoff frame is received, the port returns to the unauthorized state.

For information about configuring IEEE 802.1x port-based authentication, see the "Configuring IEEE 802.1x Authentication" section of the "Configuring IEEE 802.1x Port-Based Authentication" chapter in the *Catalyst 3750 Switch Software Configuration Guide, 12.2(25)SEE*.

IEEE 802.1x Host Mode

Note This section describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

You can configure an IEEE 802.1x port for single-host or for multi-host mode. In single-host mode (see Figure 1 on page 5), only one supplicant can be authenticated by the IEEE 802.1x-enabled switch port. The router detects the supplicant by sending an EAPOL frame when the port link state changes to the up state. If a supplicant leaves or is replaced with another supplicant, the router changes the port link state to down, and the port returns to the unauthorized state.

In multi-host mode, you can attach multiple hosts to a single IEEE 802.1x-enabled port. In this mode, only one of the attached supplicants must be authorized for all supplicants to be granted network access. If the port becomes unauthorized (reauthentication fails or an EAPOL-logoff message is received), the router denies network access to all of the attached supplicants.

Note Cisco 870 series platforms do not support single-host mode.

For information about configuring IEEE 802.1x host mode, see the "Configuring the Host Mode" section of the "Configuring IEEE 802.1x Port-Based Authentication" chapter in the *Catalyst 3750 Switch Software Configuration Guide, 12.2(25)SEE*.

IEEE 802.1x with RADIUS Accounting

Note This section describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

This section describes IEEE 802.1x RADIUS accounting and includes the following topics:

IEEE 802.1x RADIUS Accounting

Note If you plan to implement system-wide accounting, you should also configure IEEE 802.1x accounting. Moreover, you need to inform the accounting server of the system reload event when the system is reloaded to ensure that the accounting server is aware that all outstanding IEEE 802.1x sessions on this system are closed.

Note To enable IEEE 802.1x accounting, you must first configure IEEE 802.1x authentication and switch-to-RADIUS server communication.

IEEE 802.1x RADIUS accounting relays important events to the RADIUS server (such as the supplicant's connection session). This session is defined as the interval beginning when the supplicant is authorized to use the port and ending when the supplicant stops using the port.

Note You must configure the IEEE 802.1x supplicant to send an EAP-logoff (Stop) message to the switch when the user logs off. If you do not configure the IEEE 802.1x supplicant, an EAP-logoff message is not sent to the switch and the accompanying accounting Stop message is not sent to the authentication server. See the Microsoft Knowledge Base article at the location: http://support.microsoft.com.

After the supplicant is authenticated, the switch sends accounting-request packets to the RADIUS server, which responds with accounting-response packets to acknowledge the receipt of the request.

A RADIUS accounting-request packet contains one or more Attribute-Value (AV) pairs to report various events and related information to the RADIUS server. The following events are tracked:

- User successfully authenticates.
- User logs off.
- Link-down occurs on an IEEE 802.1x port.
- Reauthentication succeeds.
- Reauthentication fails.

When the port state transitions between authorized and unauthorized, the RADIUS messages are transmitted to the RADIUS server.

The switch does not log any accounting information. Instead, it sends such information to the RADIUS server, which must be configured to log accounting messages.

This is the IEEE 802.1x RADIUS accounting process

1. A user connects to a port on the router.
2. Authentication is performed.
3. VLAN assignment is enabled, as appropriate, based on the RADIUS server configuration.
4. The router sends a start message to an accounting server.
5. Reauthentication is performed, as necessary.
6. The port sends an interim accounting update to the accounting server that is based on the result of reauthentication.
7. The user disconnects from the port.
8. The router sends a stop message to the accounting server.

The switch port does not log IEEE 802.1x accounting information. Instead, it sends this information to the RADIUS server, which must be configured to log accounting messages.

To configure IEEE 802.1x accounting, you need to do the following tasks:

- Enable accounting in your RADIUS server.
- Enable IEEE 802.1x accounting on your switch.
- Enable AAA accounting by using the **aaa system accounting** command.

Enabling AAA system accounting along with IEEE 802.1x accounting allows system reload events to be sent to the accounting RADIUS server for logging. When the accounting RADIUS server receives notice of a system reload event, the server can infer that all active IEEE 802.1x sessions are appropriately closed.

Because RADIUS uses the unreliable transport protocol User Datagram Protocol (UDP), accounting messages may be lost due to poor network conditions. If the switch does not receive the accounting response message from the RADIUS server after a configurable number of retransmissions of an accounting request, the following system message appears:

```
Accounting message %s for session %s failed to receive Accounting Response.
```

When the stop message is not transmitted successfully, a message like the following appears:

```
00:09:55: %RADIUS-3-NOACCOUNTINGRESPONSE: Accounting message Start for session
172.20.50.145 sam 11/06/03 07:01:16 11000002 failed to receive Accounting Response.
```

Use the **show radius statistics** command to display the number of RADIUS messages that do not receive the accounting response message.

For information about configuring IEEE 802.1x RADIUS accounting, see the "Enabling 802.1X Accounting" section of the "Configuring 802.1X Port-Based Authentication" chapter in the *Catalyst 4500 Series Switch Cisco IOS Software Configuration Guide,* 12.2(31)SGA.

IEEE 802.1x Accounting Attribute-Value Pairs

The information sent to the RADIUS server is represented in the form of AV pairs. These AV pairs provide data for different applications. (For example, a billing application might require information that is in the Acct-Input-Octets or the Acct-Output-Octets attributes of a RADIUS packet.)

AV pairs are automatically sent by a router that is configured for IEEE 802.1x accounting. Three types of RADIUS accounting packets are sent by a router:

- START–sent when a new user session starts
- INTERIM–sent during an existing session for updates
- STOP–sent when a session terminates

Table 1 lists the AV pairs and when they are sent by the router:

Table 1 Accounting AV Pairs

Attribute Number	AV Pair Name	START	INTERIM	STOP
Attribute[1]	User-Name	Always	Always	Always
Attribute[4]	NAS-IP-Address	Always	Always	Always
Attribute[5]	NAS-Port	Always	Always	Always
Attribute[6]	Service-Type	Always	Always	Always
Attribute[8]	Framed-IP-Address	Never	Sometimes[1]	Sometimes[1]
Attribute[25]	Class	Always	Always	Always
Attribute[30]	Called-Station-ID	Always	Always	Always
Attribute[31]	Calling-Station-ID	Always	Always	Always
Attribute[40]	Acct-Status-Type	Always	Always	Always
Attribute[41]	Acct-Delay-Time	Always	Always	Always
Attribute[42]	Acct-Input-Octets	Never	Always	Always
Attribute[43]	Acct-Output-Octets	Never	Always	Always
Attribute[44]	Acct-Session-ID	Always	Always	Always
Attribute[45]	Acct-Authentic	Always	Always	Always

Table 1 Accounting AV Pairs (continued)

Attribute Number	AV Pair Name	START	INTERIM	STOP
Attribute[46]	Acct-Session-Time	Never	Never	Always
Attribute[47]	Acct-Input-Packets	Never	Always	Always
Attribute[48]	Acct-Output-Packets	Never	Always	Always
Attribute[49]	Acct-Terminate-Cause	Never	Never	Always
Attribute[61]	NAS-Port-Type	Always	Always	Always

1. The Framed-IP-Address AV pair is sent only if a valid Dynamic Host Control Protocol (DHCP) binding exists for the host in the DHCP snooping bindings table.

You can configure the ISR to send Cisco vendor-specific attributes (VSAs) to the RADIUS server. Table 2 lists the available Cisco AV pairs.

Note To enable VSAs to be sent in the accounting records you must configure the **radius-server vsa send accounting** command.

Table 2 Cisco Vendor-Specific Attributes

Attribute Number	AV Pair Name	START	INTERIM	STOP
Attribute[26,9,1]	Cisco-Avpair: connect-progress	Always	Always	Always
Attribute[26,9,2]	cisco-nas-port	Always	Always	Always
Attribute[26,9,1]	Cisco-Avpair: disc-cause	Never	Never	Always

You can view the AV pairs that are being sent by the router by entering the **debug radius accounting** privileged EXEC command. For more information about this command, see the *Cisco IOS Debug Command Reference,* Release 12.4T, at this URL:

http://www.cisco.com/en/US/docs/ios/12_4t/debug/command/reference/tdb_r.html

For more information about AV pairs, see RFC 3580, *IEEE 802.1x Remote Authentication Dial In User Service (RADIUS) Usage Guidelines*.

How to Use IEEE 802.1x Authentication With Other Features

The following sections describe how to use IEEE 802.1x Authentication in combination with other features on the switch ports on an ISR router.

IEEE 802.1x Authentication with VLAN Assignment

Note This section describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

In Cisco IOS Release 12.4(11)T and later releases, the switch ports support IEEE 802.1x authentication with VLAN assignment. After successful IEEE 802.1x authentication of a port, the RADIUS server sends the VLAN assignment to configure the switch port. You can use the VLAN Assignment feature to limit network access for certain users.

The RADIUS server database maintains the username-to-VLAN mappings, assigning the VLAN based on the username of the supplicant connected to the switch port.

This section contains the following information about IEEE 802.1x VLAN assignment:

- Prerequisites for IEEE 802.1x VLAN Assignment, page 13
- Restrictions for IEEE 802.1x VLAN Assignment, page 13
- Configuring VLAN Assignment, page 14

Prerequisites for IEEE 802.1x VLAN Assignment

Before the VLAN Assignment feature is implemented, the following conditions must be met:

- IEEE 802.1x must be enabled on the switch port.
- EAP support must be enabled on the RADIUS server.
- AAA authorization must be configured on the port for all network-related service requests.
- The port must be successfully authenticated.

Restrictions for IEEE 802.1x VLAN Assignment

These are the restrictions that apply to the VLAN Assignment feature:

- The switch port is always assigned to the configured access VLAN when any of the following conditions occurs:
  - No VLAN is supplied by the RADIUS server.
  - The VLAN information from the RADIUS server is not valid.
  - IEEE 802.1x authentication is disabled on the port.
  - The port is in the force authorized, force unauthorized, unauthorized, or shutdown state.

Note An access VLAN is a VLAN assigned to an access port. All packets sent from or received on this port belong to this VLAN.

- Assignment to the configured access VLAN prevents ports from appearing unexpectedly in an inappropriate VLAN because of a configuration error. Examples of configuration errors include the following:
  - A nonexistent or malformed VLAN ID
  - Attempted assignment to a voice VLAN ID

- The IEEE 802.1x authentication with VLAN assignment feature is not supported on trunk ports, dynamic ports, or with dynamic-access port assignment through a VLAN Membership Policy Server (VMPS).
- If the multi-host mode is enabled on an IEEE 802.1x port, all hosts are placed in the same VLAN (specified by the RADIUS server) as the first authenticated host.
- If an IEEE 802.1x port is authenticated and put in the RADIUS server-assigned VLAN, any change to the port access VLAN configuration does not take effect.

Configuring VLAN Assignment

Note This section describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

To configure VLAN assignment on a switch port, you need to perform these tasks:

- Enable AAA authorization by using the **network** keyword to allow interface configuration from the RADIUS server. For detailed instructions, see the "Configuring RADIUS Authorization for User Privileged Access and Network Services" section of the "Configuring Switch-Based Authentication" chapter in the *Catalyst 3750 Switch Software Configuration Guide, 12.2(25)SEE*.
- Enable IEEE 802.1x authentication. For detailed instructions, see the "Configuring RADIUS Login Authentication" section of the "Configuring Switch-Based Authentication' chapter in the *Catalyst 3750 Switch Software Configuration Guide, 12.2(25)SEE*.

Note The VLAN assignment feature is automatically enabled when you configure IEEE 802.1x authentication on an access port.

- Assign vendor-specific tunnel attributes in the RADIUS server. The RADIUS server must return these attributes to the router:
  - [64] Tunnel-Type = VLAN
  - [65] Tunnel-Medium-Type = 802
  - [81] Tunnel-Private-Group-ID = VLAN name or VLAN ID

  Attribute [64] must contain the value "VLAN" (type 13). Attribute [65] must contain the value "802" (type 6). Attribute [81] specifies the VLAN name or VLAN ID assigned to the IEEE 802.1x-authenticated user.

For examples of tunnel attributes, see the "Configuring the Switch to Use Vendor-Specific RADIUS Attributes" section of the "Configuring Switch-Based Authentication" chapter in the *Catalyst 3750 Switch Software Configuration Guide, 12.2(25)SEE*.

IEEE 802.1x Authentication with Guest VLAN

Note This section describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

You can configure a guest VLAN for each IEEE 802.1x-capable switch port on the router to provide limited services to clients, such as downloading the IEEE 802.1x client. These clients might be upgrading their system for IEEE 802.1x authentication, and some hosts, such as Windows 98 systems, might not be IEEE 802.1x-capable.

When you enable a guest VLAN on an IEEE 802.1x port, the router assigns clients to a guest VLAN when the router does not receive a response to its EAP request/identity frame or when EAPOL packets are not sent by the client.

The router maintains the EAPOL packet history. If an EAPOL packet is detected on the interface during the lifetime of the link, the router determines that the device connected to that interface is an IEEE 802.1x-capable client, and the interface does not change to the guest VLAN state. EAPOL history is cleared if the interface link status goes down. If no EAPOL packet is detected on the interface, the interface changes to the guest VLAN state.

In Cisco IOS Release 12.4(11)T and later releases, if devices send EAPOL packets to the router during the lifetime of the link, the router does not allow clients that fail authentication access to the guest VLAN.

Note If an EAPOL packet is detected after the interface has changed to the guest VLAN, the interface reverts to an unauthorized state, and IEEE 802.1x authentication restarts.

Any number of IEEE 802.1x-incapable clients are allowed access when the router port is moved to the guest VLAN. If an IEEE 802.1x-capable client joins the same port on which the guest VLAN is configured, the port is put into the unauthorized state in the user-configured access VLAN, and authentication is restarted.

Guest VLANs are supported on IEEE 802.1x ports in single-host or multi-host mode.

You can configure any active VLAN except a remote switch port analyzer (RSPAN) VLAN or a voice VLAN as an IEEE 802.1x guest VLAN. The guest VLAN feature is not supported on internal VLANs (routed ports) or trunk ports; it is supported only on access ports.

For information about configuring a guest VLAN, see the "Configuring a Guest VLAN" section of the "Configuring IEEE 802.1x Port-Based Authentication" chapter in the *Catalyst 3750 Switch Software Configuration Guide, 12.2(25)SEE*.

IEEE 802.1x with RADIUS-Supplied Session Timeout

Note This section describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

You can specify whether a switch port uses a locally configured or a RADIUS-provided reauthentication timeout. If the switch port is configured to use the local timeout, it reauthenticates the host when the timer expires.

If the switch port is configured to use the RADIUS-provided timeout, it looks in the RADIUS Access-Accept message for the Session-Timeout and optional Termination-Action attributes. The switch port uses the value of the Session-Timeout attribute to determine the duration of the session, and it uses the value of the Termination-Action attribute to determine the switch action when the session's timer expires.

If the Termination-Action attribute is present and its value is RADIUS-Request, the switch port reauthenticates the host. If the Termination-Action attribute is not present, or its value is Default, the switch port terminates the session.

Note The supplicant on the port detects that its session has been terminated and attempts to initiate a new session. Unless the authentication server treats this new session differently, the supplicant may see only a brief interruption in network connectivity as the switch sets up a new session.

If the switch port is configured to use the RADIUS-supplied timeout, but the Access-Accept message does not include a Session-Timeout attribute, the switch port never reauthenticates the supplicant. This behavior is consistent with Cisco's wireless access points.

For details on how to configure RADIUS-provided session timeout, see the "Configuring RADIUS-Provided Session Timeouts" section in the "Configuring 802.1X Port-Based Authentication" chapter of the *Catalyst 4500 Series Switch Cisco IOS Software Configuration Guide, 12.2(31)SG*.

IEEE 802.1x Authentication with Voice VLAN Ports

Note This section describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

A voice VLAN port is a special access port associated with two VLAN identifiers:

- Voice VLAN identifier (VVID) to carry voice traffic to and from the IP phone. The VVID is used to configure the IP phone connected to the port.
- Port VLAN identifier (PVID) to carry the data traffic to and from the workstation connected to the router through the IP phone. The PVID is the native VLAN of the port.

The IP phone uses the VVID for its voice traffic, regardless of the authorization state of the port. This allows the phone to work independently of IEEE 802.1x authentication.

In single-host mode, only the IP phone is allowed on the voice VLAN. In multi-host mode, additional supplicants can send traffic on the voice VLAN after a supplicant is authenticated on the PVID. When multi-host mode is enabled, the supplicant authentication affects both the PVID and the VVID.

A voice VLAN port becomes active when there is a link, and the device MAC address appears after the first CDP message from the IP phone. Cisco IP phones do not relay CDP messages from other devices. As a result, if several IP phones are connected in series, the router recognizes only the one directly connected to it. When IEEE 802.1x authentication is enabled on a voice VLAN port, the router drops packets from unrecognized IP phones more than one hop away.

When IEEE 802.1x authentication is enabled on a port, you cannot configure a port VLAN that is equal to a voice VLAN.

Note If you enable IEEE 802.1x authentication on an access port on which a voice VLAN is configured and to which a Cisco IP Phone is connected, the Cisco IP phone loses connectivity to the router for up to 30 seconds.

For information about configuring IEEE 802.1x with voice VLANs, see the "Configuring IEEE 802.1X with Voice VLAN" section in the "Configuring 802.1X Port-Based Authentication" chapter of the *Catalyst 4500 Series Switch Cisco IOS Software Configuration Guide, 12.2(31)SG*.

Enabling IEEE 802.1x SNMP Notifications

Note This section describes IEEE 802.1x security features available only on the switch ports in a Cisco ISR.

Follow the steps below to enable Simple Network Management Protocol (SNMP) notifications for IEEE 802.1x features on the switch ports.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server enable traps dot1x**

DETAILED STEPS

	Command	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables higher privilege levels, such as privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**snmp-server enable traps dot1x** *notification type* **Example:** `Router (config)# snmp-server enable traps dot1x no-guest-vlan`	Enables SNMP logging and reporting when no Guest VLAN is configured or available.

IEEE 802.1x MIB Support

Cisco IOS Release 12.4(11)T provides support for the following MIBs that provide SNMP access to IEEE 802.1x feature components:

- IEEE8021-PAE-MIB
- Cisco-PAE-MIB

The IEEE8021-PAE-MIB supports reporting of the following information:

- The state of the IEEE 802.1x state machine on a particular port
- Statistics associated with the state of the IEEE 802.1x state machine

The Cisco-PAE-MIB provides SNMP support for the logging and reporting of events, including:

- Port mode
- Guest VLAN number (Details the Guest VLAN number configured on a port.)

- InGuestVLAN (Indicates whether a port is in the Guest VLAN.)

Configuration Examples for IEEE 802.1x Features

This section provides the following comprehensive configuration examples:

Enabling IEEE 802.1x and AAA on a Port: Example

This example shows how to enable IEEE 802.1x and AAA on Fast Ethernet port 2/1, and how to verify the configuration:

Note Whenever you configure any IEEE 802.1x parameter on a port, a dot1x authenticator is automatically created on the port. As a result **dot1x pae authenticator** appears in the configuration to ensure that IEEE 802.1x authentication still works without manual intervention on legacy configurations. The appearance of the IEEE 802.1x information in the configuration is likely to change in future releases.

This example shows how to enable IEEE 802.1x and AAA on Fast Ethernet port 2/1, and how to verify the configuration:

```
Router# configure terminal
Router(config)# dot1x system-auth-control
Router(config)# aaa new-model
Router(config)# aaa authentication dot1x default group radius
Router(config)# interface fastethernet2/1
Router(config-if)# switchport mode access
Router(config-if)# dot1x pae authenticator
Router(config-if)# dot1x port-control auto
Router(config-if)# end
Router# show dot1x interface fastethernet7/1 details
```

```
Dot1x Info for FastEthernet7/1
-----------------------------------
PAE                       = AUTHENTICATOR
PortControl               = AUTO
ControlDirection          = Both
HostMode                  = SINGLE_HOST
ReAuthentication          = Disabled
QuietPeriod               = 60
ServerTimeout             = 30
SuppTimeout               = 30
ReAuthPeriod              = 3600 (Locally configured)
ReAuthMax                 = 2
MaxReq                    = 2
TxPeriod                  = 30
RateLimitPeriod           = 0

Dot1x Authenticator Client List
-------------------------------
Supplicant                = 1000.0000.2e00
        Auth SM State     = AUTHENTICATED
        Auth BEND SM Stat = IDLE
Port Status               = AUTHORIZED

Authentication Method     = Dot1x
Authorized By             = Authentication Server
Vlan Policy               = N/A
```

Enabling IEEE 802.1x RADIUS Accounting: Example

This example shows how to specify the server with IP address 172.20.39.46 as the RADIUS server. The first command configures the RADIUS server, specifying port 1612 as the authorization port, 1813 as the UDP port for accounting, and rad123 as the encryption key:

```
Router# configure terminal
Router(config)# radius-server host 172.20.39.46 auth-port 1812 acct-port 1813 key rad123
Router(config)# aaa accounting dot1x default start-stop group radius
Router(config)# aaa accounting system default start-stop group radius
Router(config)# end
Router#
```

Note You must configure the RADIUS server to perform accounting tasks.

Configuring IEEE 802.1x with Guest VLAN: Example

This example shows how to enable the guest VLAN feature and to specify VLAN 5 as a guest VLAN:

```
Router# configure terminal
Router(config)# interface gigabitethernet0/1
Router(config-if)# switchport mode access
Router(config-if)# dot1x pae authenticator
Router(config-if)# dot1x guest-vlan 5
Router(config-if)# dot1x port-control auto
Router(config-if)# end
Router#
```

Configuring RADIUS-Provided Session Timeout: Example

This example assumes you have enabled IEEE 802.1x reauthentication and shows how to configure the switch port to derive the reauthentication period from the server and to verify the configuration:

```
Router# configure terminal
Router(config)# interface fastethernet7/1
Router(config-if)# switchport mode access
Router(config-if)# dot1x pae authenticator
Router(config-if)# dot1x timeout reauth-period server
Router(config-if)# end
Router#
```

Configuring IEEE 802.1x with Voice VLAN: Example

This example shows how to enable IEEE 802.1x with voice VLAN feature on Fast Ethernet interface 5/9:

```
Router# configure terminal
Router(config)# interface fastethernet5/9
Router(config-if)# switchport access vlan 2
Router(config-if)# switchport mode access
Router(config-if)# switchport voice vlan 10
Router(config-if)# dot1x pae authenticator
Router(config-if)# dot1x port-control auto
Router(config-if)# end
Router(config# end
Router#
```

Displaying IEEE 802.1x Statistics and Status: Example

To display IEEE 802.1x statistics for all ports, use the **show dot1x all statistics** privileged EXEC command. To display IEEE 802.1x statistics for a specific port, use the **show dot1x statistics interface** *interface-id* privileged EXEC command.

To display the IEEE 802.1x administrative and operational status for the switch, use the **show dot1x all** [**details | statistics | summary**] privileged EXEC command. To display the IEEE 802.1x administrative and operational status for a specific port, use the **show dot1x interface** *interface-id* privileged EXEC command. For detailed information about the fields in these displays, see the command reference for this release.

This example shows the output of the **show dot1x all** command:

```
Router-871# show dot1x all

Sysauthcontrol                  Enabled
Dot1x Protocol Version     2

Dot1x Info for FastEthernet1
-----------------------------------
PAE                       = AUTHENTICATOR
PortControl               = AUTO
ControlDirection          = Both
HostMode                  = MULTI_HOST
ReAuthentication          = Disabled
QuietPeriod               = 60
ServerTimeout             = 30
SuppTimeout               = 30
ReAuthPeriod              = 3600 (Locally configured)
```

```
ReAuthMax                = 2
MaxReq                   = 2
TxPeriod                 = 30
RateLimitPeriod          = 0
Router-871#
```

This example shows the output of the **show dot1x summary** command:

```
Router-871# show dot1x all summary

Interface             PAE             Client                          Status
-----------------------------------------------------------------------------------------
Fa1                   AUTH             000d.bcef.bfdc           AUTHORIZED
```

Additional References

The following sections provide references related to the IEEE 802.1x Port-Based Authentication feature.

Related Documents

Related Topic	Document Title
Configuring IEEE 802.1x Port-Based Authentication	The chapter "Configuring 802.1X Port-Based Authentication" in the *Catalyst 4500 Series Switch Cisco IOS Software Configuration Guide*, 12.2(31)SGA
IEEE 802.1x Commands	*Catalyst 4500 Series Switch Cisco IOS Command Reference*, Release 12.2(31)SGA
IEEE 802.1x Commands	*Catalyst 3750 Switch Command Reference*, Cisco IOS Release 12.2(25)SEE
VPN Access Control Using IEEE 802.1x Authentication	The "VPN Access Control Using 802.1X Authentication" section in the "Configuring 802.1X Authentication Services" chapter in Part 6: "Other Security Features" of the *Cisco IOS Security Configuration Guide*, Release 12.4

Standards

Standard	Title
IEEE 802.1x	*Port Based Network Access Control*

MIBs

MIB	MIBs Link
• IEEE8021-PAE-MIB • Cisco-PAE-MIB	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
RFC 3580	*IEEE 802.1x Remote Authentication Dial In User Service (RADIUS) Usage Guidelines*

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. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register on Cisco.com.	http://www.cisco.com/techsupport

Command Reference

This section documents modified commands only.

Modified Commands

- **aaa accounting**
- **dot1x guest-vlan**
- **snmp-server enable traps**

aaa accounting

To enable authentication, authorization, and accounting (AAA) accounting of requested services for billing or security purposes when you use RADIUS or TACACS+, use the **aaa accounting** command in global configuration mode. To disable AAA accounting, use the **no** form of this command.

aaa accounting {**auth-proxy** | **system** | **network** | **exec** | **connection** | **commands** *level* | **dot1x**} {**default** | *list-name*} [**vrf** *vrf-name*] {**start-stop** | **stop-only** | **none**} [**broadcast**] **group** *group-name*

no aaa accounting {**auth-proxy** | **system** | **network** | **exec** | **connection** | **commands** *level* | **dot1x**} {**default** | *list-name*} [**vrf** *vrf-name*] {**start-stop** | **stop-only** | **none**} [**broadcast**] **group** *group-name*

Syntax Description

auth-proxy	Provides information about all authenticated-proxy user events.
system	Performs accounting for all system-level events not associated with users, such as reloads. **Note** When system accounting is used and the accounting server is unreachable at system startup time, the system will not be accessible for approximately two minutes.
network	Runs accounting for all network-related service requests, including Serial Line Internet Protocol (SLIP), PPP, PPP Network Control Protocols (NCPs), and AppleTalk Remote Access Protocol (ARAP).
exec	Runs accounting for EXEC shell session. This keyword might return user profile information such as what is generated by the **autocommand** command.
connection	Provides information about all outbound connections made from the network access server, such as Telnet, local-area transport (LAT), TN3270, packet assembler and disassembler (PAD), and rlogin.
commands *level*	Runs accounting for all commands at the specified privilege level. Valid privilege level entries are integers from 0 through 15.
dot1x	Provides information about all IEEE 802.1x-related user events.
default	Uses the listed accounting methods that follow this argument as the default list of methods for accounting services.
list-name	Character string used to name the list of at least one of the following accounting methods: • **group radius**—Uses the list of all RADIUS servers for authentication as defined by the **aaa group server radius** command. • **group tacas+**—Uses the list of all TACACS+ servers for authentication as defined by the **aaa group server tacacs+** command. • **group** *group-name*—Uses a subset of RADIUS or TACACS+ servers for accounting as defined by the server group *group-name*.
vrf *vrf-name*	(Optional) Specifies a virtual route forwarding (VRF) configuration. VRF is used *only* with system accounting.

start-stop	Sends a "start" accounting notice at the beginning of a process and a "stop" accounting notice at the end of a process. The "start" accounting record is sent in the background. The requested user process begins regardless of whether the "start" accounting notice was received by the accounting server.
stop-only	Sends a "stop" accounting notice at the end of the requested user process.
none	Disables accounting services on this line or interface.
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.
group *group-name*	Specifies the accounting method list. Enter at least one of the following keywords: • **auth-proxy**—Uses the list of all RADIUS servers for authentication as defined by the **aaa group server radius** command. • **commands**—Creates a method list to provide accounting information about specific, individual EXEC commands associated with a specific privilege level. • **connection**—Creates a method list to provide accounting information about all outbound connections made from the network access server. • **exec**—Creates a method list to provide accounting records about user EXEC terminal sessions on the network access server, including username, date, and start and stop times. • **network**—Creates a method list to provide accounting information for SLIP, PPP, NCPs, and ARAP sessions. • **resource**—Creates a method list to provide accounting records for calls that have passed user authentication or calls that failed to be authenticated. • **tunnel**—Creates a method list to provide accounting records (Tunnel-Start, Tunnel-Stop, and Tunnel-Reject) for virtual private dialup network (VPDN) tunnel status changes. • **tunnel-link**—Creates a method list to provide accounting records (Tunnel-Link-Start, Tunnel-Link-Stop, and Tunnel-Link-Reject) for VPDN tunnel-link status changes.

Defaults

AAA accounting is disabled.

Command Modes

Global configuration

Command History

Release	Modification
10.3	This command was introduced.
12.0(5)T	Group server support was added.
12.1(1)T	The **broadcast** keyword was introduced on the Cisco AS5300 and Cisco AS5800 universal access servers.

Release	Modification
12.1(5)T	The **auth-proxy** keyword was added.
12.2(1)DX	The **vrf** keyword and *vrf-name* argument were introduced on the Cisco 7200 series and Cisco 7401ASR.
12.2(2)DD	This command was integrated into Cisco IOS Release 12.2(2)DD.
12.2(4)B	This command was integrated into Cisco IOS Release 12.2(4)B.
12.2(13)T	The **vrf** keyword and *vrf-name* argument were integrated into Cisco IOS Release 12.2(13)T.
12.2(15)B	The tunnel and tunnel-link accounting methods were introduced.
12.3(4)T	The tunnel and tunnel-link accounting methods were integrated into Cisco IOS Release 12.3(4)T.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.4(11)T	The **dot1x** keyword was integrated into Cisco IOS Release 12.4(11)T.

Usage Guidelines

Use the **aaa accounting** command to enable accounting and to create named method lists that define specific accounting methods on a per-line or per-interface basis.

Table 3 contains descriptions of keywords for aaa accounting methods.

Table 3 aaa accounting Methods

Keyword	Description
group radius	Uses the list of all RADIUS servers for authentication as defined by the **aaa group server radius** command.
group tacacs+	Uses the list of all TACACS+ servers for authentication as defined by the **aaa group server tacacs+** command.
group *group-name*	Uses a subset of RADIUS or TACACS+ servers for accounting as defined by the server group *group-name*.

In Table 3, the **group radius** and **group tacacs+** methods refer to a set of previously defined RADIUS or TACACS+ servers. Use the **radius-server host** and **tacacs-server host** commands to configure the host servers. Use the **aaa group server radius** and **aaa group server tacacs+** commands to create a named group of servers.

Cisco IOS software supports the following two methods of accounting:

- 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.
- TACACS+—The network access server reports user activity to the TACACS+ security server in the form of accounting records. Each accounting record contains accounting AV pairs and is stored on the security server.

Method lists for accounting define the way accounting will be performed. Named accounting method lists enable you to designate a particular security protocol to be used on specific lines or interfaces for particular types of accounting services. Create a list by entering the *list-name* and the *method*, where *list-name* is any character string used to name this list (excluding the names of methods, such as RADIUS or TACACS+) and *method* identifies the methods to be tried in sequence as given.

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 (where this accounting type applies) 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.

Named accounting method lists are specific to the indicated type of accounting. Method list keywords are described in Table 4.

Table 4 aaa accounting Method List Keywords

Keyword	Description
auth-proxy	Creates a method list to provide accounting information about all authenticated hosts that use the authentication proxy service.
commands	Creates a method list to provide accounting information about specific, individual EXEC commands associated with a specific privilege level.
connection	Creates a method list to provide accounting information about all outbound connections made from the network access server.
exec	Creates a method list to provide accounting records about user EXEC terminal sessions on the network access server, including username; date; start and stop times.
network	Creates a method list to provide accounting information for SLIP, PPP, NCPs, and ARAP sessions.
resource	Creates a method list to provide accounting records for calls that have passed user authentication or calls that failed to be authenticated.
tunnel	Creates a method list to provide accounting records (Tunnel-Start, Tunnel-Stop, and Tunnel-Reject) for virtual private dialup network (VPDN) tunnel status changes.
tunnel-link	Creates a method list to provide accounting records (Tunnel-Link-Start, Tunnel-Link-Stop, and Tunnel-Link-Reject) for VPDN tunnel-link status changes.

Note System accounting does not use named accounting lists; you can define the default list only for system accounting.

For minimal accounting, include the **stop-only** keyword to send a "stop" record accounting notice at the end of the requested user process. For more accounting, you can include the **start-stop** keyword, so that RADIUS or TACACS+ sends a "start" accounting notice at the beginning of the requested process and a "stop" accounting notice at the end of the process. Accounting is stored only on the RADIUS or TACACS+ server. The **none** keyword disables accounting services for the specified line or interface.

To specify an accounting configuration for a particular VRF, specify a default system accounting method list, and use the **vrf** keyword and *vrf-name* argument. System accounting does not have knowledge of VRF unless specified.

When AAA accounting is activated, the network access server monitors either RADIUS accounting attributes or TACACS+ AV pairs pertinent to the connection, depending on the security method you have implemented. The network access server reports these attributes as accounting records, which are then stored in an accounting log on the security server. For a list of supported RADIUS accounting attributes, see "RADIUS Attributes" in the "*Cisco IOS Security Configuration Guide*. For a list of supported TACACS+ accounting AV pairs, see "TACACS+ Attributes" in the *Cisco IOS Security Configuration Guide*.

Note This command cannot be used with TACACS or extended TACACS.

Cisco Service Selection Gateway Broadcast Accounting

To configure Cisco Service Selection Gateway (SSG) broadcast accounting, the *list-name* argument must be ssg_broadcast_accounting. For more information about configuring SSG, see the chapter "Configuring Accounting for SSG" in the *Cisco IOS Service Selection Gateway Configuration Guide*, Release 12.4T.

Examples

The following example defines a default commands accounting method list, where accounting services are provided by a TACACS+ security server, set for privilege level 15 commands with a stop-only restriction.

```
aaa accounting commands 15 default stop-only group tacacs+
```

The following example defines a default auth-proxy accounting method list, where accounting services are provided by a TACACS+ security server with a start-stop restriction. The **aaa accounting** command activates authentication proxy accounting.

```
aaa new-model
aaa authentication login default group tacacs+
aaa authorization auth-proxy default group tacacs+
aaa accounting auth-proxy default start-stop group tacacs+
```

The following example defines a default system accounting method list, where accounting services are provided by RADIUS security server "sg_water" with a start-stop restriction. The **aaa accounting** command specifies accounting for vrf "water."

```
aaa accounting system default vrf water start-stop group sg_water
```

The following example defines a default IEEE 802.1x accounting method list, where accounting services are provided by a RADIUS server. The **aaa accounting** command activates IEEE 802.1x accounting.

```
aaa new model
aaa authentication dot1x default group radius
aaa authorization dot1x default group radius
aaa accounting dot1x default start-stop group radius
```

The following example shows how to enable network accounting and send tunnel and tunnel-link accounting records to the RADIUS server. (Tunnel-Reject and Tunnel-Link-Reject accounting records are automatically sent if either start or stop records are configured.)

```
aaa accounting network tunnel start-stop group radius
aaa accounting network session start-stop group radius
```

Related Commands

Command	Description
aaa authentication ppp	Specifies one or more AAA authentication methods for use on serial interfaces running PPP.
aaa authorization	Sets parameters that restrict user access to a network.
aaa group server radius	Groups different RADIUS server hosts into distinct lists and distinct methods.
aaa group server tacacs	Groups different server hosts into distinct lists and distinct methods.
aaa new-model	Enables the AAA access control model.
radius-server host	Specifies a RADIUS server host.
tacacs-server host	Specifies a TACACS+ server host.

dot1x guest-vlan

To specify an active VLAN as an IEEE 802.1x guest VLAN, use the **dot1x guest-vlan** command in interface configuration mode. To return to the default setting, use the **no** form of this command.

dot1x guest-vlan *vlan-id*

no dot1x guest-vlan

Syntax Description

vlan-id	Specify an active VLAN as an IEEE 802.1x guest VLAN. The range is 1 to 4094.

Command Default

No guest VLAN is configured.

Command Modes

Interface configuration

Command History

Release	Modification
12.1(14)EA1	This command was introduced.
12.2(25)SE	This command was modified to change the default guest VLAN behavior.
12.4(11)T	This command was integrated into Cisco IOS Release 12.4(11)T.

Usage Guidelines

You can configure a guest VLAN on a static-access port.

For each IEEE 802.1x port, you can configure a guest VLAN to provide limited services to clients (a device or workstation connected to the switch) not running IEEE 802.1x authentication. These users might be upgrading their systems for IEEE 802.1x authentication, and some hosts, such as Windows 98 systems, might not be IEEE 802.1x capable.

When you enable a guest VLAN on an IEEE 802.1x port, the software assigns clients to a guest VLAN when it does not receive a response to its Extensible Authentication Protocol over LAN (EAPOL) request/identity frame or when EAPOL packets are not sent by the client.

With Cisco IOS Release 12.4(11)T and later, the switch port maintains the EAPOL packet history. If another EAPOL packet is detected on the interface during the lifetime of the link, the guest VLAN feature is disabled. If the port is already in the guest VLAN state, the port returns to the unauthorized state, and authentication restarts. The EAPOL history is reset upon loss of link.

Any number of non-IEEE 802.1x-capable clients are allowed access when the switch port is moved to the guest VLAN. If an IEEE 802.1x-capable client joins the same port on which the guest VLAN is configured, the port is put into the unauthorized state in the RADIUS-configured or user-configured access VLAN, and authentication is restarted.

Guest VLANs are supported on IEEE 802.1x switch ports in single-host or multi-host mode.

You can configure any active VLAN except a Remote Switched Port Analyzer (RSPAN) VLAN or a voice VLAN as an IEEE 802.1x guest VLAN. The guest VLAN feature is not supported on internal VLANs (routed ports) or trunk ports; it is supported only on access ports.

After you configure a guest VLAN for an IEEE 802.1x port to which a DHCP client is connected, you might need to get a host IP address from a DHCP server. You can change the settings for restarting the IEEE 802.1x authentication process on the switch before the DHCP process on the client times out and tries to get a host IP address from the DHCP server. You should decrease the settings for the IEEE 802.1x authentication process using the **dot1x max-reauth-req** and **dot1x timeout tx-period** interface configuration commands. The amount of decrease depends on the connected IEEE 802.1x client type.

Examples

This example shows how to specify VLAN 5 as an IEEE 802.1x guest VLAN:

```
Switch(config-if)# dot1x guest-vlan 5
```

This example shows how to set 3 as the quiet time on the switch, to set 15 as the number of seconds that the switch waits for a response to an EAP-request/identity frame from the client before resending the request, and to enable VLAN 2 as an IEEE 802.1x guest VLAN when an IEEE 802.1x port is connected to a DHCP client:

```
Switch(config-if)# dot1x timeout max-reauth-req 3
Switch(config-if)# dot1x timeout tx-period 15
Switch(config-if)# dot1x guest-vlan 2
```

You can display the IEEE 802.1x administrative and operational status for the device or for the specified interface by entering the **show dot1x** [**interface** *interface-id*] privileged EXEC command.

Related Commands

Command	Description
dot1x max-reauth-req	Specifies the number of times that the switch retransmits an EAP-request/identity frame to the client before restarting the authentication process.
dot1x timeout	Sets authentication retry timeouts.
show dot1x	Displays details for an identity profile.

snmp-server enable traps

To enable all Simple Network Management Protocol (SNMP) notification types that are available on your system, use the **snmp-server enable traps** command in global configuration mode. To disable all available SNMP notifications, use the **no** form of this command.

snmp-server enable traps [*notification-type*] [**vrrp**]

no snmp-server enable traps [*notification-type*] [**vrrp**]

Syntax Description

notification-type (Optional) Type of notification (trap or inform) to enable or disable. If no type is specified, all notifications available on your device are enabled or disabled (if the **no** form is used). The notification type can be one of the following keywords:

alarms—Enables alarm filtering to limit the number of syslog messages generated. Alarms are generated for the severity configured as well as for the higher severity values.

- The *severity* argument is an integer or string value that identifies the severity of an alarm. Integer values are from 1 to 4. String values are critical, major, minor, and informational. The default is 4, or informational. Severity levels are defined as follows:
  - 1—Critical. The condition affects service.
  - 2—Major. Immediate action is needed.
  - 3—Minor. Minor warning conditions.
  - 4—Informational. No action is required. This is the default.
- **config**—Controls configuration notifications, as defined in the CISCO-CONFIG-MAN-MIB (enterprise 1.3.6.1.4.1.9.9.43.2). The notification type is (1) ciscoConfigManEvent.
- **dot1x**—Enables IEEE 802.1x traps. This notification type is defined in the CISCO PAE MIB.
- **ds0-busyout**—Sends notification when the busyout of a DS0 interface changes state (Cisco AS5300 platform only). This notification is defined in the CISCO-POP-MGMT-MIB (enterprise 1.3.6.1.4.1.9.10.19.2), and the notification type is (1) cpmDS0BusyoutNotification.
- **ds1-loopback**—Sends notification when the DS1 interface goes into loopback mode (Cisco AS5300 platform only). This notification type is defined in the CISCO-POP-MGMT-MIB (enterprise 1.3.6.1.4.1.9.10.19.2) as (2) cpmDS1LoopbackNotification.
- **dsp**—Enables SNMP digital signal processing (DSP) traps. This notification type is defined in the CISCO-DSP-MGMT-MIB.
- **dsp oper-state**—Sends a DSP notification made up of both a DSP ID that indicates which DSP is affected and an operational state that indicates whether the DSP has failed or recovered.
- **entity**—Controls Entity MIB modification notifications. This notification type is defined in the ENTITY-MIB (enterprise 1.3.6.1.2.1.47.2) as (1) entConfigChange.

	• **hsrp**—Controls Hot Standby Routing Protocol (HSRP) notifications, as defined in the CISCO-HSRP-MIB (enterprise 1.3.6.1.4.1.9.9.106.2). The notification type is (1) cHsrpStateChange. • **ipmulticast**—Controls IP multicast notifications. • **modem-health**—Controls modem-health notifications. • **rsvp**—Controls Resource Reservation Protocol (RSVP) flow change notifications. • **tty**—Controls TCP connection notifications. • **xgcp**—Sends External Media Gateway Control Protocol (XGCP) notifications. This notification is from the XGCP-MIB-V1SMI.my, and the notification is enterprise 1.3.6.1.3.90.2 (1) xgcpUpDownNotification. **Note** For additional notification types, see the Related Commands table.
vrrp	(Optional) Specifies the Virtual Router Redundancy Protocol (VRRP).

Command Default

No notifications controlled by this command are sent.

Command Modes

Global configuration

Command History

Release	Modification
10.3	This command was introduced.
12.0(2)T	The **rsvp** notification type was added in Cisco IOS Release 12.0(2)T.
12.0(3)T	The **hsrp** notification type was added in Cisco IOS Release 12.0(3)T.
12.0(24)S	This command was integrated into Cisco IOS Release 12.0(24)S.
12.2(14)SX	Support for this command was introduced on the Supervisor Engine 720.
12.2(18)S	This command was integrated into Cisco IOS Release 12.2(18)S.
12.2(17d)SXB	Support for this command on the Supervisor Engine 2 was extended to Release 12.2(17d)SXB.
12.3(11)T	The **vrrp** notification type was added in Cisco IOS Release 12.3(11)T.
12.4(4)T	Support for the **alarms** notification type and *severity* argument was added in Cisco IOS Release 12.4(4)T. Support for the **dsp** and **dsp oper-state** notification types was added in Cisco IOS Release 12.4(4)T.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.4(11)T	The **dot1x** notification type was added in Cisco IOS Release 12.4(11)T.

Usage Guidelines

For additional notification types, see the Related Commands table for this command.

SNMP notifications can be sent as traps or inform requests. This command enables both traps and inform requests for the specified notification types. To specify whether the notifications should be sent as traps or informs, use the **snmp-server host** [**traps** | **informs**] command.

To configure the router to send these SNMP notifications, you must enter at least one **snmp-server enable traps** command. If you enter the command with no keywords, all notification types are enabled. If you enter the command with a keyword, only the notification type related to that keyword is enabled. To enable multiple types of notifications, you must issue a separate **snmp-server enable traps** command for each notification type and notification option.

Most notification types are disabled by default but some cannot be controlled with the **snmp-server enable traps** command.

The **snmp-server enable traps** command is used in conjunction with the **snmp-server host** command. Use the **snmp-server host** command to specify which host or hosts receive SNMP notifications. To send notifications, you must configure at least one **snmp-server host** command.

Examples

The following example shows how to enable the router to send all traps to the host specified by the name myhost.cisco.com, using the community string defined as public:

```
Router(config)# snmp-server enable traps
Router(config)# snmp-server host myhost.cisco.com public
```

The following example shows how to configure an alarm severity threshold of 3:

```
Router# snmp-server enable traps alarms 3
```

The following example shows how to enable the generation of a DSP operational state notification from from the command-line interface (CLI):

```
Router(config)# snmp-server enable traps dsp oper-state
```

The following example shows how to enable the generation of a DSP operational state notification from a network management device:

```
setany -v2c 1.4.198.75 test cdspEnableOperStateNotification.0 -i 1
cdspEnableOperStateNotification.0=true(1)
```

The following example shows how to send no traps to any host. The Border Gateway Protocol (BGP) traps are enabled for all hosts, but the only traps enabled to be sent to a host are ISDN traps (which are not enabled in this example).

```
Router(config)# snmp-server enable traps bgp
Router(config)# snmp-server host user1 public isdn
```

The following example shows how to enable the router to send all inform requests to the host at the address myhost.cisco.com, using the community string defined as public:

```
Router(config)# snmp-server enable traps
Router(config)# snmp-server host myhost.cisco.com informs version 2c public
```

The following example shows how to send HSRP MIB traps to the host myhost.cisco.com using the community string public:

```
Router(config)# snmp-server enable traps hsrp
Router(config)# snmp-server host myhost.cisco.com traps version 2c public hsrp
```

The following example shows that VRRP will be used as the protocol to enable the traps:

```
Router(config)# snmp-server enable traps vrrp
Router(config)# snmp-server host myhost.cisco.com traps version 2c vrrp
```

The following example shows how to send IEEE 802.1x MIB traps to the host myhost.cisco.com using the community string defined as public:

```
Router(config)# snmp-server enable traps dot1x
Router(config)# snmp-server host myhost.cisco.com traps public
```

Related Commands

Command	Description
snmp-server enable traps atm pvc	Enables ATM PVC SNMP notifications.
snmp-server enable traps atm pvc extension	Enables extended ATM PVC SNMP notifications.
snmp-server enable traps bgp	Enables BGP server state change SNMP notifications.
snmp-server enable traps calltracker	Enables Call Tracker callSetup and callTerminate SNMP notifications.
snmp-server enable traps envmon	Enables environmental monitor SNMP notifications.
snmp-server enable traps frame-relay	Enables Frame Relay DLCI link status change SNMP notifications.
snmp-server enable traps ipsec	Enables IPsec SNMP notifications.
snmp-server enable traps isakmp	Enables IPsec ISAKMP SNMP notifications.
snmp-server enable traps isdn	Enables ISDN SNMP notifications.
snmp-server enable traps memory	Enables memory pool and buffer pool SNMP notifications.
snmp-server enable traps mpls ldp	Enables MPLS LDP SNMP notifications.
snmp-server enable traps mpls traffic-eng	Enables MPLS TE tunnel state-change SNMP notifications.
snmp-server enable traps mpls vpn	Enables MPLS VPN specific SNMP notifications.
snmp-server enable traps repeater	Enables RFC 1516 hub notifications.
snmp-server enable traps snmp	Enables RFC 1157 SNMP notifications.
snmp-server enable traps syslog	Enables the sending of system logging messages via SNMP.
snmp-server host	Specifies whether you want the SNMP notifications sent as traps or informs, the version of SNMP to use, the security level of the notifications (for SNMPv3), and the destination host (recipient) for the notifications.
snmp-server informs	Specifies inform request options.
snmp-server trap-source	Specifies the interface (and hence the corresponding IP address) from which an SNMP trap should originate.
snmp trap illegal-address	Issues an SNMP trap when a MAC address violation is detected on an Ethernet hub port of a Cisco 2505, Cisco 2507, or Cisco 2516 router.
vrrp shutdown	Disables a VRRP group.

Feature Information for Configuring IEEE 802.1x Port-Based Authentication

Table 5 lists the features in this module and provides links to specific configuration information. Only features that were introduced or modified in Cisco IOS Release 12.4(11)T or a later release appear in the table.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Note Table 5 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 5 Feature Information for Configuring IEEE 802.1x Port-Based Authentication

Feature Name	Releases	Feature Information
IEEE 802.1x Authenticator	12.3(4)T	This feature was introduced to prevent unauthorized devices (supplicants) from gaining access to the network. This feature is available on the following Cisco ISRs equipped with cards or modules that include switch ports: • Cisco 800 Series ISR • Cisco 870 Series ISR • Cisco 1800 Series ISR • Cisco 2800 Series ISR • Cisco 3800 Series ISR In Cisco IOS Release 12.4(11)T, this feature was modified to include the other features listed in Table 5. The following sections provide information about this feature: • IEEE 802.1x Authenticator, page 5 • Enabling IEEE 802.1x and AAA on a Port: Example, page 18
IEEE 802.1x RADIUS Accounting	12.4(11)T	This feature relays important events to the RADIUS server (such as the supplicant's connection session). This information is used for security and billing purposes. In Cisco IOS Release 12.4(11)T, this feature was introduced on the following Cisco ISRs equipped with cards or modules that include switch ports: • Cisco 800 Series ISR • Cisco 870 Series ISR • Cisco 1800 Series ISR • Cisco 2800 Series ISR • Cisco 3800 Series ISR The following sections provide information about this feature: • IEEE 802.1x with RADIUS Accounting, page 9 • Enabling IEEE 802.1x RADIUS Accounting: Example, page 19

Table 5 Feature Information for Configuring IEEE 802.1x Port-Based Authentication (continued)

Feature Name	Releases	Feature Information
IEEE 802.1x—VLAN Assignment	12.4(11)T	This feature allows the RADIUS server to send the VLAN assignment to configure the switch port. In Cisco IOS Release 12.4(11)T, this feature was introduced on the following Cisco ISRs equipped with cards or modules that include switch ports: • Cisco 800 Series ISR • Cisco 870 Series ISR • Cisco 1800 Series ISR • Cisco 2800 Series ISR • Cisco 3800 Series ISR The following sections provide information about this feature: • IEEE 802.1x Authentication with VLAN Assignment, page 13 • Configuring VLAN Assignment, page 14
IEEE 802.1x Guest VLAN	12.4(11)T	This feature allows you to configure a guest VLAN for each IEEE 802.1x-capable switch port on the router to provide limited services to clients, such as downloading the IEEE 802.1x client. In Cisco IOS Release 12.4(11)T, this feature was introduced on the following Cisco ISRs equipped with cards or modules that include switch ports: • Cisco 800 Series ISR • Cisco 870 Series ISR • Cisco 1800 Series ISR • Cisco 2800 Series ISR • Cisco 3800 Series ISR The following sections provide information about this feature: • IEEE 802.1x Authentication with Guest VLAN, page 14 • Configuring IEEE 802.1x with Guest VLAN: Example, page 19

Table 5 Feature Information for Configuring IEEE 802.1x Port-Based Authentication (continued)

Feature Name	Releases	Feature Information
IEEE 802.1x RADIUS-Supplied Session Timeout	12.4(11)T	This feature allows you to specify whether a switch port uses a locally configured or a RADIUS-provided reauthentication timeout. In Cisco IOS Release 12.4(11)T, this feature was introduced on the following Cisco ISRs equipped with cards or modules that include switch ports: • Cisco 800 Series ISR • Cisco 870 Series ISR • Cisco 1800 Series ISR • Cisco 2800 Series ISR • Cisco 3800 Series ISR The following sections provide information about this feature: • IEEE 802.1x with RADIUS-Supplied Session Timeout, page 15 • Configuring RADIUS-Provided Session Timeout: Example, page 20

Table 5 Feature Information for Configuring IEEE 802.1x Port-Based Authentication (continued)

Feature Name	Releases	Feature Information
IEEE 802.1x—Voice VLAN	12.4(11)T	This feature allows you to configure a special access port associated with two VLAN identifiers: • Voice VLAN identifier (VVID) to carry voice traffic to and from the IP phone. The VVID is used to configure the IP phone connected to the port. • Port VLAN identifier (PVID) to carry the data traffic to and from the workstation connected to the router through the IP phone. The PVID is the native VLAN of the port. In Cisco IOS Release 12.4(11)T, this feature was introduced on the following Cisco ISRs equipped with cards or modules that include switch ports: • Cisco 800 Series ISR • Cisco 870 Series ISR • Cisco 1800 Series ISR • Cisco 2800 Series ISR • Cisco 3800 Series ISR The following sections provide information about this feature: • IEEE 802.1x Authentication with Voice VLAN Ports, page 16 • Configuring IEEE 802.1x with Voice VLAN: Example, page 20
IEEE 802.1x MIB Support	12.4(11)T	This feature provides support for the following MIBs: • IEEE8021-PAE-MIB • Cisco-PAE-MIB In Cisco IOS Release 12.4(11)T, this feature was introduced on the following Cisco ISRs equipped with cards or modules that include switch ports: • Cisco 800 Series ISR • Cisco 870 Series ISR • Cisco 1800 Series ISR • Cisco 2800 Series ISR • Cisco 3800 Series ISR The following sections provide information about this feature: • IEEE 802.1x MIB Support, page 17 • Enabling IEEE 802.1x SNMP Notifications, page 17

Glossary

authentication server—Entity that provides an authentication service to an authenticator. Typically, a RADIUS server operates as an authentication server, with RADIUS acting as a transport for EAP from the authenticator to the authentication server.

authenticator—Facilitates the authentication and granting of service to a supplicant. Typically, an authenticator transposes an EAP conversation from supplicant to authentication server. An authenticator is usually an EAP conduit, but is aware of the conversation.

EAPOL—Extensible Authentication Protocol over LAN. Primarily, IEEE 802.1x is an encapsulation definition for EAP over IEEE 802 media.The key protocol for the transport of an end-to-end EAP conversation via IEEE 802 media between a supplicant and an authenticator.

IEEE 802.1x—Authentication standard for port-based access control over any IEEE 802 or PPP media. Used primarily to identify users before allowing their traffic onto the network. IEEE 802.1x is a framework designed to address and provide port-based access control using authentication.

supplicant—Usually a laptop or other device that requires authentication or has to access service from a network point of attachment.

Note See *Internetworking Terms and Acronyms* for terms not included in this glossary.