CHAPTER 9

Configuring IEEE 802.1x Port-Based Authentication

This chapter describes how to configure IEEE 802.1x port-based authentication on the Catalyst 3750 Metro switch. As LANs extend to hotels, airports, and corporate lobbies, creating insecure environments, IEEE 802.1x prevents unauthorized devices (clients) from gaining access to the network.

For complete syntax and usage information for the commands used in this chapter, see the command reference for this release.

Note Some IEEE 802.1x (**dot1x**) commands are visible on the switch but are not supported. For a list of unsupported commands see Appendix C, "Unsupported Commands in Cisco IOS Release12.2(50)SE."

This chapter consists of these sections:

Understanding IEEE 802.1x Port-Based Authentication

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

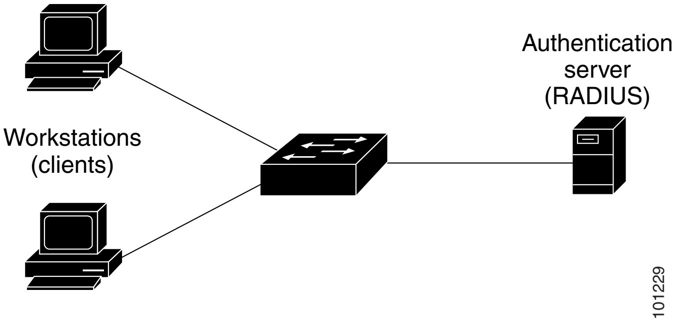
Until the client is authenticated, IEEE 802.1x access control allows only Extensible Authentication Protocol over LAN (EAPOL), Cisco Discovery Protocol (CDP), and Spanning Tree Protocol (STP) traffic through the port to which the client is connected. After authentication is successful, normal traffic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

These sections describe IEEE 802.1x port-based authentication:

Device Roles

With IEEE 802.1x port-based authentication, the devices in the network have specific roles as shown in Figure 9-1.

Figure 9-1 IEEE 802.1x Device Roles



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

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*—performs the actual authentication of the client. The authentication server validates the identity of the client and notifies the switch whether or not the client is authorized to access the LAN and switch services. Because the switch acts as the proxy, the authentication service is transparent to the client. In this release, the RADIUS security system with Extensible Authentication Protocol (EAP) extensions is the only supported authentication server. It is available in Cisco Secure Access Control Server Version 3.0 or later. RADIUS operates in a client/server model in which secure authentication information is exchanged between the RADIUS server and one or more RADIUS clients.
- *Switch* (edge switch or wireless access point)—controls the physical access to the network based on the authentication status of the client. The switch acts as an intermediary (proxy) between the client and the authentication server, requesting identity information from the client, verifying that

information with the authentication server, and relaying a response to the client. The switch includes the RADIUS client, which is responsible for encapsulating and decapsulating the EAP frames and interacting with the authentication server.

When the switch receives EAPOL frames and relays them to the authentication server, the Ethernet header is stripped and the remaining EAP frame is re-encapsulated in the RADIUS format. The EAP frames are not modified or examined during encapsulation, and the authentication server must support EAP within the native frame format. When the switch 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.

The devices that can act as intermediaries include the Catalyst 3750, Catalyst 3550, Catalyst 2970, Catalyst 2955, Catalyst 2950, Catalyst 2940 switches, or a wireless access point. These devices must be running software that supports the RADIUS client and IEEE 802.1x.

Authentication Initiation and Message Exchange

The switch or the client can initiate authentication. If you enable authentication on a port by using the **dot1x port-control auto** interface configuration command, the switch must initiate authentication when the port link state transitions from down to up. It then sends an EAP-request/identity frame to the client to request its identity (typically, the switch sends an initial identity/request frame followed by one or more requests for authentication information). Upon receipt of the frame, the client responds with an EAP-response/identity frame.

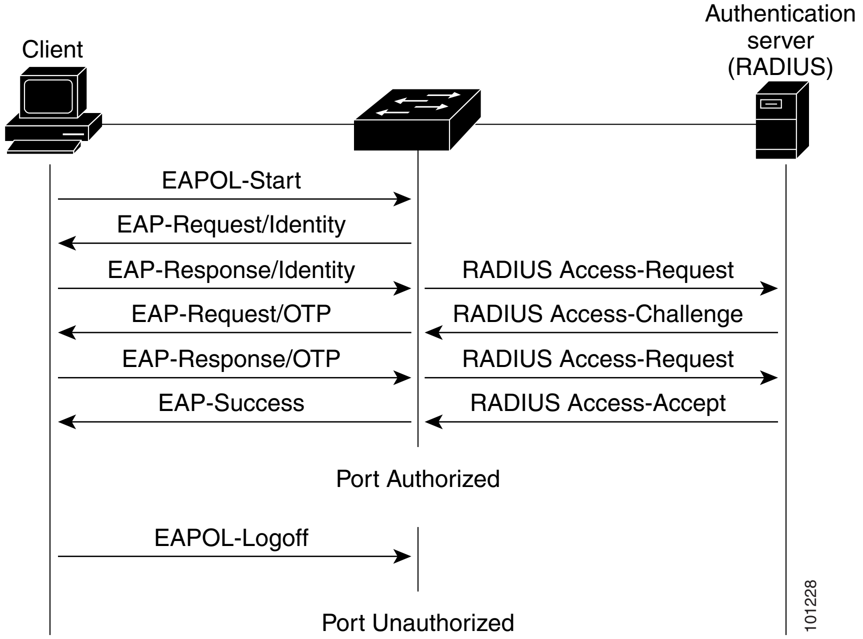
However, if during bootup, the client does not receive an EAP-request/identity frame from the switch, the client can initiate authentication by sending an EAPOL-start frame, which prompts the switch to request the client's identity.

Note If IEEE 802.1x is not enabled or supported on the network access device, any EAPOL frames from the client are dropped. If the client does not receive an EAP-request/identity frame after three attempts to start authentication, the client sends frames as if the port is in the authorized state. A port in the authorized state effectively means that the client has been successfully authenticated. For more information, see the "Ports in Authorized and Unauthorized States" section on page 9-4.

When the client supplies its identity, the switch begins its role as the intermediary, passing EAP frames between the client and the authentication server until authentication succeeds or fails. If the authentication succeeds, the switch port becomes authorized. For more information, see the "Ports in Authorized and Unauthorized States" section on page 9-4.

The specific exchange of EAP frames depends on the authentication method being used. Figure 9-2 shows a message exchange initiated by the client when the client uses the One-Time-Password (OTP) authentication method with a RADIUS server.

Figure 9-2 Message Exchange



Ports in Authorized and Unauthorized States

Depending on the switch port state, the switch can grant a client access to the network. The port starts in the *unauthorized* state. While in this state, the port disallows all ingress and egress traffic except for IEEE 802.1x, CDP, and STP protocol packets. When a client is successfully authenticated, the port transitions to the *authorized* state, allowing all traffic for the client to flow normally.

If a client that does not support IEEE 802.1x is connected to an unauthorized IEEE 802.1x port, the switch requests the client's identity. In this situation, 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 client connects to a port that is not running the IEEE 802.1x protocol, the client initiates the authentication process by sending the EAPOL-start frame. When no response is received, the client sends the request for a fixed number of times. Because no response is received, the client 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 transition 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 client to authenticate. The switch cannot provide authentication services to the client 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 transitions from down to up or when an EAPOL-start frame is received. The switch requests the identity of the client and begins relaying authentication messages between the client and the authentication server. Each client attempting to access the network is uniquely identified by the switch by using the client MAC address.

If the client is successfully authenticated (receives an Accept frame from the authentication server), the port state changes to authorized, and all frames from the authenticated client 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 switch 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 client logs off, it sends an EAPOL-logoff message, causing the switch port to transition to the unauthorized state.

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

IEEE 802.1x Accounting

The IEEE 802.1x standard defines how users are authorized and authenticated for network access but does not keep track of network usage. IEEE 802.1x accounting is disabled by default. You can enable IEEE 802.1x accounting to monitor this activity on IEEE 802.1x-enabled ports:

- User successfully authenticates.
- User logs off.
- Link-down occurs.
- Re-authentication successfully occurs.
- Re-authentication fails.

The switch 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.

Supported Topologies

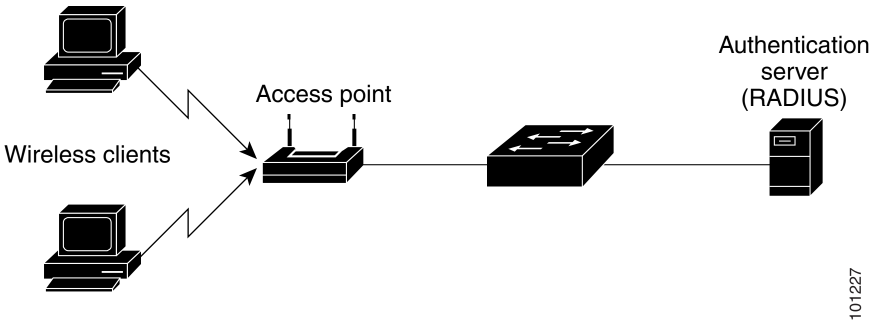
The IEEE 802.1x port-based authentication is supported in two topologies:

- Point-to-point
- Wireless LAN

In a point-to-point configuration (see Figure 9-1 on page 9-2), only one client can be connected to the IEEE 802.1x-enabled switch port. The switch detects the client when the port link state changes to the up state. If a client leaves or is replaced with another client, the switch changes the port link state to down, and the port returns to the unauthorized state.

Figure 9-3 shows IEEE 802.1x port-based authentication in a wireless LAN. The IEEE 802.1x port is configured as a multiple-hosts port that becomes authorized as soon as one client is authenticated. When the port is authorized, all other hosts indirectly attached to the port are granted access to the network. If the port becomes unauthorized (re-authentication fails or an EAPOL-logoff message is received), the switch denies access to the network to all of the attached clients. In this topology, the wireless access point is responsible for authenticating the clients attached to it, and the wireless access point acts as a client to the switch.

Figure 9-3 Wireless LAN Example



Using 802.1x Readiness Check

The 802.1x readiness check monitors IEEE 802.1x activity on all the switch ports and displays information about the devices connected to the ports that support IEEE 802.1x. You can use this feature to determine if the devices connected to the switch ports are IEEE 802.1x-capable. You use an alternate authentication for the devices that do not support IEEE 802.1x functionality.

This feature only works if the supplicant on the client supports a query with the NOTIFY EAP notification packet. The client must respond within the IEEE 802.1x timeout value.

For information on configuring the switch for the 802.1x readiness check, see the "Configuring 802.1x Readiness Check" section on page 9-15.

Using IEEE 802.1x with Port Security

You can configure IEEE 802.1x port and port security in either single-host or multiple-hosts mode. (You also must configure port security on the port by using the **switchport port-security** interface configuration command.) When you enable port security and IEEE 802.1x on a port, IEEE 802.1x authenticates the port, and port security manages network access for all MAC addresses, including that of the client. You can then limit the number or group of clients that can access the network through an IEEE 802.1x port.

These are some examples of the interaction between IEEE 802.1x and port security on the switch:

- When a client is authenticated, and the port security table is not full, the client MAC address is added to the port security list of secure hosts. The port then proceeds to come up normally.

  When a client is authenticated and manually configured for port security, it is guaranteed an entry in the secure host table (unless port security static aging has been enabled).

  A security violation occurs if the client is authenticated, but the port security table is full. This can happen if the maximum number of secure hosts has been statically configured or if the client ages out of the secure host table. If the client address is aged, its place in the secure host table can be taken by another host.

  If the security violation is caused by the first authenticated host, the port becomes error-disabled and immediately shuts down.

  The port security violation modes determine the action for security violations. For more information, see the "Security Violations" section on page 25-10.

- When you manually remove an IEEE 802.1x client address from the port security table by using the **no switchport port-security mac-address** *mac-address* interface configuration command, you should re-authenticate the IEEE 802.1x client by using the **dot1x re-authenticate interface** *interface-id* privileged EXEC command.
- When an IEEE 802.1x client logs off, the port transitions to an unauthenticated state, and all dynamic entries in the secure host table are cleared, including the entry for the client. Normal authentication then takes place.
- If the port is administratively shut down, the port becomes unauthenticated, and all dynamic entries are removed from the secure host table.
- Port security and a voice VLAN can be configured simultaneously on an IEEE 802.1x port that is in either single-host or multiple-hosts mode. Port security applies to both the voice VLAN identifier (VVID) and the port VLAN identifier (PVID).
- You can configure the **dot1x violation-mode** interface configuration command so that a port shuts down, generates a syslog error, or discards packets from a new device when it connects to an IEEE 802.1x-enabled port or when the maximum number of allowed devices have been authenticated. For more information see the "Maximum Number of Allowed Devices Per Port" section on page 9-15 and the command reference for this release.

For more information about enabling port security on your switch, see the "Configuring Port Security" section on page 25-8.

Using IEEE 802.1x with Voice VLAN Ports

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

- VVID to carry voice traffic to and from the IP phone. The VVID is used to configure the IP phone connected to the port.
- PVID to carry the data traffic to and from the workstation connected to the switch through the IP phone. The PVID is the native VLAN of the port.

Each port that you configure for a voice VLAN is associated with a PVID and a VVID. This configuration allows voice traffic and data traffic to be separated onto different VLANs. The IP phone uses the VVID for its voice traffic regardless of the authorized or unauthorized state of the port. This allows the phone to work independently of IEEE 802.1x authentication.

When you enable the single-host mode, multiple IP phones are allowed on the VVID; only one IEEE 802.1x client is allowed on the PVID. When you enable the multiple-hosts mode and when an IEEE 802.1x user is authenticated on the primary VLAN, additional clients on the voice VLAN are unrestricted after IEEE 802.1x authentication succeeds on the primary VLAN.

A voice VLAN port becomes active when there is 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 switch recognizes only the one directly connected to it. When IEEE 802.1x is enabled on a voice VLAN port, the switch drops packets from unrecognized IP phones more than one hop away.

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

For more information about voice VLANs, see the Chapter 15, "Configuring Voice VLAN."

Using IEEE 802.1x with VLAN Assignment

The switch supports IEEE 802.1x with VLAN assignment. After successful IEEE 802.1x authentication of a port, the RADIUS server sends the VLAN assignment to configure the switch port. The RADIUS server database maintains the username-to-VLAN mappings, which assigns the VLAN based on the username of the client connected to the switch port. You can use this feature to limit network access for certain users.

When configured on the switch and the RADIUS server, IEEE 802.1x with VLAN assignment has these characteristics:

- If no VLAN is supplied by the RADIUS server or if IEEE 802.1x authorization is disabled, the port is configured in its access VLAN after successful authentication.
- If IEEE 802.1x authorization is enabled but the VLAN information from the RADIUS server is not valid, the port returns to the unauthorized state and remains in the configured access VLAN. This prevents ports from appearing unexpectedly in an inappropriate VLAN because of a configuration error.

  Configuration errors could include specifying a VLAN for a routed port, a malformed VLAN ID, a nonexistent or internal (routed port) VLAN ID, or an attempted assignment to a voice VLAN ID.
- If IEEE 802.1x authorization is enabled and all information from the RADIUS server is valid, the port is placed in the specified VLAN after authentication.
- If the multiple-hosts 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 IEEE 802.1x and port security are enabled on a port, the port is placed in RADIUS server assigned VLAN.
- If IEEE 802.1x is disabled on the port, it is returned to the configured access VLAN.

When the port is in the force authorized, force unauthorized, unauthorized, or shutdown state, it is put into the configured access VLAN.

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.

The IEEE 802.1x 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).

To configure VLAN assignment you need to perform these tasks:

- Enable AAA authorization by using the **network** keyword to allow port configuration from the RADIUS server.
- Enable IEEE 802.1x. (The VLAN assignment feature is automatically enabled when you configure IEEE 802.1x on an access port).
- Assign vendor-specific tunnel attributes in the RADIUS server. The RADIUS server must return these attributes to the switch:
  - [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 on page 8-28.

Using IEEE 802.1x with Guest VLAN

You can configure a guest VLAN for each IEEE 802.1x port on the switch to provide limited services to clients (for example, how to download 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 the authentication server does not receive a response to its EAP request/identity frame, clients that are not IEEE 802.1x-capable are put into the guest VLAN for the port, if one is configured. However, the server does not grant IEEE 802.1x-capable clients that fail authentication access to the network.

The switch maintains the EAPOL packet history. If an EAPOL packet is detected on the interface during the lifetime of the link, the switch determines that the device connected to that interface is an IEEE 802.1x-capable supplicant, and the interface does not transition 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, it is transitioned to the guest VLAN state.

If the switch is trying to authorize an IEEE 802.1x-capable voice device and the AAA server is unavailable, the authorization attempt fails, but the detection of the EAPOL packet is saved in the EAPOL history. When the AAA server becomes available, the switch authorizes the voice device. However, the switch no longer allows other devices access to the guest VLAN. To prevent this situation, use one of these command sequences:

- Enter the **dot1x guest-vlan supplicant** global configuration command to allow access to the guest VLAN.
- Enter the **shutdown** interface configuration command followed by the **no shutdown** interface configuration command to restart the port.

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

Any number of hosts are allowed access when the switch port is moved to the guest VLAN. If an IEEE 802.1x-capable host 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 multiple-hosts mode.

You can configure any active 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.

For more information, see the "Configuring a Guest VLAN" section on page 9-24.

Using IEEE 802.1x with Restricted VLAN

You can configure a restricted VLAN (sometimes called an *authentication failed VLAN*) for each IEEE 802.1x port on a switch to provide limited services to clients that cannot access the guest VLAN. These clients are IEEE 802.1x-compliant and cannot access another VLAN because they fail the authentication process. A restricted VLAN allows users without valid credentials on an authentication server (typically, visitors to an enterprise) to access a limited set of services. The administrator can control the services available to the restricted VLAN.

Note You can configure a VLAN to be both the guest VLAN and the restricted VLAN if you want to provide the same services to both types of users.

Without this feature, the client indefinitely attempts and fails authentication and the switch port remains in the spanning-tree blocking state. With this feature, you can configure the switch port to be in the restricted VLAN after a specified number of authentication attempts (the default value is 3 attempts).

The authenticator counts the failed authentication attempts for the client. When this count exceeds the configured maximum authentication attempts, the port moves to the restricted VLAN. The failed attempt count increments when the RADIUS server replies with either an *EAP failure* or an empty response without an EAP packet. When the port moves into the restricted VLAN, the failed attempt counter resets.

Users who fail authentication remain in the restricted VLAN until the next re-authentication attempt. A port in the restricted VLAN tries to re-authenticate at configured intervals (the default is 60 seconds). If re-authentication fails, the port remains in the restricted VLAN. If re-authentication is successful, the port moves either to the configured VLAN or to a VLAN sent by the RADIUS server. You can disable re-authentication. If you do this, the only way to start the authentication process again is for the port to receive a *link dow*n or *EAP logoff* event. We recommend that you keep re-authentication enabled if a client might connect through a hub. When a client disconnects from the hub, the port might not receive the *link down* or *EAP logoff* event.

After a port moves to the restricted VLAN, it sends a simulated EAP success message to the client instead of an EAP failure message. This prevents clients from indefinitely attempting authentication. Some clients (for example, devices running Windows XP) cannot implement DHCP without EAP success.

Restricted VLANs are supported only on IEEE 802.1x ports in single-host mode and on Layer 2 ports.

You can configure any active VLAN except an RSPAN VLAN, a primary private VLAN, or a voice VLAN as an IEEE 802.1x restricted VLAN. The restricted VLAN feature is not supported on internal VLANs (routed ports) or trunk ports; it is supported only on access ports.

This feature works with port security. As soon as the port is authorized, a MAC address is provided to port security. If port security does not permit the MAC address or if the maximum secure address count is reached, the port becomes unauthorized and error-disabled.

Other port security features such as Dynamic ARP Inspection, DHCP snooping, and IP source guard can be configured independently on a restricted VLAN.

Using IEEE 802.1x with Per-User ACLs

You can enable per-user access control lists (ACLs) to provide different levels of network access and service to an IEEE 802.1x-authenticated user. When the RADIUS server authenticates a user connected to an IEEE 802.1x port, it retrieves the ACL attributes based on the user identity and sends them to the switch. The switch applies the attributes to the IEEE 802.1x port for the duration of the user session. The switch removes the per-user ACL configuration when the session is over, if authentication fails, or if a link-down condition occurs. The switch does not save RADIUS-specified ACLs in the running configuration. When the port is unauthorized, the switch removes the ACL from the port.

You can configure router ACLs and input port ACLs. However, a port ACL takes precedence over a router ACL. If you apply input port ACL to a port that belongs to a VLAN, the port ACL takes precedence over an input router ACL applied to the VLAN interface. Incoming packets received on the port to which a port ACL is applied are filtered by the port ACL. Incoming routed packets received on other ports are filtered by the router ACL. Outgoing routed packets are filtered by the router ACL. To avoid configuration conflicts, you should carefully plan the user profiles stored on the RADIUS server.

RADIUS supports per-user attributes, including vendor-specific attributes. These vendor-specific attributes (VSAs) are in octet-string format and are passed to the switch during the authentication process. The VSAs used for per-user ACLs are `inacl#<`*n*`>` for the ingress direction and `outacl#<`*n*`>` for the egress direction. MAC ACLs are supported only in the ingress direction. The switch supports VSAs only in the ingress direction. It does not support port ACLs in the egress direction on Layer 2 ports. For more information, see Chapter 34, "Configuring Network Security with ACLs."

Use only the extended ACL syntax style to define the per-user configuration stored on the RADIUS server. When the definitions are passed from the RADIUS server, they are created by using the extended naming convention. However, if you use the Filter-Id attribute, it can point to a standard ACL.

You can use the Filter-Id attribute to specify an inbound or outbound ACL that is already configured on the switch. The attribute contains the ACL number followed by *.in* for ingress filtering or *.out* for egress filtering. If the RADIUS server does not allow the *.in* or *.out* syntax, the access list is applied to the outbound ACL by default. Because of limited support of Cisco IOS access lists on the switch, the Filter-Id attribute is supported only for IP ACLs numbered 1 to 199 and 1300 to 2699 (IP standard and IP extended ACLs).

Only one IEEE 802.1x-authenticated user is supported on a port. If the multiple-hosts mode is enabled on the port, the per-user ACL attribute is disabled for the associated port.

The maximum size of the per-user ACL is 4000 ASCII characters.

For examples of vendor-specific attributes, see the "Configuring the Switch to Use Vendor-Specific RADIUS Attributes" section on page 8-28. For more information about configuring ACLs, see Chapter 34, "Configuring Network Security with ACLs."

To configure per-user ACLs, you need to perform these tasks:

- Enable AAA authentication.
- Enable AAA authorization by using the **network** keyword to allow port configuration from the RADIUS server.
- Enable IEEE 802.1x.
- Configure the user profile and VSAs on the RADIUS server.
- Configure the IEEE 802.1x port for single-host mode.

Note Per-user ACLs are supported only in single-host mode.

802.1x Switch Supplicant with Network Edge Access Topology (NEAT)

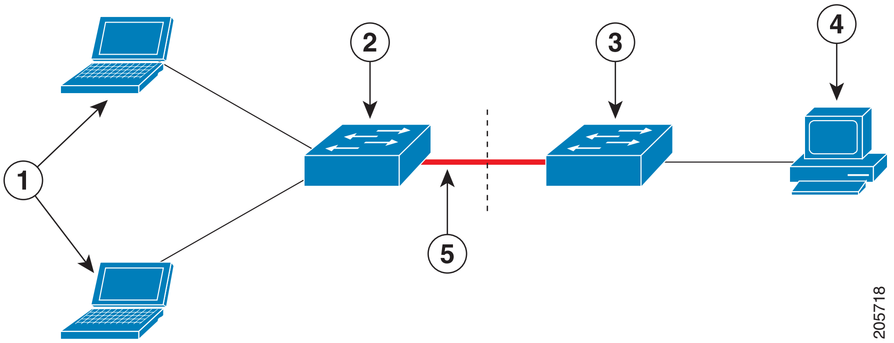
NEAT extends identity to areas outside the wiring closet (such as conference rooms) through the following:

- 802.1x switch supplicant: You can configure a switch to act as a supplicant to another switch by using the 802.1x supplicant feature. This configuration is helpful in a scenario where, for example, a switch is outside a wiring closet and is connected to an upstream switch through a trunk port. A switch configured with the 802.1x switch supplicant feature authenticates with the upstream switch for secure connectivity.

Note You cannot enable MDA or multiauth mode on the authenticator switch interface that connects to one more supplicant switches.

- Host Authorization: NEAT ensures that only traffic from authorized hosts (connecting to the switch with supplicant) is allowed on the network. The switches use Client Information Signalling Protocol (CISP) to send the MAC addresses connecting to the supplicant switch to the authenticator switch, as shown in Figure 9-4.
- Auto enablement: Automatically enables trunk configuration on the authenticator switch, allowing user traffic from multiple VLANs coming from supplicant switches.

Figure 9-4 Authenticator and Supplicant Switch using CISP



1	Workstations (clients)	**2**	Supplicant switch (outside wiring closet)
3	Authenticator switch	**4**	Access control server (ACS)
5	Trunk port		

For more information, see the "Configuring 802.1x Switch Supplicant with NEAT" section on page 9-27.

Configuring IEEE 802.1x Authentication

These sections describe how to configure IEEE 802.1x port-based authentication on your switch:

- Default IEEE 802.1x Configuration, page 9-13
- IEEE 802.1x Configuration Guidelines, page 9-14
- Configuring 802.1x Readiness Check, page 9-15 (optional)
- Configuring IEEE 802.1x Violation Modes, page 9-16
- Configuring IEEE 802.1x Authentication, page 9-17 (required)
- Configuring the Switch-to-RADIUS-Server Communication, page 9-18 (required)
- Configuring Periodic Re-Authentication, page 9-20 (optional)

- Manually Re-Authenticating a Client Connected to a Port, page 9-20 (optional)
- Changing the Quiet Period, page 9-20 (optional)
- Changing the Switch-to-Client Retransmission Time, page 9-21 (optional)
- Setting the Switch-to-Client Frame-Retransmission Number, page 9-22 (optional)
- Setting the Re-Authentication Number, page 9-22 (optional)
- Configuring the Host Mode, page 9-23 (optional)
- Configuring a Guest VLAN, page 9-24 (optional)
- Configuring a Restricted VLAN, page 9-25 (optional)
- Resetting the IEEE 802.1x Configuration to the Default Values, page 9-26 (optional)
- Configuring IEEE 802.1x Accounting, page 9-27 (optional)
- Configuring 802.1x Switch Supplicant with NEAT, page 9-27 (optional)

Default IEEE 802.1x Configuration

Table 9-1 shows the default IEEE 802.1x configuration.

Table 9-1 Default IEEE 802.1x Configuration

Feature	Default Setting
Authentication, authorization, and accounting (AAA)	Disabled.
RADIUS server • IP address • UDP authentication port • Key	 • None specified. • 1812. • None specified.
Switch IEEE 802.1x enable state	Disabled.
Per-port IEEE 802.1x enable state	Disabled (force-authorized). The port sends and receives normal traffic without IEEE 802.1x-based authentication of the client.
Periodic re-authentication	Disabled.
Number of seconds between re-authentication attempts	3600 seconds.
Re-authentication number	2 times (number of times that the switch restarts the authentication process before the port changes to the unauthorized state).
Quiet period	60 seconds (number of seconds that the switch remains in the quiet state following a failed authentication exchange with the client).
Retransmission time	30 seconds (number of seconds that the switch should wait for a response to an EAP request/identity frame from the client before resending the request).
Maximum retransmission number	2 times (number of times that the switch will send an EAP-request/identity frame before restarting the authentication process).
Host mode	Single-host mode.

Table 9-1 Default IEEE 802.1x Configuration (continued)

Feature	Default Setting
Guest VLAN	None specified.
Restricted VLAN	None specified.
Client timeout period	30 seconds (when relaying a request from the authentication server to the client, the amount of time the switch waits for a response before resending the request to the client.)
Authentication server timeout period	30 seconds (when relaying a response from the client to the authentication server, the amount of time the switch waits for a reply before resending the response to the server.) You can change this timeout period by using the **dot1x timeout server-timeout** interface configuration command.

IEEE 802.1x Configuration Guidelines

These are the IEEE 802.1x authentication configuration guidelines:

- When IEEE 802.1x is enabled, ports are authenticated before any other Layer 2 or Layer 3 features are enabled.
- The IEEE 802.1x protocol is supported on Layer 2 static-access ports, voice VLAN ports, and Layer 3 routed ports, but it is not supported on these port types:
  - Trunk port—If you try to enable IEEE 802.1x on a trunk port, an error message appears, and IEEE 802.1x 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.
  - Dynamic ports—A port in dynamic mode can negotiate with its neighbor to become a trunk port. If you try to enable IEEE 802.1x on a dynamic port, an error message appears, and IEEE 802.1x 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.
  - Dynamic-access ports—If you try to enable IEEE 802.1x on a dynamic-access (VLAN Query Protocol [VQP]) port, an error message appears, and IEEE 802.1x 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.
  - EtherChannel port—Do not configure a port that is an active member of an EtherChannel as an IEEE 802.1x port. If IEEE 802.1x is enabled on a not-yet active port of an EtherChannel, the port does not join the EtherChannel.

    Note In software releases earlier than Cisco IOS Release 12.2(25)EY, if IEEE 802.1x is enabled on a not-yet active port of an EtherChannel, the port does not join the EtherChannel.

  - Switched Port Analyzer (SPAN) and Remote SPAN (RSPAN) destination ports—You can enable IEEE 802.1x on a port that is a SPAN or RSPAN destination port. However, IEEE 802.1x is disabled until the port is removed as a SPAN or RSPAN destination port. You can enable IEEE 802.1x on a SPAN or RSPAN source port.

- 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.
- When IEEE 802.1x is enabled on a port, you cannot configure a port VLAN that is equal to a voice VLAN.
- The IEEE 802.1x with VLAN assignment feature is not supported on trunk ports, dynamic ports, or with dynamic-access port assignment through a VMPS.
- You can configure any VLAN except an RSPAN VLAN, a primary private VLAN, or a voice VLAN as an IEEE 802.1x restricted VLAN. The restricted VLAN feature is not supported on internal VLANs (routed ports) or trunk ports; it is supported only on access ports.
- You can configure IEEE 802.1x on a private-VLAN port, but do not configure IEEE 802.1x with port security, a voice VLAN, a guest VLAN, a restricted VLAN, or a per-user ACL on private-VLAN ports.

Maximum Number of Allowed Devices Per Port

This is the maximum number of devices allowed on an IEEE 802.1x-enabled port:

- In single-host mode, only one device is allowed on the access VLAN. If the port is also configured with a voice VLAN, an unlimited number of Cisco IP phones can send and receive traffic through the voice VLAN.
- In multidomain authentication (MDA) mode, one device is allowed for the access VLAN, and one IP phone is allowed for the voice VLAN.
- In multihost mode, only one IEEE 802.1x supplicant is allowed on the port, but an unlimited number of non-IEEE 802.1x hosts are allowed on the access VLAN. An unlimited number of devices are allowed on the voice VLAN.

Configuring 802.1x Readiness Check

The 802.1x readiness check monitors IEEE 802.1x activity on all the switch ports and displays information about the devices connected to the ports that support IEEE 802.1x. You can use this feature to determine if the devices connected to the switch ports are IEEE 802.1x-capable.

The 802.1x readiness check is allowed on all ports that can be configured for IEEE 802.1x. The readiness check is not available on a port that is configured as **dot1x force-unauthorized**.

Follow these guidelines to enable the readiness check on the switch:

- The readiness check is typically used before IEEE 802.1x is enabled on the switch.
- If you use the **dot1x test eapol-capable** privileged EXEC command without specifying an interface, all the ports on the switch stack are tested.
- When you configure the **dot1x test eapol-capable** command on an IEEE 802.1x-enabled port, and the link comes up, the port queries the connected client about its IEEE 802.1x capability. When the client responds with a notification packet, it is IEEE 802.1x-capable. A syslog message is generated if the client responds within the timeout period. If the client does not respond to the query, the client is not IEEE 802.1x-capable. No syslog message is generated.
- The readiness check can be sent on a port that handles multiple hosts (for example, a PC that is connected to an IP phone). A syslog message is generated for each of the clients that respond to the readiness check within the timer period.

Beginning in privileged EXEC mode, follow these steps to enable the IEEE 802.1x readiness check on the switch:

	Command	Purpose
Step 1	**dot1x test eapol-capable** [**interface** *interface-id*]	Enable the 802.1x readiness check on the switch. (Optional) For *interface-id* specify the port on which to check for IEEE 802.1x readiness. **Note** If you omit the optional **interface** keyword, all interfaces on the switch are tested.
Step 1	**configure terminal**	(Optional) Enter global configuration mode.
Step 2	**dot1x test timeout** *timeout*	(Optional) Configure the timeout used to wait for EAPOL response. The range is from 1 to 65535 seconds. The default is 10 seconds.
Step 3	**end**	(Optional) Return to privileged EXEC mode.
Step 4	**show running-config**	(Optional) Verify your modified timeout values.

This example shows how to enable a readiness check on a switch to query a port. It also shows the response received from the queried port verifying that the device connected to it is IEEE 802.1x-capable:

```
switch# dot1x test eapol-capable interface gigabitethernet1/0/13

DOT1X_PORT_EAPOL_CAPABLE:DOT1X: MAC 00-01-02-4b-f1-a3 on gigabitethernet1/0/13 is EAPOL
capable
```

Configuring IEEE 802.1x Violation Modes

You can configure an IEEE 802.1x port so that it shuts down, generates a syslog error, or discards packets from a new device when:

- a device connects to an IEEE 802.1x-enable port
- the maximum number of allowed about devices have been authenticated on the port

Beginning in privileged EXEC mode, follow these steps to configure the security violation actions on the switch:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**aaa new-model**	Enable AAA.
Step 3	**aaa authentication dot1x** {**default**} *method1*	Create an IEEE 802.1x authentication method list. To create a default list that is used when a named list is *not* specified in the **authentication** command, use the **default** keyword followed by the method that is to be used in default situations. The default method list is automatically applied to all ports. For *method1*, enter the **group radius** keywords to use the list of all RADIUS servers for authentication. **Note** Though other keywords are visible in the command-line help string, only the **group radius** keywords are supported.

	Command	Purpose
Step 4	**interface** *interface-id*	Specify the port connected to the client that is to be enabled for IEEE 802.1x authentication, and enter interface configuration mode.
Step 5	**switchport mode access**	Set the port to access mode.
Step 6	**dot1x violation-mode** {**shutdown** | **restrict** | **protect**}	Configure the violation mode. The keywords have these meanings: • **shutdown**–Error disable the port. • **restrict**–Generate a syslog error. • **protect**–Drop packets from any new device that sends traffic to the port.
Step 7	**end**	Return to privileged EXEC mode.
Step 8	**show dot1x**	Verify your entries.
Step 9	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Configuring IEEE 802.1x Authentication

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

The software uses the first method listed to authenticate users. If that method fails to respond, the software selects the next authentication method in the method list. This process continues until there is successful communication with a listed authentication method or until all defined methods are exhausted. If authentication fails at any point in this cycle, the authentication process stops, and no other authentication methods are attempted.

To allow per-user ACLs or VLAN assignment, you must enable AAA authorization to configure the switch for all network-related service requests.

Beginning in privileged EXEC mode, follow these steps to configure IEEE 802.1x port-based authentication. This procedure is required.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**aaa new-model**	Enable AAA.
Step 3	**aaa authentication dot1x** {**default**} *method1* [*method2...*]	Create an IEEE 802.1x authentication method list. To create a default list that is used when a named list is *not* specified in the **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 ports. Enter at least one of these keywords: • **group radius**—Use the list of all RADIUS servers for authentication. • **none**—Use no authentication. The client is automatically authenticated by the switch without using the information supplied by the client.
Step 4	**dot1x system-auth-control**	Enable IEEE 802.1x authentication globally on the switch.

	Command	Purpose
Step 5	**aaa authorization network** {**default**} **group radius**	(Optional) Configure the switch for user RADIUS authorization for all network-related service requests, such as per-user ACLs or VLAN assignment. **Note** For per-user ACLs, single-host mode must be configured. This setting is the default.
Step 6	**interface** *interface-id*	Specify the port connected to the client that is to be enabled for IEEE 802.1x authentication, and enter interface configuration mode.
Step 7	**dot1x port-control auto**	Enable IEEE 802.1x authentication on the port. For feature interaction information, see the "IEEE 802.1x Configuration Guidelines" section on page 9-14.
Step 8	**end**	Return to privileged EXEC mode.
Step 9	**show dot1x**	Verify your entries.
Step 10	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To disable AAA, use the **no aaa new-model** global configuration command. To disable IEEE 802.1x AAA authentication, use the **no aaa authentication dot1x** {**default** | *list-name*} global configuration command. To disable IEEE 802.1x AAA authorization, use the **no aaa authorization** global configuration command. To disable IEEE 802.1x authentication on the switch, use the **no dot1x system-auth-control** global configuration command.

This example shows how to enable AAA and IEEE 802.1x on a port:

```
Switch# configure terminal
Switch(config)# aaa new-model
Switch(config)# aaa authentication dot1x default group radius
Switch(config)# dot1x system-auth-control
Switch(config)# interface fastethernet1/0/1
Switch(config)# switchport mode access
Switch(config-if)# dot1x port-control auto
Switch(config-if)# end
```

Configuring the Switch-to-RADIUS-Server Communication

RADIUS security servers are identified by their hostname or IP address, hostname and specific UDP port numbers, or IP address and specific UDP port numbers. The combination of the IP address and UDP port number creates a unique identifier, which enables RADIUS requests to be sent to multiple UDP ports on a server at the same IP address. If two different host entries on the same RADIUS server are configured for the same service—for example, authentication—the second host entry configured acts as the fail-over backup to the first one. The RADIUS host entries are tried in the order that they were configured.

Beginning in privileged EXEC mode, follow these steps to configure the RADIUS server parameters on the switch. This procedure is required.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**radius-server host** {*hostname* | *ip-address*} **auth-port** *port-number* **key** *string*	Configure the RADIUS server parameters. For *hostname* | *ip-address,* specify the hostname or IP address of the remote RADIUS server. For **auth-port** *port-number*, specify the UDP destination port for authentication requests. The default is 1812. The range is 0 to 65536. For **key** *string*, specify the authentication and encryption key used between the switch and the RADIUS daemon running on the RADIUS server. The key is a text string that must match the encryption key used on the RADIUS server. **Note** Always configure the key as the last item in the **radius-server host** command syntax because leading spaces are ignored, but spaces within and at the end of the key are used. If you use spaces in the key, do not enclose the key in quotation marks unless the quotation marks are part of the key. This key must match the encryption used on the RADIUS daemon. If you want to use multiple RADIUS servers, re-enter this command.
Step 3	**end**	Return to privileged EXEC mode.
Step 4	**show running-config**	Verify your entries.
Step 5	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To delete the specified RADIUS server, use the **no radius-server host** {*hostname* | *ip-address*} global configuration command.

This example shows how to specify the server with IP address 172.20.39.46 as the RADIUS server, to use port 1612 as the authorization port, and to set the encryption key to *rad123*, matching the key on the RADIUS server:

```
Switch(config)# radius-server host 172.120.39.46 auth-port 1612 key rad123
```

You can globally configure the timeout, retransmission, and encryption key values for all RADIUS servers by using the **radius-server host** global configuration command. If you want to configure these options on a per-server basis, use the **radius-server timeout**, **radius-server retransmit**, and the **radius-server key** global configuration commands. For more information, see the “Configuring Settings for All RADIUS Servers” section on page 8-28.

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

Configuring Periodic Re-Authentication

You can enable periodic IEEE 802.1x client re-authentication and specify how often it occurs. If you do not specify a time period before enabling re-authentication, the number of seconds between re-authentication attempts is 3600.

Beginning in privileged EXEC mode, follow these steps to enable periodic re-authentication of the client and to configure the number of seconds between re-authentication attempts. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode.
Step 3	**dot1x reauthentication**	Enable periodic re-authentication of the client, which is disabled by default.
Step 4	**dot1x timeout reauth-period** *seconds*	Set the number of seconds between re-authentication attempts. The range is 1 to 65535; the default is 3600 seconds. This command affects the behavior of the switch only if periodic re-authentication is enabled.
Step 5	**end**	Return to privileged EXEC mode.
Step 6	**show dot1x interface** *interface-id*	Verify your entries.
Step 7	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To disable periodic re-authentication, use the **no dot1x reauthentication** interface configuration command.To return to the default number of seconds between re-authentication attempts, use the **no dot1x timeout reauth-period** interface configuration command.

This example shows how to enable periodic re-authentication and set the number of seconds between re-authentication attempts to 4000:

```
Switch(config-if)# dot1x reauthentication
Switch(config-if)# dot1x timeout reauth-period 4000
```

Manually Re-Authenticating a Client Connected to a Port

You can manually re-authenticate the client connected to a specific port at any time by entering the **dot1x re-authenticate interface** *interface-id* privileged EXEC command. This step is optional. If you want to enable or disable periodic re-authentication, see the "Configuring Periodic Re-Authentication" section on page 9-20.

This example shows how to manually re-authenticate the client connected to a port:

```
Switch# dot1x re-authenticate interface fastethernet1/0/1
```

Changing the Quiet Period

When the switch cannot authenticate the client, the switch remains idle for a set period of time and then tries again. The **dot1x timeout quiet-period** interface configuration command controls the idle period. A failed authentication of the client might occur because the client provided an invalid password. You can provide a faster response time to the user by entering a smaller number than the default.

Beginning in privileged EXEC mode, follow these steps to change the quiet period. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode.
Step 3	**dot1x timeout quiet-period** *seconds*	Set the number of seconds that the switch remains in the quiet state following a failed authentication exchange with the client. The range is 1 to 65535 seconds; the default is 60.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**show dot1x interface** *interface-id*	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To return to the default quiet time, use the **no dot1x timeout quiet-period** interface configuration command.

This example shows how to set the quiet time on the switch to 30 seconds:

```
Switch(config-if)# dot1x timeout quiet-period 30
```

Changing the Switch-to-Client Retransmission Time

The client responds to the EAP-request/identity frame from the switch with an EAP-response/identity frame. If the switch does not receive this response, it waits a set period of time (known as the retransmission time) and then resends the frame.

Note You should change the default value of this command only to adjust for unusual circumstances such as unreliable links or specific behavioral problems with certain clients and authentication servers.

Beginning in privileged EXEC mode, follow these steps to change the amount of time that the switch waits for client notification. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode.
Step 3	**dot1x timeout tx-period** *seconds*	Set the number of seconds that the switch waits for a response to an EAP-request/identity frame from the client before resending the request. The range is 1 to 65535 seconds; the default is 30.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**show dot1xinterface** *interface-id*	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To return to the default retransmission time, use the **no dot1x timeout tx-period** interface configuration command.

This example shows how to set 60 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:

```
Switch(config-if)# dot1x timeout tx-period 60
```

Setting the Switch-to-Client Frame-Retransmission Number

In addition to changing the switch-to-client retransmission time, you can change the number of times that the switch sends an EAP-request/identity frame (assuming no response is received) to the client before restarting the authentication process.

Note You should change the default value of this command only to adjust for unusual circumstances such as unreliable links or specific behavioral problems with certain clients and authentication servers.

Beginning in privileged EXEC mode, follow these steps to set the switch-to-client frame-retransmission number. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode.
Step 3	**dot1x max-reauth-req** *count*	Set the number of times that the switch sends an EAP-request/identity frame to the client before restarting the authentication process. The range is 1 to 10; the default is 2.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**show dot1x interface** *interface-id*	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To return to the default retransmission number, use the **no dot1x max-req** interface configuration command.

This example shows how to set 5 as the number of times that the switch sends an EAP-request/identity request before restarting the authentication process:

```
Switch(config-if)# dot1x max-req 5
```

Setting the Re-Authentication Number

You can also change the number of times that the switch restarts the authentication process before the port changes to the unauthorized state.

Note You should change the default value of this command only to adjust for unusual circumstances such as unreliable links or specific behavioral problems with certain clients and authentication servers.

Beginning in privileged EXEC mode, follow these steps to set the re-authentication number. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode.
Step 3	**dot1x max-reauth-req** *count*	Set the number of times that the switch restarts the authentication process before the port changes to the unauthorized state. The range is 1 to 10; the default is 2.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**show dot1x interface** *interface-id*	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To return to the default re-authentication number, use the **no dot1x max-reauth-req** interface configuration command.

This example shows how to set 4 as the number of times that the switch restarts the authentication process before the port changes to the unauthorized state:

```
Switch(config-if)# dot1x max-reauth-req 4
```

Configuring the Host Mode

You can configure an IEEE 802.1x port for single-host or for multiple-hosts mode. In single-host mode, only one host is allowed on an IEEE 802.1x port. When the host is authenticated, the port is placed in the authorized state. When the host leaves the port, the port becomes unauthorized. Packets from hosts other than the authenticated one are dropped.

You can attach multiple hosts to a single IEEE 802.1x-enabled port as shown in Figure 9-3 on page 9-6. In this mode, only one of the attached hosts must be successfully authorized for all hosts to be granted network access. If the port becomes unauthorized (re-authentication fails or an EAPOL-logoff message is received), all attached clients are denied access to the network.

With the multiple-hosts mode enabled, you can use IEEE 802.1x to authenticate the port and port security to manage network access for all MAC addresses, including that of the client.

Beginning in privileged EXEC mode, follow these steps to allow multiple hosts (clients) on an IEEE 802.1x-authorized port that has the **dot1x port-control** interface configuration command set to **auto**. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to which multiple hosts are indirectly attached, and enter interface configuration mode.
Step 3	**dot1x host-mode multi-host**	Allow multiple hosts (clients) on an IEEE 802.1x-authorized port. Make sure that the **dot1x port-control** interface configuration command set is set to **auto** for the specified port.
Step 4	**end**	Return to privileged EXEC mode.

	Command	Purpose
Step 5	**show dot1x interface** *interface-id*	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Enter the **dot1x host-mode single-host** interface configuration command to set the interface to allow a single host on the port.

Note Although visible in the command-line interface help, the **dot1x host-mode multi-domain** interface configuration command is not supported. Configuring this command on an interface causes the interface to go into the error-disabled state.

To disable multiple hosts on the port, use the **no dot1x host-mode multi-host** interface configuration command.

This example shows how to enable IEEE 802.1x on a port and to allow multiple hosts:

```
Switch(config)# interface fastethernet1/0/1
Switch(config-if)# dot1x port-control auto
Switch(config-if)# dot1x host-mode multi-host
```

Configuring a Guest VLAN

When you configure a guest VLAN, clients that are not IEEE 802.1x-capable are put into the guest VLAN when the server does not receive a response to its EAP request/identity frame. Clients that are IEEE 802.1x-capable but fail authentication are not granted access to the network. The switch supports guest VLANs in single-host or multiple-hosts mode.

Beginning in privileged EXEC mode, follow these steps to configure a guest VLAN. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode. For the supported port types, see the "IEEE 802.1x Configuration Guidelines" section on page 9-14.
Step 3	**dot1x guest-vlan** *vlan-id*	Specify an active VLAN as an IEEE 802.1x guest VLAN. The range is 1 to 4094. You can configure any active VLAN except an internal VLANs (routed port), an RSPAN VLAN, or a voice VLAN as an IEEE 802.1x guest VLAN.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**show dot1x interface** *interface-id*	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To disable and remove the guest VLAN, use the **no dot1x guest-vlan** interface configuration command. If the port is currently authorized in the guest VLAN, the port returns to the unauthorized state.

This example shows how to enable VLAN 2 as an IEEE 802.1x guest VLAN on a port:

```
Switch(config)# interface gigabitethernet1/0/2
Switch(config-if)# dot1x guest-vlan 2
```

Configuring a Restricted VLAN

When you configure a restricted VLAN on a switch, clients that are IEEE 802.1x-compliant are moved into the restricted VLAN when the authentication server does not receive a valid username and password. The switch supports restricted VLANs only in single-host mode.

Beginning in privileged EXEC mode, follow these steps to configure a restricted VLAN. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode. For the supported port types, see the "IEEE 802.1x Configuration Guidelines" section on page 10-18.
Step 3	**switchport mode access** or **switchport mode private-vlan host**	Set the port to access mode, or Configure the Layer 2 port as a private-VLAN host port.
Step 4	**dot1x port-control auto**	Enable IEEE 802.1x authentication on the port.
Step 5	**dot1x auth-fail vlan** *vlan-id*	Specify an active VLAN as an IEEE 802.1x restricted VLAN. The range is 1 to 4094. You can configure any active VLAN except an internal VLAN (routed port), an RSPAN VLAN, a primary private VLAN, or a voice VLAN as an IEEE 802.1x restricted VLAN.
Step 6	**end**	Return to privileged EXEC mode.
Step 7	**show dot1x interface** *interface-id*	(Optional) Verify your entries.
Step 8	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To disable and remove the restricted VLAN, use the **no dot1x auth-fail vlan** interface configuration command. The port returns to the unauthorized state.

This example shows how to enable *VLAN 2* as an IEEE 802.1x restricted VLAN:

```
Switch(config)# interface gigabitethernet0/2
Switch(config-if)# dot1x auth-fail vlan 2
```

Use the **dot1x auth-fail max-attempts** interface configuration command to configure the maximum number of authentication attempts allowed before a user is assigned to the restricted VLAN. The range of allowable authentication attempts is 1 to 3. The default is 3 attempts.

Beginning in privileged EXEC mode, follow these steps to configure the maximum number of allowed authentication attempts. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode. For the supported port types, see the "IEEE 802.1x Configuration Guidelines" section on page 10-18.
Step 3	**switchport mode access** or **switchport mode private-vlan host**	Set the port to access mode, or Configure the Layer 2 port as a private-VLAN host port.
Step 4	**dot1x port-control auto**	Enable IEEE 802.1x authentication on the port.
Step 5	**dot1x auth-fail vlan** *vlan-id*	Specify an active VLAN as an IEEE 802.1x restricted VLAN. The range is 1 to 4094. You can configure any active VLAN except an internal VLAN (routed port), an RSPAN VLAN, a primary private VLAN, or a voice VLAN as an IEEE 802.1x restricted VLAN.
Step 6	**dot1x auth-fail max-attempts** *max attempts*	Specify a number of authentication attempts to allow before a port moves to the restricted VLAN. The range is 1 to 3, and the default is 3.
Step 7	**end**	Return to privileged EXEC mode.
Step 8	**show dot1x interface** *interface-id*	(Optional) Verify your entries.
Step 9	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

To return to the default value, use the **no dot1x auth-fail max-attempts** interface configuration command.

This example shows how to set *2* as the number of authentication attempts allowed before the port moves to the restricted VLAN:

```
Switch(config-if)# dot1x auth-fail max-attempts
```

Resetting the IEEE 802.1x Configuration to the Default Values

Beginning in privileged EXEC mode, follow these steps to reset the IEEE 802.1x configuration to the default values. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode.
Step 3	**dot1x default**	Reset the configurable IEEE 802.1x parameters to the default values.
Step 4	**end**	Return to privileged EXEC mode.
Step 5	**show dot1x interface** *interface-id*	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

Configuring IEEE 802.1x Accounting

Enabling AAA system accounting with IEEE 802.1x accounting allows system reload events to be sent to the accounting RADIUS server for logging. The server can then infer that all active IEEE 802.1x sessions are closed.

Because RADIUS uses the unreliable UDP transport protocol, accounting messages might 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, this system message appears:

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

When the stop message is not sent successfully, this message appears:

```
00:09:55: %RADIUS-4-RADIUS_DEAD: RADIUS server 172.20.246.201:1645,1646 is not responding.
```

Note You must configure the RADIUS server to perform accounting tasks, such as logging start, stop, and interim-update messages and time stamps. To turn on these functions, enable logging of "Update/Watchdog packets from this AAA client" in your RADIUS server Network Configuration tab. Next, enable "CVS RADIUS Accounting" in your RADIUS server System Configuration tab.

Beginning in privileged EXEC mode, follow these steps to configure IEEE 802.1x accounting after AAA is enabled on your switch. This procedure is optional.

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**aaa accounting dot1x default start-stop group radius**	Enable IEEE 802.1x accounting using the list of all RADIUS servers.
Step 3	**aaa accounting system default start-stop group radius**	(Optional) Enables system accounting (using the list of all RADIUS servers) and generates system accounting reload event messages when the switch reloads.
Step 4	**end**	Return to privileged EXEc mode.
Step 5	**show running-config**	Verify your entries.
Step 6	**copy running-config startup-config**	(Optional) Saves your entries in the configuration file.

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

This example shows how to configure IEEE 802.1x accounting. The first command configures the RADIUS server, specifying 1813 as the UDP port for accounting:

```
Switch(config)# radius-server host 172.120.39.46 auth-port 1812 acct-port 1813 key rad123
Switch(config)# aaa accounting dot1x default start-stop group radius
Switch(config)# aaa accounting system default start-stop group radius
```

Configuring 802.1x Switch Supplicant with NEAT

Configuring this feature requires that one switch (outside a wiring closet) is configured as supplicant and is connected to an authenticator switch.

Note You cannot enable MDA or multiauth mode on the authenticator switch interface that connects to one more supplicant switches.

For overview information, see the "802.1x Switch Supplicant with Network Edge Access Topology (NEAT)" section on page 9-11.

Note The *cisco-av-pairs* must be configured as *device-traffic-class=switch* on the ACS, which sets the interface as a trunk after the supplicant is successfuly authenticated.

Beginning in privileged EXEC mode, follow these steps to configure a switch as an authenticator:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**cisp enable**	Enable CISP.
Step 3	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode.
Step 4	**switchport mode access**	(Optional) Set the port mode to **access**.
Step 5	**authentication port-control auto**	Set the port-authentication mode to auto.
Step 6	**dot1x pae authenticator**	Configure the interface as a port access entity (PAE) authenticator.
Step 7	**spanning-tree portfast**	Enable Port Fast on an access port connected to a single workstation or server..
Step 8	**end**	Return to privileged EXEC mode.
Step 9	**show running-config interface** *interface-id*	Verify your configuration.
Step 10	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

This example shows how to configure a switch as an 802.1x authenticator:

```
Switch# configure terminal
Switch(config)# cisp enable
Switch(config)# interface gigabitethernet2/0/1
Switch(config-if)# switchport mode access
Switch(config-if)# authentication port-control auto
Switch(config-if)# dot1x pae authenticator
Switch(config-if)# spanning-tree portfast trunk
```

Beginning in privileged EXEC mode, follow these steps to configure a switch as a supplicant:

	Command	Purpose
Step 1	**configure terminal**	Enter global configuration mode.
Step 2	**cisp enable**	Enable CISP.
Step 3	**dot1x credentials** *profile*	Create 802.1x credentials profile. This must be attached to the port that is configured as supplicant.
Step 4	**username** *suppswitch*	Create a username.

	Command	Purpose
Step 5	**password** *password*	Create a password for the new username.
Step 6	**interface** *interface-id*	Specify the port to be configured, and enter interface configuration mode.
Step 7	**switchport trunk encapsulation dot1q**	Set the port to trunk mode.
Step 8	**switchport mode trunk**	Configure the interface as a VLAN trunk port.
Step 9	**dot1x pae supplicant**	Configure the interface as a port access entity (PAE) supplicant.
Step 10	**dot1x credentials** *profile-name*	Attach the 802.1x credentials profile to the interface.
Step 11	**end**	Return to privileged EXEC mode.
Step 12	**show running-config interface** *interface-id*	Verify your configuration.
Step 13	**copy running-config startup-config**	(Optional) Save your entries in the configuration file.

This example shows how to configure a switch as a supplicant:

```
Switch# configure terminal
Switch(config)# cisp enable
Switch(config)# dot1x credentials test
Switch(config)# username suppswitch
Switch(config)# password myswitch
Switch(config)# interface gigabitethernet 1/0/1
Switch(config-if)# switchport trunk encapsulation dot1q
Switch(config-if)# dot1x pae supplicant
Switch(config-if)# dot1x credentials test
Switch(config-if)# end
```

Displaying IEEE 802.1x Statistics and Status

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** 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.