802-1x Port Based Authentication

- 802.1X port-based authentication, on page 1
- Usage guidelines and restrictions for 802.1X port-based authentication, on page 3
- Understanding 802.1X Port-Based Authentication, on page 4
- Configure 802.1X host-modes, on page 5
- Configure 802.1X with remote RADIUS authentication, on page 5
- Configure 802.1X with local EAP authentication, on page 7
- Configure router as 802.1X supplicant, on page 8
- Verify 802.1X Port-Based Authentication, on page 9

802.1X port-based authentication

The 802.1X port-based authentication is a type of authentication that enables port-based network access control as defined by the IEEE 802.1X standard that

- operates at the Layer 2 and prevents an unauthorized network device from connecting to a network via LAN ports,
- uses a client-server model to authenticate a client network device (hereafter referred to as client) before allowing it access to a network, and
- controls port access, ensuring the port-interface blocks all traffic to and from a client until it is successfully authenticated.

In 802.1X port-based authentication, the client-server model involves a client device requesting network access by communicating with an authentication server, typically a Remote Authentication Dial-In User Service (RADIUS) server. The client sends its credentials, which the server verifies against authorized user databases. Upon successful authentication, the server permits network access, ensuring only authorized devices can connect.

This chapter describes how to configure IEEE 802.1X port-based authentication in Cisco 8000 series routers to prevent unauthorized network devices from gaining access to the network.

Table 1: Feature History Table

Feature Name	Release Information	Feature Description
802.1X port-based authentication	Release 25.1.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100]); Modular Systems (8800 [LC ASIC: P100]) You can now secure network access by requiring client network devices to authenticate with encrypted digital certificates before gaining access. The 802.1X port-based authentication ensures that a port remains closed to all traffic until the connected client successfully completes authentication using the Extensible Authentication Protocol with TLS (EAP-TLS) encryption. This prevents unauthorized access and enforces secure, certificate-based communication, enhancing network security and integrity.

Supported protocols for 802.1X port-based authentication

802.1X port-based authentication supports these protocols for secure and reliable network access:

- **EAP** —Extensible Authentication Protocol (EAP) is a flexible authentication framework that supports multiple authentication methods, allowing network devices to negotiate the most appropriate protocol for secure communications.
- **EAP-TLS**—Extensible Authentication Protocol with Transport Layer Security (EAP-TLS) is an authentication protocol that leverages TLS to provide robust encryption and mutual authentication, ensuring secure and private communication between the client and server during the authentication process.
- **EAPOL**—Extensible Authentication Protocol over LAN (EAPOL) is a network protocol used in the IEEE 802.1X standard, facilitating the exchange of EAP packets over wired or wireless LANs, enabling secure port-based network access control.

IEEE 802.1X Device Roles

Devices in the network have specific roles in IEEE 802.1X authentication:

- **Authenticator**—A router that facilitates authentication for other network devices or clients on the same LAN.
- **Supplicant**—A network device or client that seeks authentication from an authenticator on a point-to-point LAN segment.

- **Authentication server**—A RADUIS server that verifies client credentials and authorizes network access through the authenticator.

802.1X host modes

The 802.1X host modes table describes the two host modes supported by 802.1X.

For information on how to configure the host modes, refer to Configure 802.1X host-modes.

Table 2: 802.1X host modes

Host modes	Description
Single-host	While in this mode, the port allows a single host or client to be authenticated and allows only ingress traffic from the authenticated peer. A security violation is detected if more than one client is present.
Multi-auth	This is the default host mode. While in this mode, multiple hosts can independently authenticate through the same port and ingress traffic is allowed from all authenticated peers. The router can support up to 20 clients using the 802.1X protocol in multi-authentication mode.

Prerequisites for 802.1X Port-Based Authentication

Prerequisites for 802.1X port-based authentication are:

- K9sec RPM is required to enable this feature.
- Ensure that both RADIUS/EAP-server and supplicant are configured with supported EAP methods when remote authentication is used.
- If the device is used as a local EAP server, only EAP-TLS method is supported.
- Ensure that a Certificate Authority (CA) server is configured for the network with a valid certificate.
- Ensure that the supplicant, authenticator, and CA server are synchronized using Network Time Protocol (NTP). If time is not synchronized on all these devices, certificates may not be validated.

Usage guidelines and restrictions for 802.1X port-based authentication

Consider these restrictions and usage guidelines when implementing 802.1X port-based authentication on the Cisco 8000 platform:

Port authentication

- 802.1X port authentication must be configured on physical ports.
- Supported modes for 802.1X port-based authentication:
    - Single-host

- Multi-auth

VLAN sub-interfaces

- VLAN sub-interfaces must have pre-configured VLAN IDs.
- All VLAN-tagged traffic is dropped until successful 802.1X authentication of the port.
- No default VLAN assignment is provided for unauthenticated MAC addresses.
- Authenticated MAC addresses are validated at the main port, independent of VLAN assignment.
- VLAN-tagged traffic is allowed only for authenticated MAC addresses.

Untagged traffic

- Untagged EAPOL traffic is always allowed.
- All other untagged traffic is dropped until successful 802.1X authentication of the port.
- Untagged traffic is allowed only for authenticated MAC addresses.
- No default VLAN assignment is provided for untagged traffic by the port.

Understanding 802.1X Port-Based Authentication

IEEE 802.1X port-based authentication is configured on Cisco 8000 series router to prevent unauthorized routers (supplicants) from gaining access to the network. An authentication server validates the supplicant that is connected to an authenticator port, before the services offered by the client or the network is made available to the supplicant.

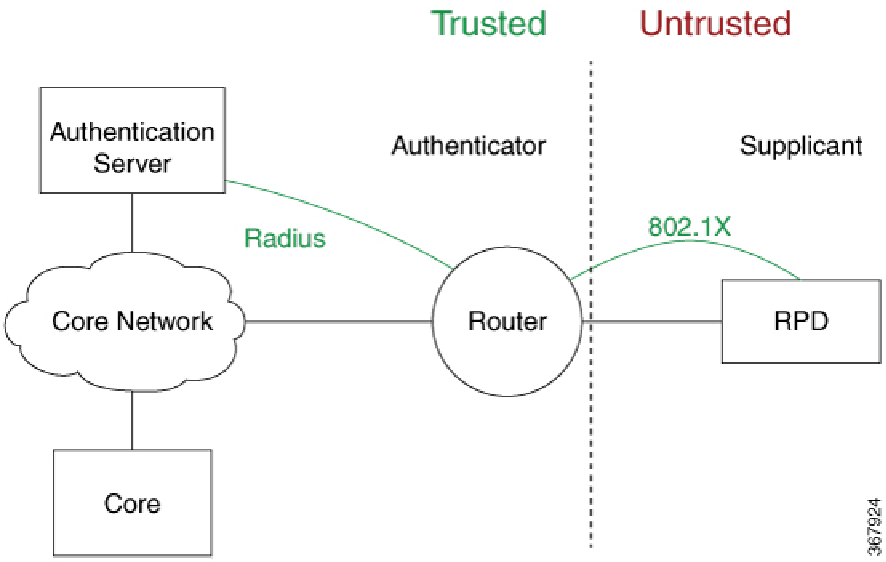
Until the supplicant is authenticated, the port is in *Unauthorized* state, and 802.1X access control allows only Extensible Authentication Protocol over LAN (EAPOL) packets through the port. EAPoL frames can have either default EtherType of 0x888E or Cisco-defined EtherType of 0x876F. After successful authentication of the supplicant, the port transitions to *Authorized* state, and normal traffic passes through the port for the authenticated client.

Periodic reauthentication can be enabled to use either the port-configured value or from authentication server. The authentication server communicates the reauthentication-timer value in Session-Timeout attribute, with the final RADIUS Access-Accept message. On 802.1X reauthentication failure, the port is blocked and moved back 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.

The following figure shows the topology for IEEE 802.1X port-based authentication:

Figure 1: Topology for IEEE 802.1X Port-Based Authentication



By default, the dot1x configured port is in multi-auth mode. However, this behaviour can be altered by changing the host mode under dot1x profile.

Note Port-control is enforced only on the ingress traffic.

Configure 802.1X host-modes

Use the following steps to configure 802.1X host-modes. Here, `host-mode` is introduced under the authenticator mode in dot1x profile. The default is `multi-auth` mode.

```
Router# configure terminal
Router(config)# dot1x profile {name}
Router(config-dot1x-auth)# pae {authenticator}
Router(config-dot1x-auth-auth)# host-mode
  multi-auth   multiple authentication mode
  multi-host   multiple host mode
  single-host  single host mode
```

Configure 802.1X with remote RADIUS authentication

Use this procedure to configure 802.1X port-based authentication using a remote RADIUS server. This method enables centralized authentication and access control, ensuring network security.

Before you begin

Before you configure 802.1X port-based authentication using a remote RADIUS server, verify

- the RADIUS server is operational and reachable, and

- the pre-shared key for secure communication between the device and the RADIUS server is available.

Procedure

Step 1 Configure the RADIUS server.

Example:

```
Router# configure terminal
         Router(config)# radius-server host 209.165.200.225 auth-port 1646 key secret007
         Router(config)# radius-server vsa attribute ignore unknown
         Router(config)# commit
```

Verify the configuration using the **show run radius** command.

Step 2 Configure the 802.1X authentication method.

Example:

```
Router# configure terminal
         Router(config)# aaa authentication dot1x default group radius
         Router(config)# commit
```

Note
Only default AAA method is supported for 802.1X authentication.

Verify the configuration using the **show run aaa** command.

Step 3 Configure the 802.1X authenticator profile.

Example:

```
Router(config)# dot1x profile auth
         Router(config-dot1x-auth)# pae authenticator
         Router(config-dot1x-auth)# authenticator
         Router(config-dot1x-auth-auth)# timer reauth-time 3600
         Router(config-dot1x-auth-auth)# host-mode {multi-auth | single-host}
         Router(config-dot1x-auth-auth)# commit
```

Verify the configuration using the **show run dot1x** command.

Step 4 Attach the 802.1X profile to an interface.

Example:

```
Router(config)# interface HundredGigE 0/3/0/0
         Router(config-if)# dot1x profile auth
         Router(config-if)# commit
```

Verify the configuration using the **show run interface HundredGigE 0/3/0/0** command.

The port now uses 802.1X EAP-TLS authentication to validate connected devices via the remote RADIUS server. Unauthorized devices cannot access the network until successfully authenticated.

Configure 802.1X with local EAP authentication

Use this procedure to configure 802.1X port-based authentication using a locally hosted EAP server on a Cisco 8000 router. This configuration enables mutual authentication between the router and client using certificates.

In local EAP authentication, the EAP-server is co-located with the authenticator locally on the router. This feature enables the router to authenticate 802.1X clients with EAP-TLS method using TLS Version 1.2. It provides EAP-TLS based mutual authentication, where a Master Session Key (MSK) is generated on successful authentication.

Procedure

Step 1 Generate an RSA key pair.

Example:

```
Router# crypto key generate rsa <keypair-label>
```

Step 2 Configure a trustpoint.

Example:

```
   Router(config)# crypto ca trustpoint <tp_name>
            Router(config-trustp)# enrollment url <ca-url>
            Router(config-trustp)# subject-name <x.500-name>
            Router(config-trustp)# rsakeypair <keypair-label>
            Router(config-trustp)# commit
```

Trustpoints let you manage and track CAs and certificates. A trustpoint includes the identity of the CA, CA-specific configuration parameters, and an association with one, enrolled identity certificate. After you have defined a trustpoint, you can reference it by name in commands requiring that you specify a CA.

Step 3 Configure a domain name.

Example:

```
Router(config)# domain name <domain-name>
```

The domain name is required for certificate enrollment.

Step 4 Configure certificates.

Example:

```
   Router# crypto ca authenticate <tp_name>
            Router# crypto ca enroll <tp_name>
```

Ensure the Certificate Authority (CA) issues the required certificates for authentication.

Step 5 Configure an EAP profile.

Example:

```
Router(config)# eap profile <profile_name>
Router(config-eap)# identity <user-name>
Router(config-eap)# method tls pki-trustpoint <tp_name>
Router(config-eap)# commit
```

Step 6 Configure the 802.1X authenticator profile.

Example:

```
Router(config)# dot1x profile local_auth
Router(config-dot1x-auth)# pae authenticator
Router(config-dot1x-auth)# authenticator
Router(config-dot1x-auth-auth)# eap profile <profile_name>
Router(config-dot1x-auth-auth)# host-mode {multi-auth | single-host}
Router(config-dot1x-auth-auth)# timer reauth-time 3600
Router(config-dot1x-auth-auth)# commit
```

Step 7 Configure 802.1X profile on an interface.

Example:

```
Router(config)# interface <interface-name>
         Router(config-if)# dot1x profile local_auth
         Router(config-if)# commit
```

The router now uses 802.1X with a local EAP server to authenticate connected devices using EAP-TLS and certificates.

Configure router as 802.1X supplicant

Before you begin

Before you configure the router as a 802.1X supplicant

- generate an RSA key pair for certificate-based authentication,
- configure a trustpoint with the appropriate Certificate Authority (CA),
- configure a domain name,
- obtain CA certificate for the given trust point and enroll the device certificate with CA, and
- ensure an EAP profile is configured for authentication.

Procedure

Step 1 Configure the 802.1X supplicant profile.

Example:

```
Router(config)# dot1x profile supp
Router(config-dot1x-supp)# pae supplicant
Router(config-dot1x-supp)# supplicant
Router(config-dot1x-supp-supp)# eap profile <profile_name>
Router(config-dot1x-supp-supp)# commit
```

Step 2 Attach the supplicant profile to an interface.

Example:

```
Router(config)# interface <interface-name>
Router(config-if)# dot1x profile supp
Router(config-if)# commit
```

The router is now configured as a supplicant in 802.1X authentication, enabling it to authenticate with an upstream authenticator using EAP-TLS and certificates.

Verify 802.1X Port-Based Authentication

The 802.1X authentication can be verified using the following:

- Show command outputs
- Syslog messages

Show Command Outputs

The **show dot1x interface** command verifies whether the 802.1X port-based authentication is successful or not. If the authentication is successful, the traffic is allowed on the configured interface.

```
Router# show dot1x interface HundredGigE 0/0/1/0 detail

Dot1x info for HundredGigE 0/0/1/0
---------------------------------------------------------------
Interface short name      : Hu 0/0/1/0
Interface handle          : 0x4080
Interface MAC             : 021a.9eeb.6a59
Ethertype                 : 888E
PAE                       : Authenticator
Dot1x Port Status         : AUTHORIZED
Dot1x Profile             : test_prof
L2 Transport              : FALSE
Authenticator:
   Port Control           : Enabled
   Config Dependency      : Resolved
   Eap profile            : None
   ReAuth                 : Disabled
Client List:
      Supplicant          : 027e.15f2.cae7
 Programming Status       : Add Success
      Auth SM State       : Authenticated
      Auth Bend SM State  : Idle
      Last authen time    : 2018 Dec 11 17:00:30.912
      Last authen server  : 10.77.132.66
      Time to next reauth : 0 day(s), 00:51:39
MKA Interface:
   Dot1x Tie Break Role   : NA (Only applicable for PAE role both)
   EAP Based Macsec       : Disabled
   MKA Start time         : NA
   MKA Stop time          : NA
   MKA Response time      : NA
```

Syslog Messages

Syslogs on Authenticator

When 802.1x configuration is applied on an interface, the port becomes 802.1X controlled, and the following syslog message is displayed:

```
%L2-DOT1X-5-PORT_CONTROL_ENABLE_SUCCESS : Hu0/0/1/0 : Port Control Enabled
```

After successful authentication of supplicant, the following syslog messages are displayed:

```
%L2-DOT1X-5-AUTH_SUCCESS : Hu0/0/1/0 : Authentication successful for client 027E.15F2.CAE7


%L2-DOT1X-5-PORT_CONTROL_ADD_CLIENT_SUCCESS : Hu0/0/1/0 : Port Access Enabled For Client
027E.15F2.CAE7
```

When 802.1X port-based configuration is removed from an interface, the following syslog message is displayed:

```
%L2-DOT1X-5-PORT_CONTROL_DISABLE_SUCCESS : Hu0/0/1/0  : Port Control Disabled
```

When authentication fails, the following syslog messages are displayed:

```
%L2-DOT1X-5-AUTH_FAIL : Hu0/0/1/0 : Authentication fail for client 027E.15F2.CAE7
```

```
%L2-DOT1X-5-PORT_CONTROL_REMOVE_CLIENT_SUCCESS : Hu0/0/1/0 : Port Access Disabled For Client
 027E.15F2.CAE7
```

When authentication server is unreachable, the following syslog message is displayed:

```
%L2-DOT1X-5-AAA_UNREACHABLE : Hu0/0/1/0 : AAA server unreachable for client 027E.15F2.CAE7
  , Retrying Authentication
```

When authentication method is not configured, the following syslog message is displayed:

```
%L2-DOT1X-4-NO_AUTHENTICATION_METHOD : Hu0/0/1/0 : No authentication method configured
```

Syslogs on Supplicant

```
%L2-DOT1X-5-SUPP_SUCCESS : Hu0/0/1/0 : Authentication successful with authenticator
008a.96a4.b050
```

```
%L2-DOT1X-5-SUPP_FAIL : Hu0/0/1/0 : Authentication successful with authenticator
0000.0000.0000.0000
```

```
%L2-DOT1X-5-SUPP_FAIL : Hu0/0/1/0 : Authentication successful with authenticator
008a.96a4.b028
```