Cisco TrustSec How-To Guide: Adding ID Stores and Creating Authentication Policies

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Current Document Version: 3.0

August 27, 2012

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Introduction

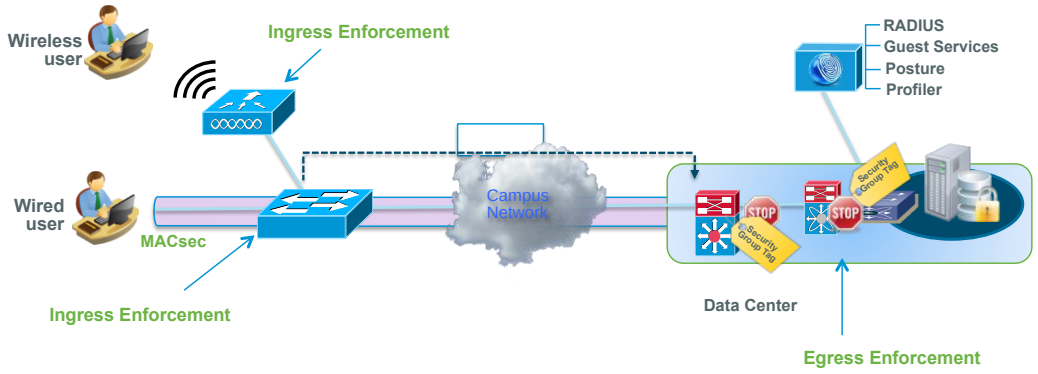
What Is the Cisco TrustSec System?

Cisco TrustSec®, a core component of the Cisco SecureX Architecture™, is an intelligent access control solution. TrustSec mitigates security risks by providing comprehensive visibility into who and what is connecting across the entire network infrastructure, and exceptional control over what and where they can go.

TrustSec builds on your existing identity-aware access layer infrastructure (switches, wireless controllers, and so on). The solution and all the components within the solution are thoroughly vetted and rigorously tested as an integrated system.

In addition to combining standards-based identity and enforcement models, such as IEEE 802.1X and VLAN control, the TrustSec system it also includes advanced identity and enforcement capabilities such as flexible authentication, Downloadable Access Control Lists (dACLs), Security Group Tagging (SGT), device profiling, posture assessments, and more.

Figure 1: TrustSec Architecture Overview

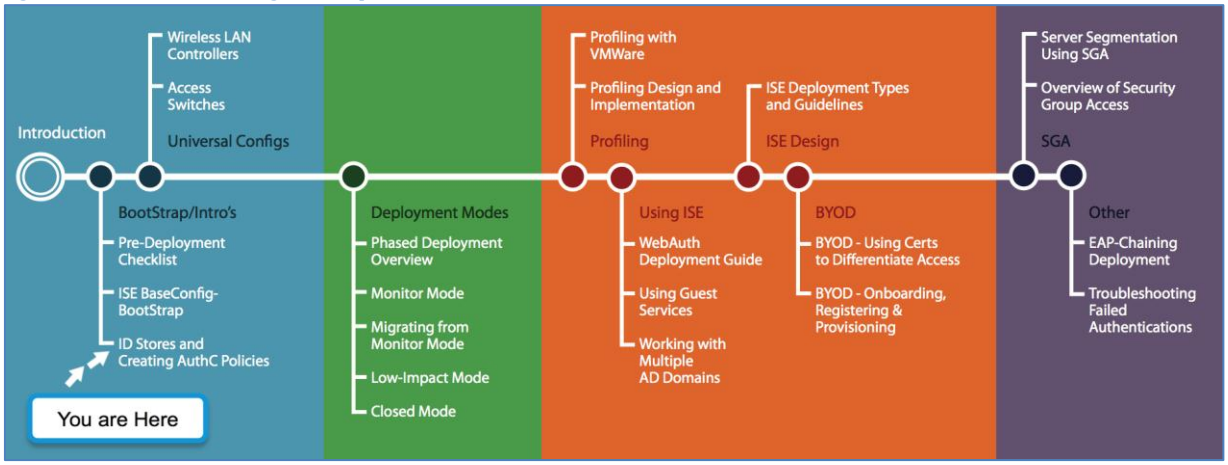


About the TrustSec How-To Guides

The TrustSec team is producing this series of How-To documents to describe best practices for TrustSec deployments. The documents in the series build on one another and guide the reader through a successful implementation of the TrustSec system. You can use these documents to follow the prescribed path to deploy the entire system, or simply pick the single use-case that meets your specific need.

Each guide is this series comes with a subway-style "You Are Here" map to help you identify the stage the document addresses and pinpoint where you are in the TrustSec deployment process (Figure 2).

Figure 2: How-To Guide Navigation Map



What does it mean to be 'TrustSec Certified'?

Each TrustSec version number (for example, TrustSec Version 2.0, Version 2.1, and so on) is a certified design or architecture. All the technology making up the architecture has undergone thorough architectural design development and lab testing. For a How-To Guide to be marked "TrustSec certified," all the elements discussed in the document must meet the following criteria:

- Products incorporated in the design must be generally available.
- Deployment, operation, and management of components within the system must exhibit repeatable processes.
- All configurations and products used in the design must have been fully tested as an integrated solution.

Many features may exist that could benefit your deployment, but if they were not part of the tested solution, they will not be marked as "TrustSec certified". The TrustSec team strives to provide regular updates to these documents that will include new features as they become available, and are integrated into the TrustSec test plans, pilot deployments, and system revisions. (i.e., TrustSec 2.2 certification).

Additionally, many features and scenarios have been tested, but are not considered a best practice, and therefore are not included in these documents. As an example, certain IEEE 802.1X timers and local web authentication features are not included.

Note: Within this document, we describe the recommended method of deployment, and a few different options depending on the level of security needed in your environment. These methods are examples and step-by-step instructions for TrustSec deployment as prescribed by Cisco best practices to help ensure a successful project deployment.

Adding Identity Stores and Creating Authentication Policies

Overview

The Cisco® Identity Services Engine (ISE) provides an internal database for authenticating users and endpoints. Internal databases are typically used to authenticate guest users via web authentication or endpoints through MAC authentication bypass (MAB). However, Cisco ISE can integrate with external identity sources to validate user or endpoint credentials and retrieve security group memberships and other attributes that are associated with the user or device for use in authorization policies. External identity sources are not only used to authenticate and authorize users and endpoints for 802.1x/MAB/web authentication, but can also be used to authenticate and authorize ISE administrator and guest sponsor users. The authentication process verifies the validity of endpoint or user's credentials by forwarding it to correct identity sources. Cisco ISE does this by processing RADIUS requests from network access devices (NADs), querying the credentials in an identity database, and forwarding the request to the authorization policy for further processing where different permissions can be assigned. This allows ISE to process different identity requests using different identity databases.

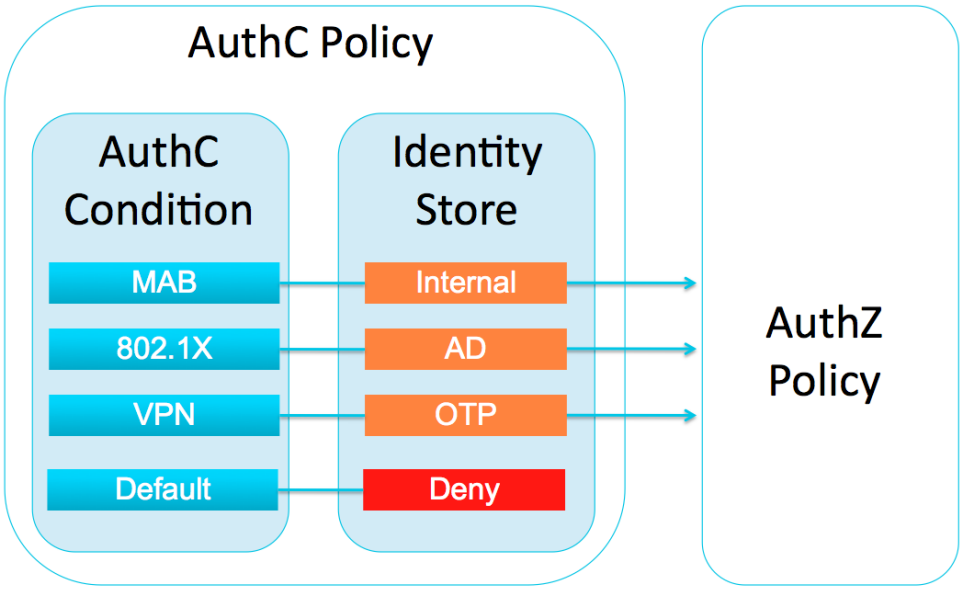
When a NAD sends an authentication request to the Cisco ISE, the request is sent as a RADIUS request (NADs may include VPN concentrators, wireless LAN controllers, and LAN switches). The RADIUS request consists of multiple attributes, including username/password, service type, class attributes, and so on. The authentication policy compares the incoming RADIUS request to the configured authentication conditions, filters out protocols and Extensible Authentication Protocol (EAP) types using filters the protocol allows, selects the assigned identity store, and processes the response sent back by the identity store. Then the authorization (AuthZ) policy takes over.

For instance, when endpoints are authenticating through Protected Extensible Authentication Protocol (PEAP) with Microsoft Challenge Handshake Authentication Protocol Version 2 (PEAP-MSCHAPv2), the ISE authentication policy can direct the request to an Active Directory (AD) identity source using the authentication conditions; however, when ISE receives a MAB request, it can direct the request to internal endpoint database. Another scenario is when VPN requests are forwarded to a one-time password (OTP) server, but WLAN and LAN 802.1X requests are forwarded to AD for authentication.

Note: For ease of reading and distinguishing terminology, we will commonly refer to authentication policies as AuthC policies, and to authorization policies as AuthZ policies.

The ISE graphical user-interface logic separates out the AuthC and AuthZ policies (Figure 3). The AuthC policy dictates what identity store to query based on the incoming authentication request. For example, an authentication request coming from a VPN gateway may be configured to check an OTP server to validate credentials. Meanwhile, using the same ISE installation, an authentication request from a Cisco Wireless LAN Controller (WLC) results in validating the credentials with Active Directory. ISE provides very powerful and flexible authentication policy functionality.

Figure 3 ISE Authentication and Authorization Policy Construct



Before you can configure AuthC policies using external identity sources, you must configure the external identity source that contains your user information in ISE. This How-To Guide provides the basic understanding of EAP methods and demonstrates how to handling identity stores by using Microsoft AD and Lightweight Directory Access Protocol (LDAP).

Understanding EAP Methods and Identity Sources

Not all identity sources support all EAP methods. When you choose an identity source, be sure to verify that it supports the EAP method you wish to deploy. Conversely, if you have already decided on an identity source to use, be sure to choose an EAP method that is supported by that source. For example, an EAP type that uses MSCHAPv2 as the inner method (such as PEAP-MSCHAPv2) can use Active Directory as a backend database, but cannot use a generic LDAP server. Table 1 shows various identity source platforms and the EAP methods they support.

Table 1 EAP Types Supported by Major Identity Source Platforms

EAP-Type	Win 7 Native	Vista Native	Win XP Native	AC 3.0	Apple SL (10.6)	Ubuntu	RHL	ACS 5.2	ISE 1.0	AD	LDAP
EAP-TLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
EAP-TTLS	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes
PEAP MSCHAPv2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
PEAP EAP-GTC	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PEAP EAP-TLS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
EAP-FAST MSCHAPv2	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
EAP-FAST EAP-GTC	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Active Directory Configuration

Cisco ISE uses an Active Directory connector so that each Cisco ISE node in a TrustSec deployment joins the AD domain and accesses AD resources just like any other Windows domain member. This scenario allows for tremendous increase in speed, ease of use, and flexibility when using Active Directory with the TrustSec security solution. ISE AD integration supports multiple AD domains provided that there is mutual trust relationship configured among the domains. If you are looking for a way to integrate ISE in an environment where a mutual trust relationship is not possible among the domains, please refer to the TrustSec Multiple Active Directories How-To Guide.

Cisco Best Practice: Both time synchronization and Domain Name System (DNS) are critical to a solid integration with Active Directory. Therefore, always use Network Time Protocol (NTP) and always ensure DNS is configured correctly, with reverse-DNS pointers for all Active Directory servers.

Cisco ISE Configuration and Active Directory Integration

Procedure 1 Join the Domain.

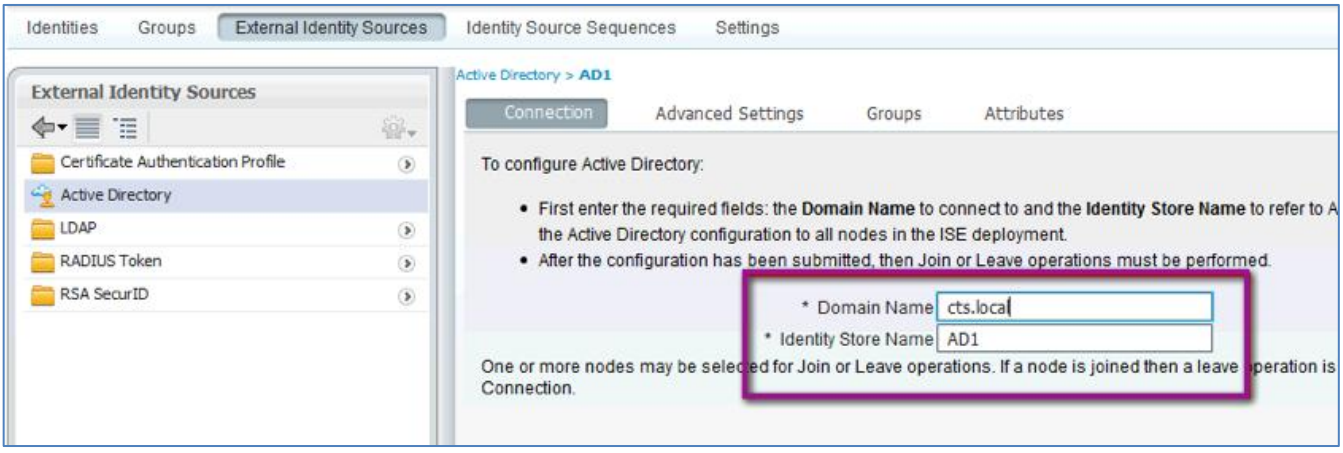
Each Cisco ISE node joins the domain separately. The following is a list of ports that must be open between all Cisco ISE nodes and Active Directory:

- SMB (TCP/445)
- KDC (TCP/88)
- Global Catalog (TCP/3268 and 3289)
- KPASS (TCP/464)
- NTP (UDP/123)
- LDAP (TCP and UDP/389)
- LDAPS (TCP/636)

Step 1 In the Cisco ISE GUI select Administration → Identity Management → External Identity Sources → Active Directory

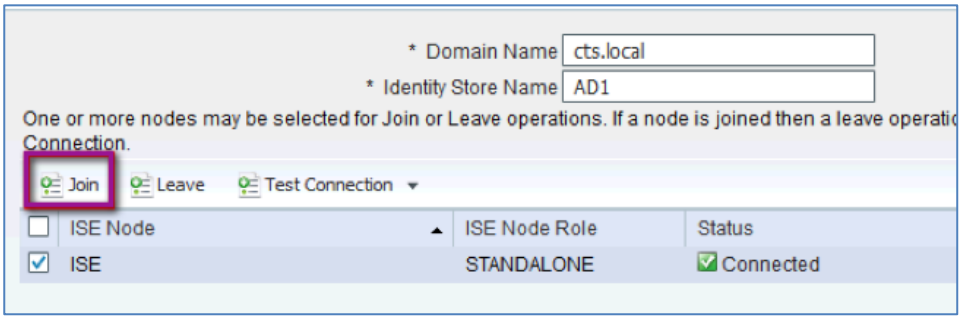
Step 2 Enter the AD Domain Name (in the example, **cts.local**) and click Save Configuration (Figure 4).

Figure 4 AD External Identity Source: Configuring AD Connector



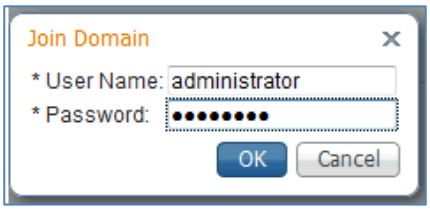
Step 3 Click the ISE checkbox and click Join (Figure 5).

Figure 5 AD External Identity Source: Join Operation



The Join Domain pop-up window appears. Enter a username and password for an AD account that has rights to join a workstation to the domain—for example, **administrator** (Figure 6).

Figure 6 AD External Identity Source: Account Information



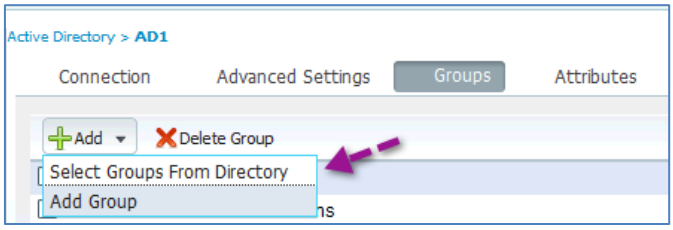
Note: The user account used for the preceding operation must have, at a minimum, permission to add and remove computers.

Note: The credentials used to add the ISE node to the domain are not saved on ISE.

Step 4 Select Administration → Identity Management → External Identity Sources → Active Directory → Groups

Step 5 Select the option Select Groups From Directory (Figure 7).

Figure 7 AD External Identity Source - Groups

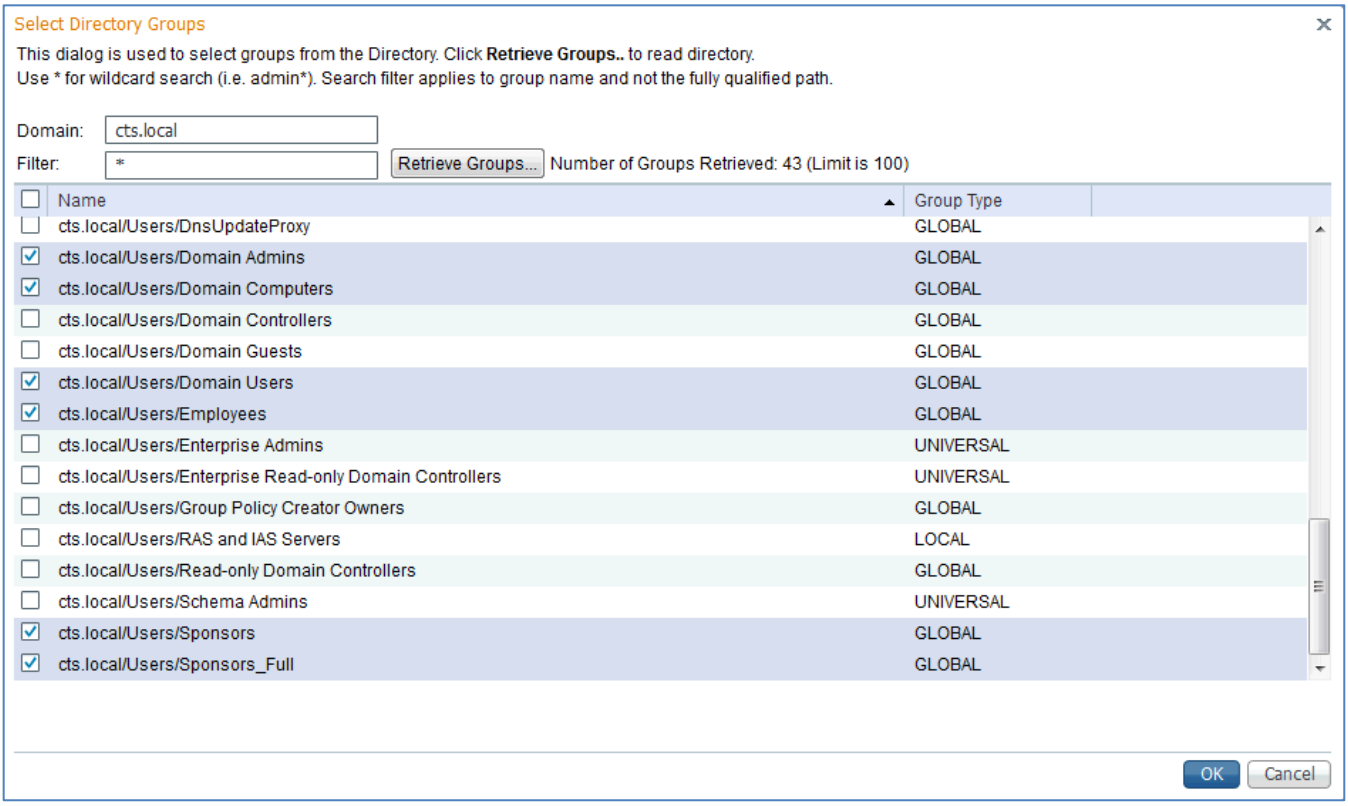


Cisco ISE allows a network administrator to select specific groups and attributes from Active Directory. This enables faster lookup times when authenticating a user against AD. It also helps to ensure that when the administrator builds a policy related to AD groups, the administrator needs to look through only a small list instead of every group in Active Directory.

Step 6 Select the groups that you want to use in policy decisions (Figure 8).

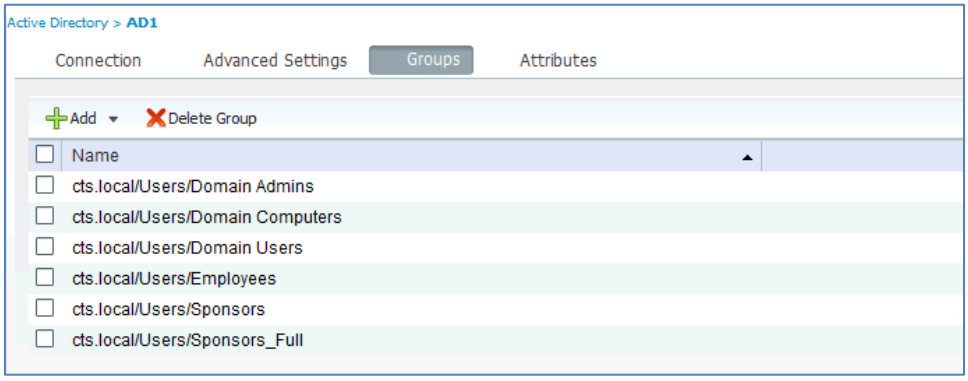
Select groups that will be used in your network access policies later. Common groups may include: Domain Computers, Contractors, Employees, Domain Users, and more. You can add and remove groups at any time.

Figure 8 AD External Identity Source – Group search



Step 7 After selecting all necessary groups, click OK (Figure 8).

Figure 9 AD External Identity Source: Select Groups



Step 8 Click Save Configuration (Figure 10).

Figure 10 Save Configuration

LDAP Configuration

Cisco ISE supports LDAP v3-compliant LDAP servers for authentication. Although LDAP server is added through the Policy Administration Node (PAN) GUI, each Policy Services Node (PSN) connects directly to the configured LDAP server for the authentication request.

LDAP can also be used during the configuration of AuthZ policies independent of whether endpoint was authenticated via LDAP. In other words you can configure authentication to use the certificate authentication profile (CAP) and do a lookup of endpoint's group membership on the configured LDAP server for further authorization conditions.

For more information on how to configure CAP using LDAP lookup, please refer to TrustSec Multiple Active Directories How-To Guide.

When you set up an LDAP server on the Cisco ISE, you'll notice that there are predefined schema for Microsoft Active Directory, Sun directory server, and Novell eDirectory. For other LDAPv3 compliant servers, you can use the custom option to configure the schema settings. The following section provides an example of configuring the ISE to connect to Microsoft Active Directory server for LDAP authentication.

Procedure 1 Add a LDAP Server

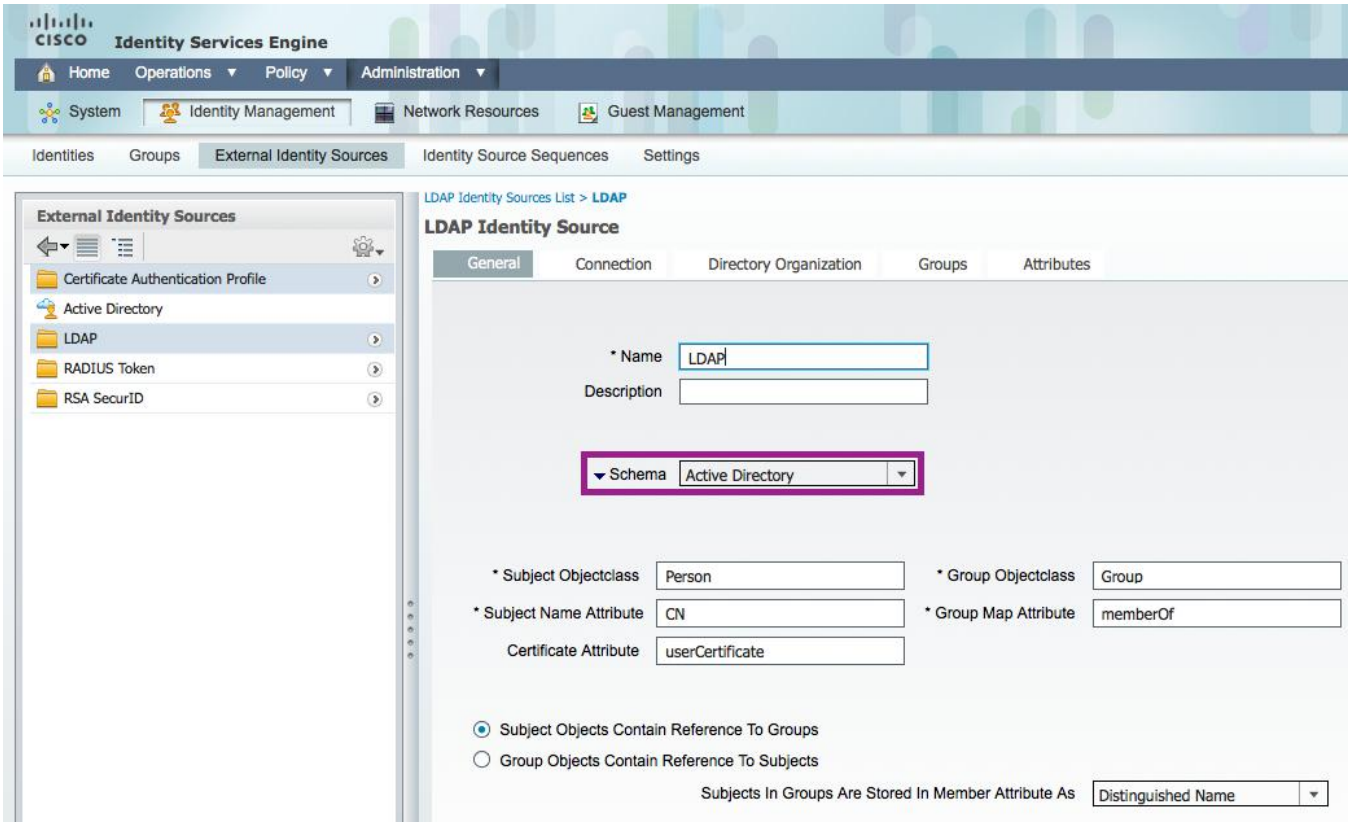
Step 1 Navigate to Administration→Identity Management→External Identity Sources→LDAP.

Step 2 Click Add.

Step 3 Enter name of the LDAP identity source.

Step 4 Select Active Directory as the Schema. Click the down-arrow to view the details of the Active Directory Schema (Figure 11).

Figure 11 LDAP External Identity Source: Schema



Step 5 Click the Connection tab.

Step 6 Enter the Hostname/IP (see Figure 12).

Step 7 Enter the Port number. In the example, this number is **389**.

Step 8 For the Access type, select Authenticated Access.

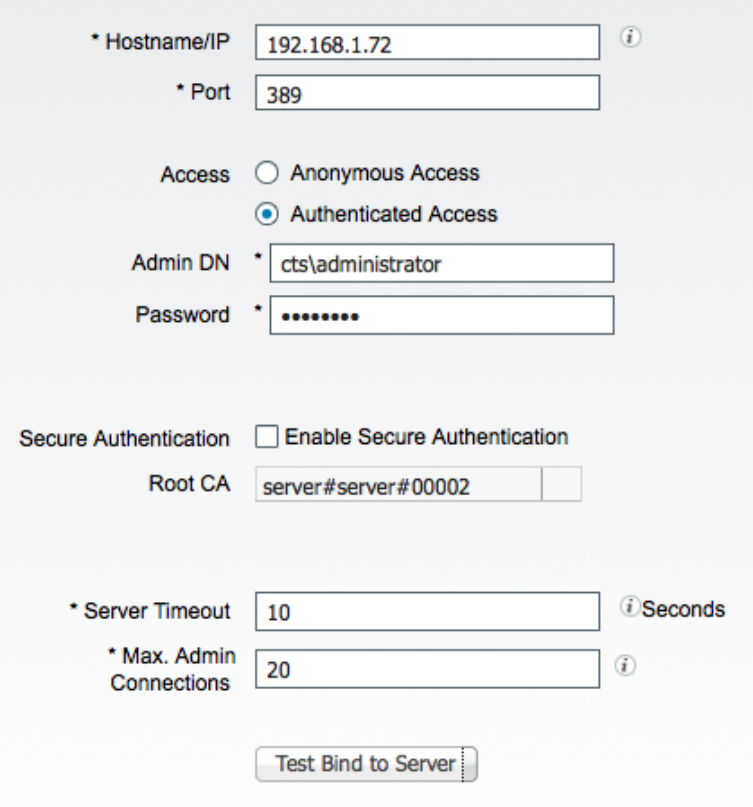
Step 9 Enter the Admin DN—in this example, **cts\administrator**. This is the Distinguished Name for a user who is a member of the Schema Admin Group within Active Directory. For example: **cn=SchemaAdmin, cn=Users, dc=demo, dc=local**.

Step 10 Enter the Admin DN's password.

Best Practice: Cisco ISE allows up to two LDAP servers for redundancy. We recommend that you use both servers in case the primary server fails

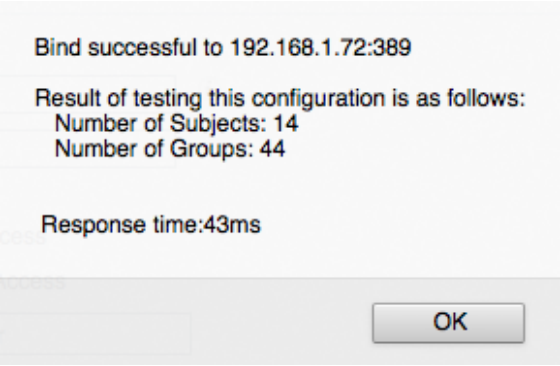
Best Practice: We recommend that you use SSL by enabling Secure Authentication. The LDAP setting may require different port.

Figure 3 LDAP External Identity Source: Configuration



Step 11 Click **Test Bind to Server** to validate the configuration. You should receive a confirmation as shown in Figure 13.

Figure 4 LDAP External Identity Source: Test Bind Validation

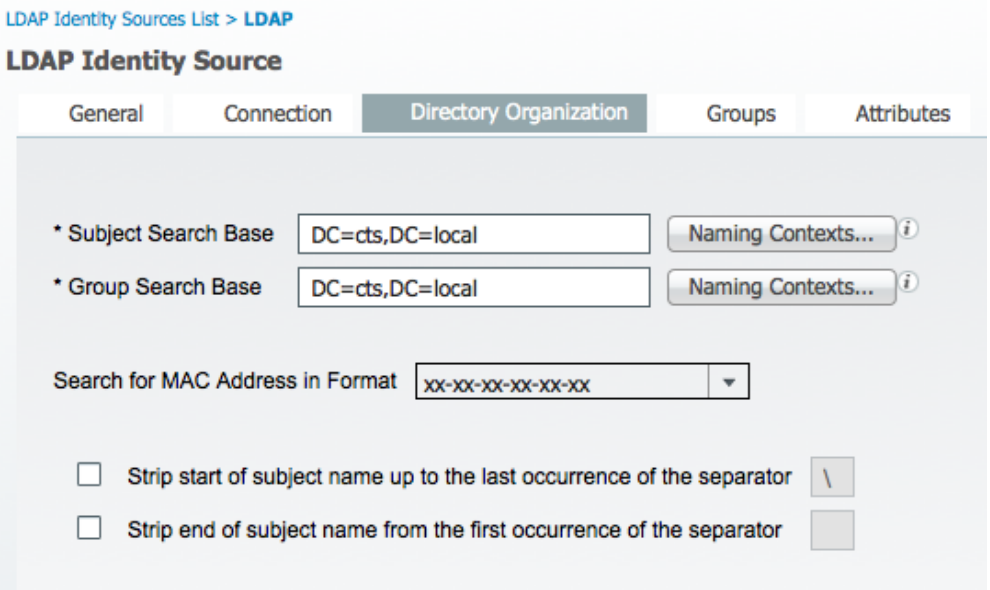


Step 12 Click the Directory Organization tab.

Step 13 Configure the Subject Search Base and the Group Search Base as **DC=cts, DC=local (Figure 14).**

Best Practice: It is a best practice to define the search bases as specifically as possible. For a standard Active Directory server configuration, the search bases to use for subject and group search is **CN=Users, <Domain Component>**. (CN=Users, DC=demo, DC=local)

Figure 14 LDAP External Identity Source: Directory Organization

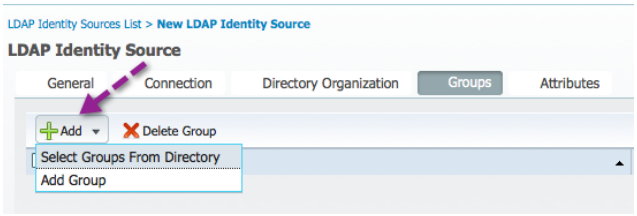


Step 14 Navigate to the Groups tab.

Step 15 Select Groups → Add → Select Groups From Directory (Figure 15).

Cisco ISE allows a network administrator to select specific groups and attributes from Active Directory. This scenario enables faster lookup times when authenticating a user. It also ensures that when building policy related to AD groups, the administrator needs to look through only a small list instead of every group in AD.

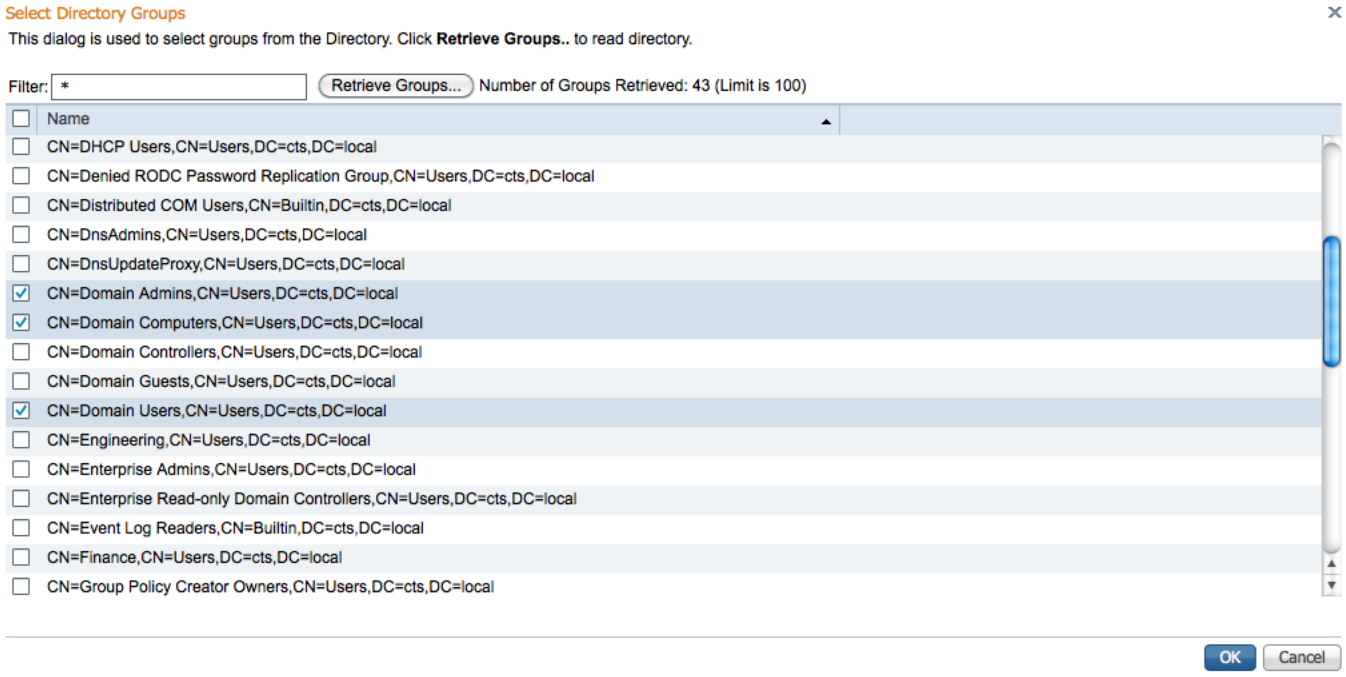
Figure 5 LDAP External Identity Source: External Groups



Note: The groups found are the result of the returned values from a search based on the **memberOf** attribute that you configured back on the general LDAP Identity Source page (Figure 11).

Step 16 Of the groups retrieved, select the specific groups that will be used to define AuthC and AuthZ policies (Figure 16).

Figure 16 LDAP External Identity Source: Search Groups



Step 17 Click Save.

Internal Database/Certificate Authorization Profile (CAP) /RADIUS Token/RADIUS Proxy

In addition to AD and LDAP, Cisco ISE also supports internal database, certificate, RADIUS token servers for OTP, and native integration for RSA SecurID token servers for authentication. ISE provides three types of internal databases: users, endpoints, and guest. The user and guest identity database are typically used for authenticating endpoints when 802.1x or web authentication is used for authentication. The endpoint identity database is used for categorization of endpoints from automated profiling, device registration, and also from manually created white lists or black lists of MAC addresses. Endpoint identity sources can be used to simply MAB endpoints or they can be combined with other conditions during authorizations for corporate BYOD policies.

Note: The guest identity database is visible only when you log into the sponsor portal page.

A certificate authentication profile (CAP) can be used to authenticate endpoints identifying themselves using digital certificates. This is used in an environment where mutual authentication using digital certificates is required. You can select which X.509 field, such as the subject of the CN= field, or the email address of the SAN, will be used for endpoint identity.

For integration with one-time password (OTP) servers, Cisco ISE supports RADIUS token servers and native SecurID integration. RADIUS token servers are used when the OTP server is running RADIUS natively and ISE forwards the RADIUS request to the OTP RADIUS server. SecurID is used where Cisco ISE terminates the RADIUS locally and forwards the OTP request to the SecurID server via the Secure Device Provisioning (SDP) feature.

Configuration of CAP and OTP is beyond the scope of this document. For more information, please refer to the ISE 1.1 User Guide document.

Identity Source Sequence

Identity sequences are used in ISE to provide a single "object" that is actually a sequence of identity stores that only ISE queries when validating credentials. This is useful when there are multiple identity databases and when it is not possible to identify which identity source the user is member of during authentication request processing. In our configuration example, we create an identity sequence that queries the following identity stores in order: Active Directory → Internal Users.

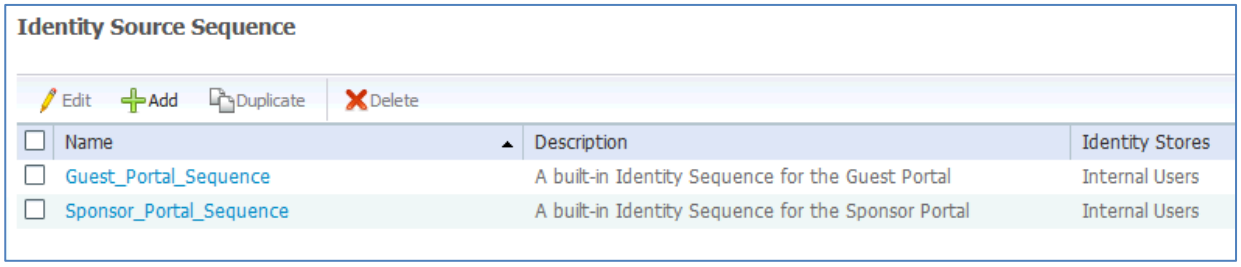
Best Practice: Avoid using identity source sequences if possible. Instead, use an authentication condition to forward the authentication request to the correct identity source.

Procedure 1 Create an Identity Sequence

Step 1 Navigate to Administration→Identity Management→Identity Source Sequences.

Step 2 There are two identity source sequences by default (Figure 17).

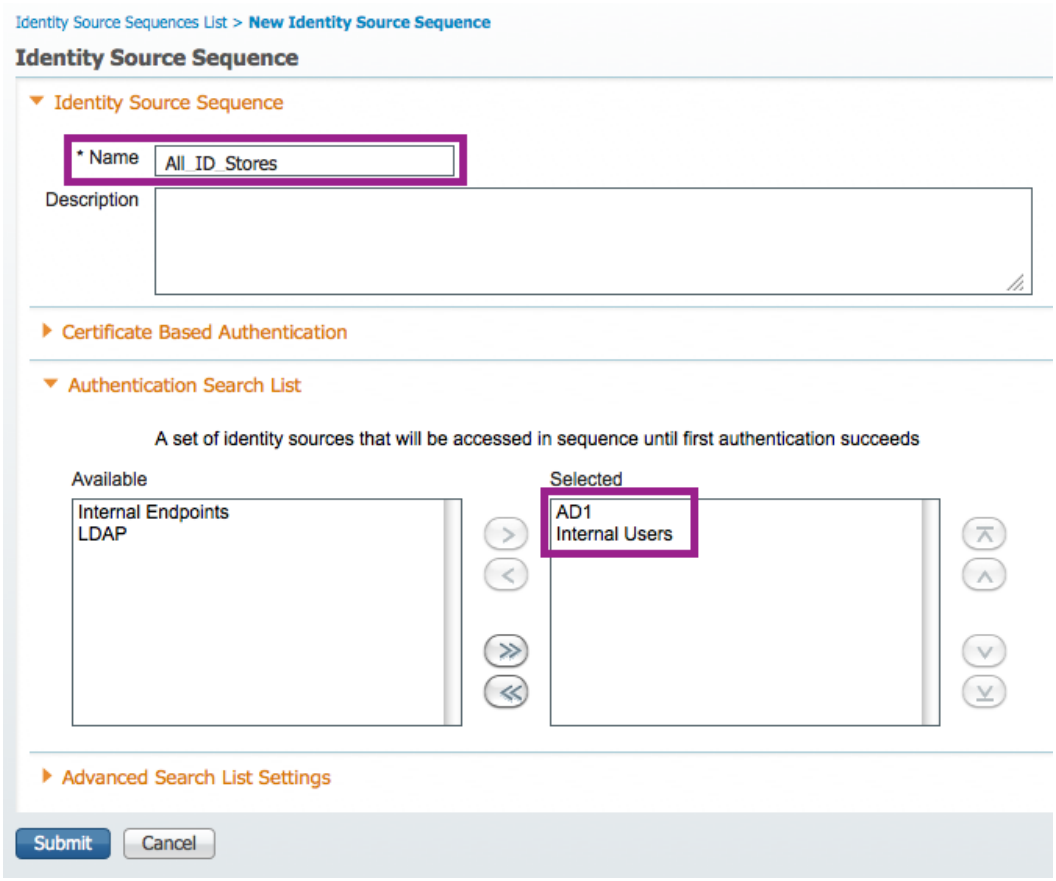
Figure 17 Adding Identity Source Sequence



Step 3 Click Add.

Step 4 Name the identity sequence **All_ID_Stores.** Select the identity stores AD1 from left pane and add it to the right pane. Then select and add Internal Users (Figure 18).

Figure 618 Configuring the Identity Source Sequence



Step 5 Scroll to the bottom of the window and click Submit.

Creating Authentication Policies

In our configuration example, we will create an authentication policy that does the following:

- Forward any MAB request to internal endpoint database
- Forward wired and wireless 802.1x requests to AD
- Forward any unknown request to All_ID_Store sequence we configured in previous section

Configuring Authentication Policy

Procedure 1 Examine the Default ISE Authentication Policy

Step 1 Navigate to Policy → Authentication.

There are two preconfigured rules in the authentication policy, as well as a default rule. The Policy Rule table behaves like an access list: it is processed from the top down, and the first match is the rule that is used.

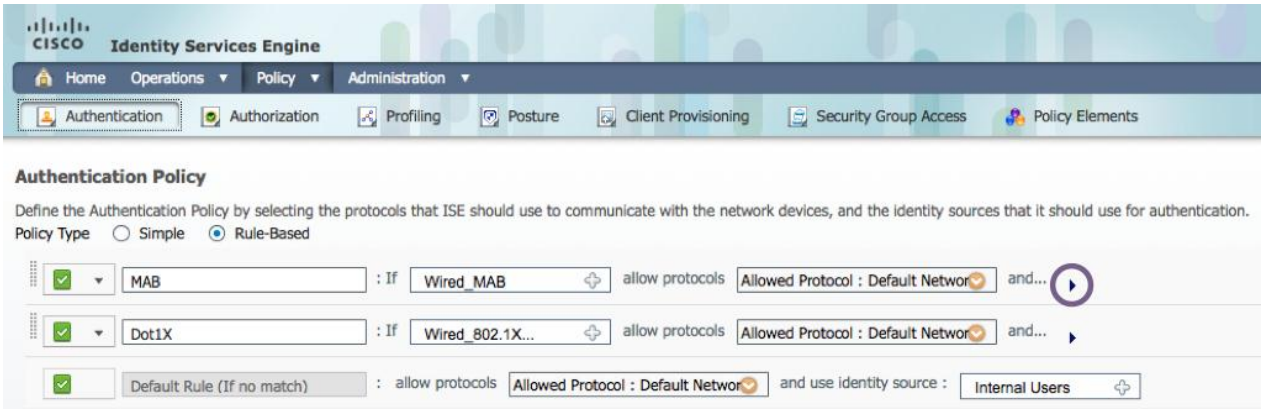
Note: There is Policy Type option at the top of the page where you can select either simple or rule-based. When Simple option is used, all authentication requests can be forwarded only to single identity source or identity source sequence. For most deployments, it is recommended to use the rule-based option for efficient routing of the authentication request to the proper identity sources.

The way an authentication request is matched to a rule-line is based on the conditions. To explain this further, we will examine the first preconfigured rule, named MAB. This is a rule for MAC authentication bypass from switches.

Cisco ISE policy constructs are built in a logical IF-THEN format. Notice the IF just before the "picker" that says Wired_MAB. This particular line is stating: "If RADIUS request is Wired_MAB, then allow the Default Network Protocols to be used."

```
IF Wired_MAB
THEN Allow the default protocols
ELSE
Move to next Line in Authentication Policy Table
```

Figure 7 Authentication Policies

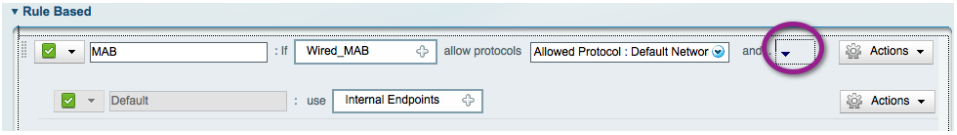


Step 2 In Figure 19, notice the "and …" after the Allowed Protocol boxes. Next to the word "and…" is a black drop-down triangle (circled in Figure 19)

Step 3 Click the triangle.

The result is shown in Figure 20. Each rule in the Authentication Policy table has a second part to it. This is the line where the credential store is chosen. By default, this preconfigured rule for MAC authentication bypass is configured to use the Internal Endpoints data store. The Internal Endpoints data store is the database of known devices internal to ISE. This database can be populated manually or dynamically.

Figure 20 Authentication Policies: MAB



Note: An example of manual population: The admin exports a list of known Cisco Unified IP Phone MAC addresses from the Cisco Unified Communications Manager interface, and imports that list into ISE.

An example of dynamic population: ISE profiling discovered this device via one or more of the profiling probes, and created the device entry in the Internal Endpoints data store.

So, the IF-THEN statement looks like this:

```
IF Wired_MAB
THEN Allow the default protocols
  AND  Check Credentials with the Internal Endpoints Data Store
ELSE
Move to next Line in Authentication Policy Table
```

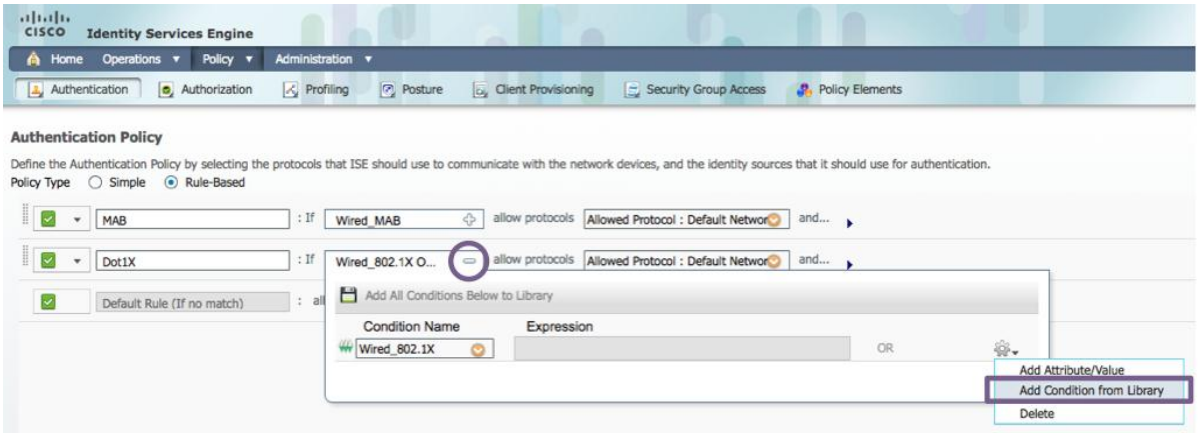
Note: The Wired_MAB is a prebuilt condition to match RADIUS attributes **service-type = call-check**, and **nas-port-type = ethernet.**

Procedure 2 Enable Wireless Authentication

Step 1 Navigate to Policy → Authentication.

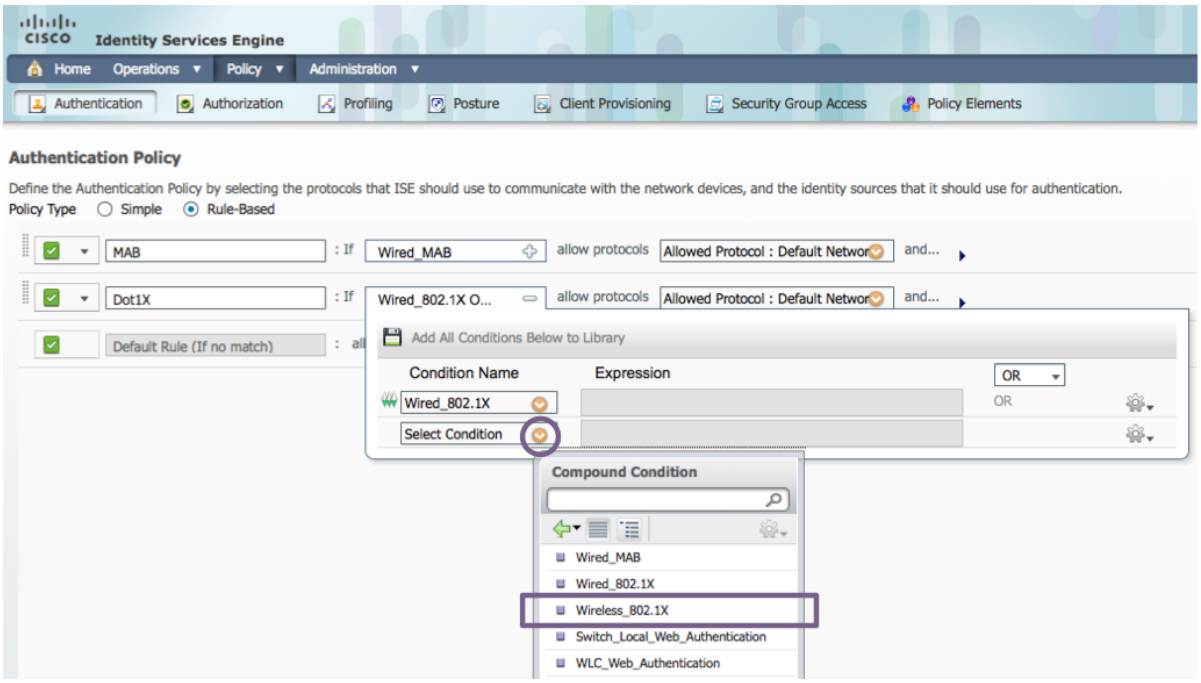
Step 2 Expand the IF conditions for the Dot1X rule and choose to Add Condition from Library (Figure 21).

Figure 8 Authentication Policies: Adding WLAN Condition 1



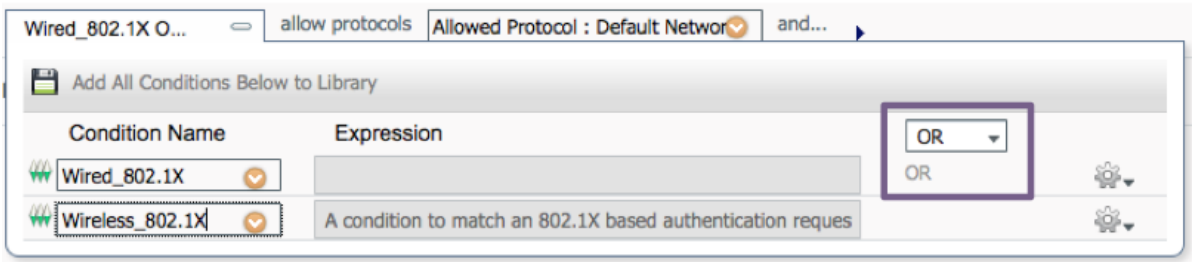
Step 3 From the Select Condition drop-down menu, select: Compound Condition → Wireless_802.1X (Figure 22).

Figure 9 Authentication Policies: Adding WLAN Condition 2



Step 4 Ensure that the operator is specified as OR, not AND (Figure 23).

Figure 23 Authentication Policies: Adding WLAN Condition 3



Step 5 Save the settings.

So, the IF-THEN statement for Dot1X rule looks like this:

```
IF Wired_802.1X or Wireless_802.1X
THEN Allow the default protocols
  AND  Check Credentials with the Internal Users Data Store
ELSE
Move to next Line in Authentication Policy Table
```

Note: Wired_802.1X is a prebuilt condition to match the following RADIUS attributes: **service-type = Framed,** and **nas-port-type = Ethernet.** In contrast, Wireless_802.1X is a prebuilt condition to match these RADIUS attributes: **service-type = call-check**, and **nas-port-type = Wireless – IEEE 802.11**.

Procedure 3 Change the identity stores.

With the preconfigured rules, MAB will use the Internal Endpoints store to look for the MAC addresses of known devices. If the incoming authentication request is an 802.1X authentication, ISE will use the Internal Users data store to check for username and password validity.

If the authentication is of another type (for example, WebAuth), it will not match either of the preconfigured rules and it will end up with the Default Rule. The default rule is preconfigured to check the Internal Users data store.

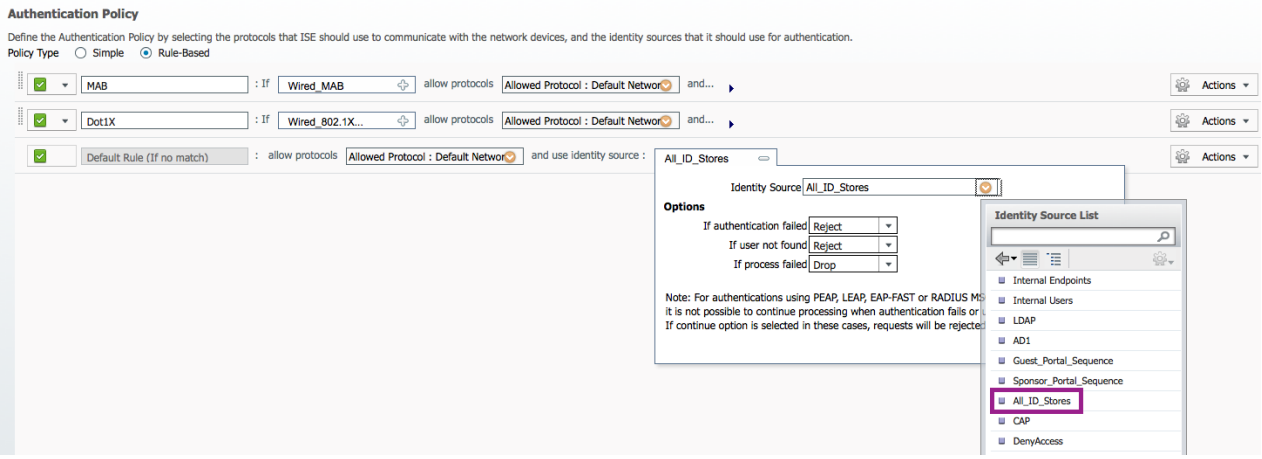
Most organizations will not want to use the default, local data stores for user accounts. The vast majority of organizations use Active Directory as their main source of user identity data. Therefore, we will change the default rule to use All_ID_Store and the Dot1X Rules to use Active Directory only.

Step 1 In the Default Rule, click the plus sign next to Internal Users.

This opens the Identity Source picker.

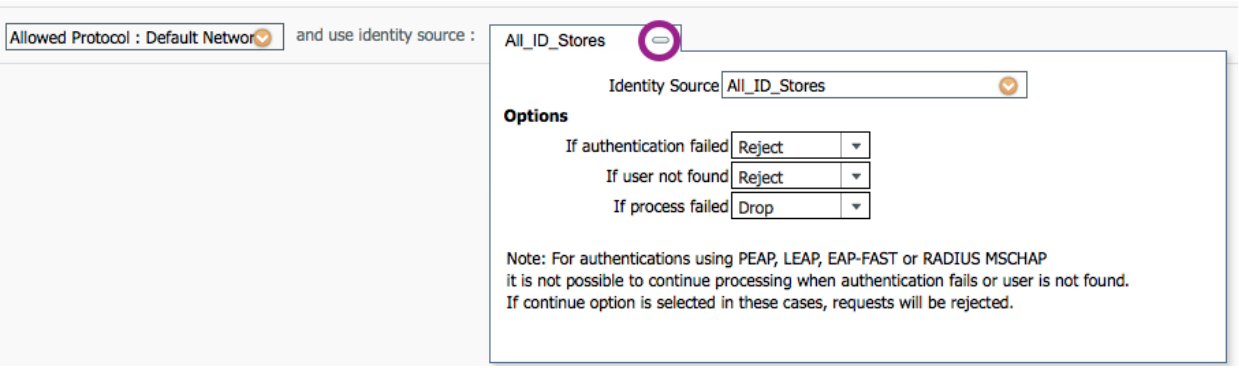
Step 2 Select the All_ID_Stores identity source sequence that we built earlier (Figure 24).

Figure 10 Authentication Policies: Modifying Default Rule 1



Step 3 Click the minus sign to close the Identity Source picker (Figure 25).

Figure 11 Authentication Policies: Modifying Default Rule 2



Step 4 Make note of the options below the Identity source.

The actions for each option are: Reject, Drop, or Continue. These three options and their respective choices are available with every authentication policy rule, including the default rule. Table 2 describes the three options. Table 3 describes their configurable actions.

Table 2 Authentication Options

Option	Description
Authentication Failed	Received explicit response that authentication has failed such as bad credentials, disabled user, and so on. The default course of action is reject.
User not found	No such user was found in any of the identity databases. The default course of action is reject.
Process failed	Unable to access the identity database or databases. The default course of action is drop.

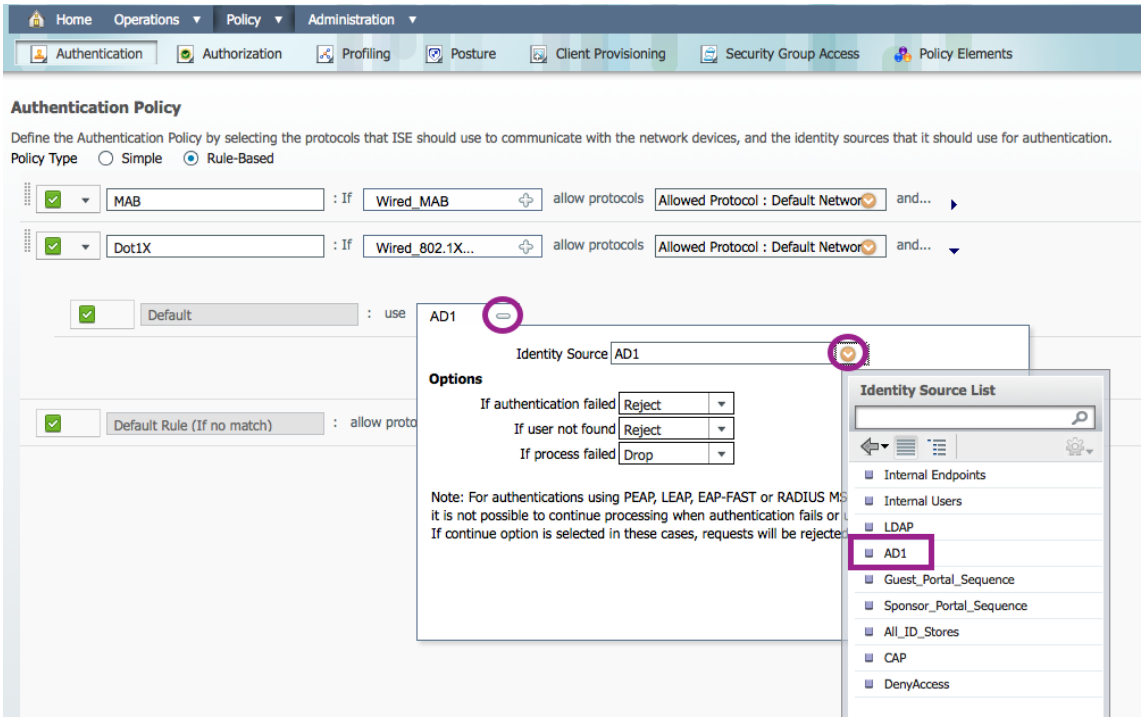
Table 3 Authentication Actions

Action	Description
Reject	Sends a RADIUS ACCESS-REJECT response to the NAD.
Drop	Drops the ACCESS-REQUEST, without sending a response.

Continue	Proceed to the authorization policy.

Step 5 Expand the Dot1X line, and repeat Steps 1 and 2 to change the identity source to be **AD1** (Figure 26).

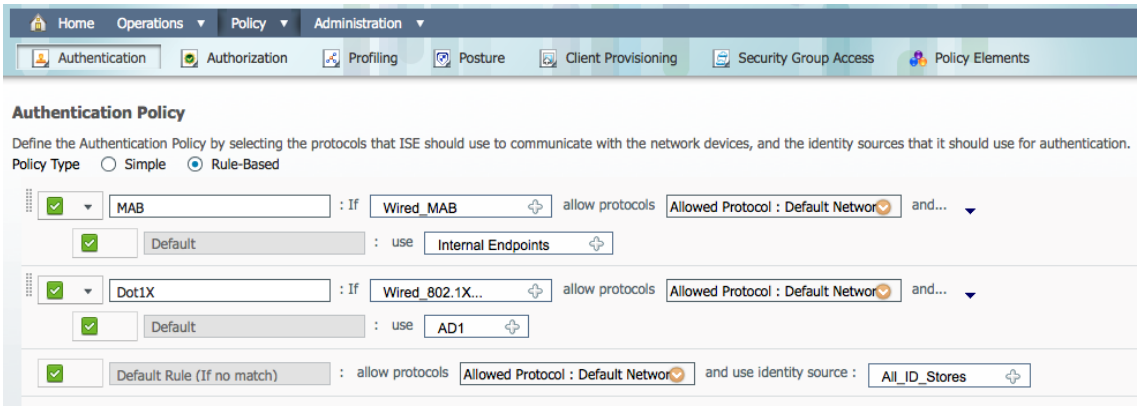
Figure 26 Authentication Policies: 802.1X Rule



Step 6 Click Save.

The authentication rule should look like that shown in Figure 27.

Figure 12 Final Authentication Policy



So, the IF-THEN statement for the ISE authentication policy rule looks like this:

```
IF Wired_MAB
THEN Allow the default protocols
  AND  Check Credentials with the Internal Endpoints Data Store
ELSE IF Wired_802.1X or Wireless_802.1X
THEN Allow the default protocols
  AND  Check Credentials with the AD1 Data Store
ELSE IF No Match
THEN Allow the default protocols
  AND  Check Credentials with the All_ID_Stores Data Store
```

Note: You can customize authentication rule extensively. In these examples, we have used the default network access as our allowed protocols. This allows the vast majority of authentication types, but using the defaults does not restrict access to a certain type of EAP method.

To configure a customized set of authentication protocols (such as EAP-TLS only), go to Policy → Policy Elements → Results → Authentication → Allowed Protocols.

Appendix A: References

Cisco TrustSec System:

- http://www.cisco.com/go/trustsec
- http://www.cisco.com/en/US/solutions/ns340/ns414/ns742/ns744/landing_DesignZone_TrustSec.html

Device Configuration Guides:

Cisco Identity Services Engine User Guides:
http://www.cisco.com/en/US/products/ps11640/products_user_guide_list.html

For more information about Cisco IOS Software, Cisco IOS XE Software, and Cisco NX-OS Software releases, please refer to following URLs:

- For Cisco Catalyst 2900 series switches:
  http://www.cisco.com/en/US/products/ps6406/products_installation_and_configuration_guides_list.html
- For Cisco Catalyst 3000 series switches:
  http://www.cisco.com/en/US/products/ps7077/products_installation_and_configuration_guides_list.html
- For Cisco Catalyst 3000-X series switches:
  http://www.cisco.com/en/US/products/ps10745/products_installation_and_configuration_guides_list.html
- For Cisco Catalyst 4500 series switches:
  http://www.cisco.com/en/US/products/hw/switches/ps4324/products_installation_and_configuration_guides_list.html
- For Cisco Catalyst 6500 series switches:
  http://www.cisco.com/en/US/products/hw/switches/ps708/products_installation_and_configuration_guides_list.html
- For Cisco ASR 1000 series routers:
  http://www.cisco.com/en/US/products/ps9343/products_installation_and_configuration_guides_list.html

For Cisco Wireless LAN Controllers: http://www.cisco.com/en/US/docs/wireless/controller/7.2/configuration/guide/cg.html