Configure TACACS+ over TLS 1.3 on an IOS XE Device with ISE

Contents

Introduction

This document describes an example for TACACS+ over TLS with Cisco Identity Services Engine (ISE) as server and a Cisco IOS® XE device as client.

Overview

The Terminal Access Controller Access-Control System Plus (TACACS+) Protocol [RFC8907] enables centralized device administration for routers, network access servers, and other networked devices through one or more TACACS+ servers. It provides authentication, authorization, and accounting (AAA) services, specifically tailored for device administration use cases.

TACACS+ over TLS 1.3 [RFC8446] enhances the protocol by introducing a secure transport layer, safeguarding highly sensitive data. This integration ensures confidentiality, integrity, and authentication for the connection and network traffic between TACACS+ clients and servers.

Using this Guide

This guide divides the activities into two parts to enable ISE to manage administrative access for Cisco IOS XE based network devices.
• Part 1 – Configure ISE for Device Admin
• Part 2 – Configure Cisco IOS XE for TACACS+ over TLS

Prerequisites

Requirements

Requirements to configure TACACS+ over TLS:

- A Certificate Authority (CA) to sign the certificate used by TACACS+ over TLS to sign the certificates ofISE and network devices.
- The root certificate from the Certificate Authority (CA).

- Network devices and ISE have DNS reachability and can resolve hostnames.

Components Used

The information in this document is based on these software and hardware versions:

- ISE VMware virtual appliance, release 3.4 patch 2
- Cisco IOS XE Software, version 17.15+

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Licensing

A Device Administration license allows you to use TACACS+ services on a Policy Service node. In a high availability (HA) standalone deployment, a Device Administration license permits you to use TACACS+ services on a single Policy Service node in the HA pair.

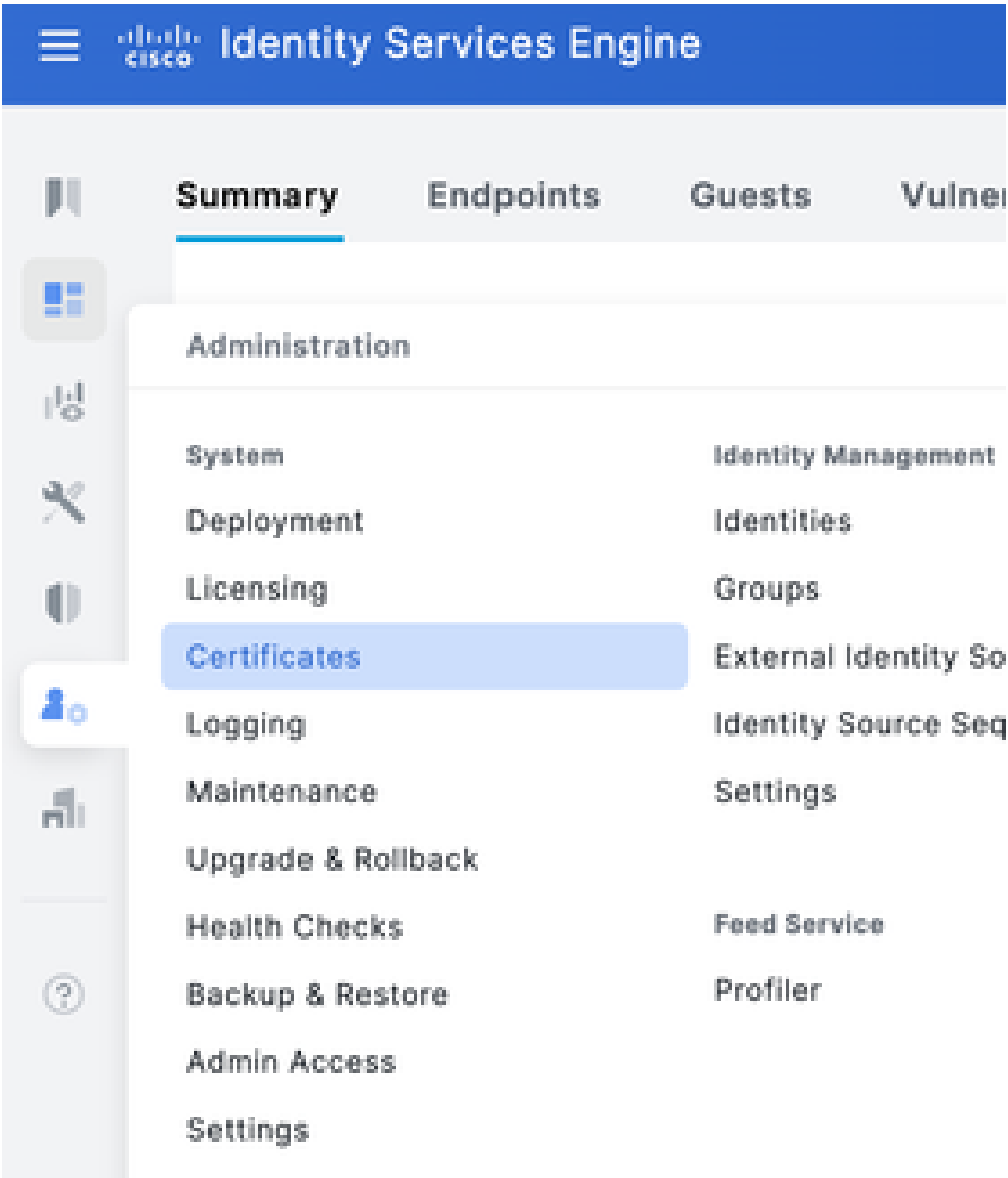
Part 1 - Configure ISE for Device Administration

Generate Certificate Signing Request for TACACS+ Server Authentication

Step 1. Log in to the **ISE admin web portal** using one of the supported browsers.

By default, ISE uses a self-signed certificate for all services. The first step is to generate a Certificate Signing Request (CSR) to have it signed by our Certificate Authority (CA).

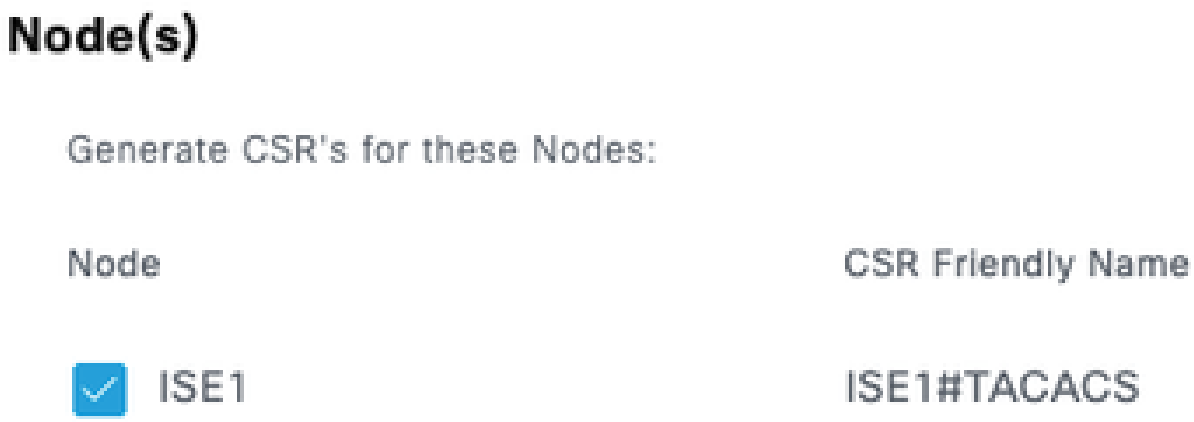
Step 2.Navigate to **Administration > System > Certificates**.



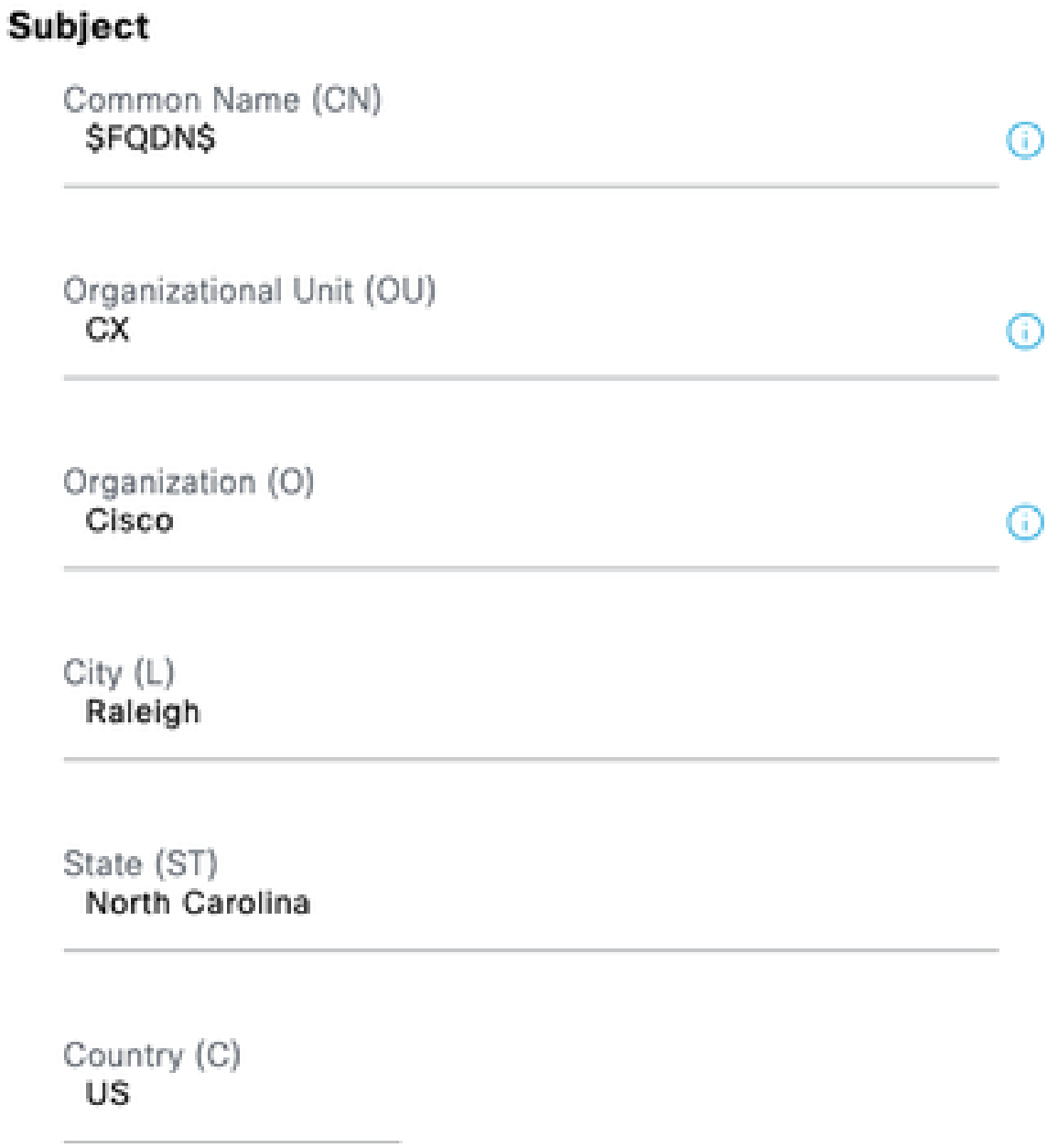
Step 3. Under **Certificate Signing Requests**, click **Generate Certificate Signing Request**.

Step 4.Select **TACACS** in**Usage**.

Step 5.Select the **PSNs**that wil have TACACS+ enabled.

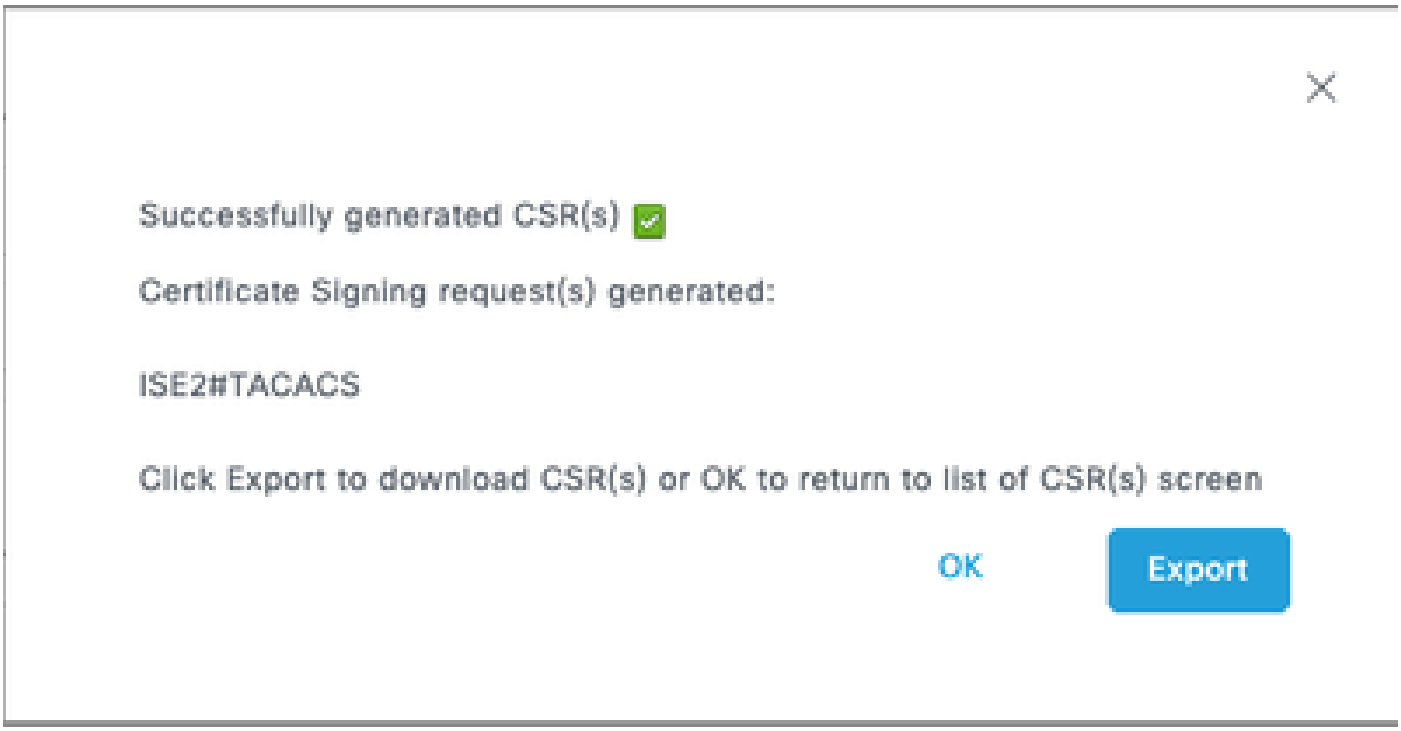


Step 6. Fill the **Subject** fields with the appropriate information.



Step 7.Add the **DNS Name** and **IP Address** under **Subject Alternative Name (SAN)**.

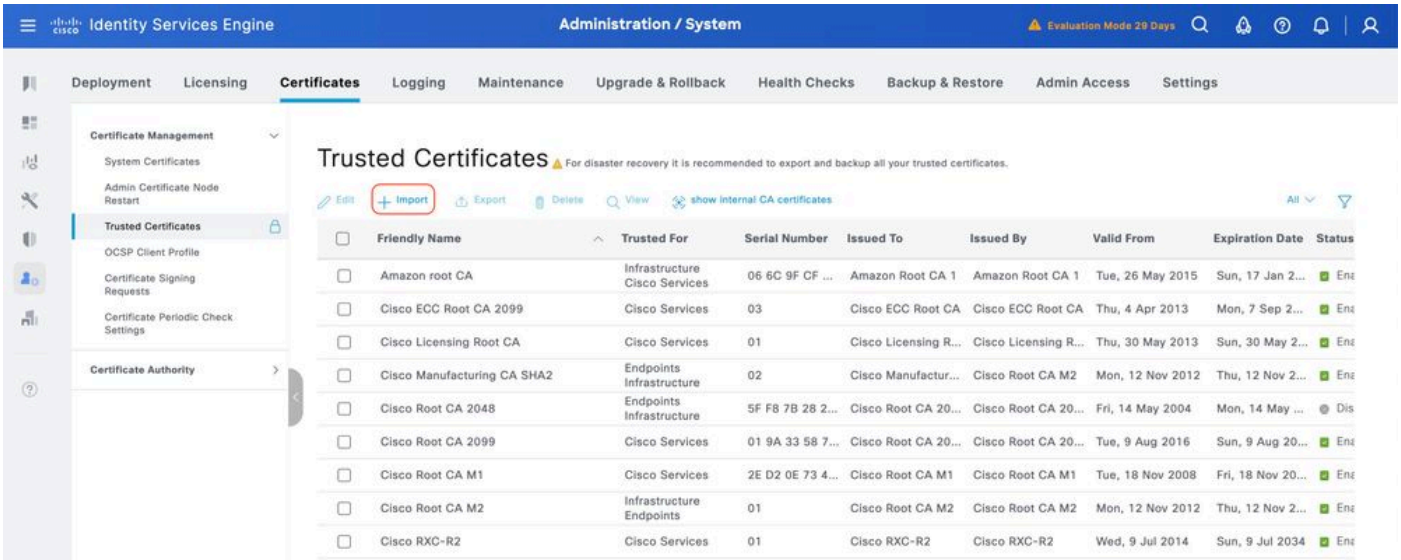
Step 8.Click **Generate** and then **Export**.



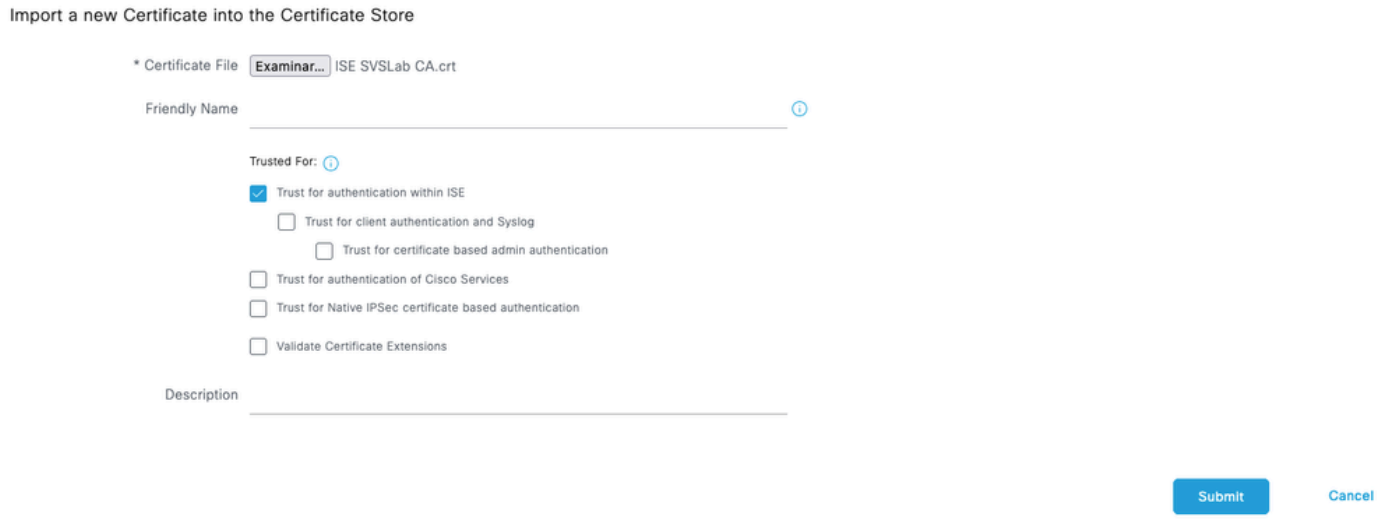
Now, you can have the certificate (CRT) signed by yourCertificate Authority (CA).

Upload Root CA Certificate for TACACS+ Server Authentication

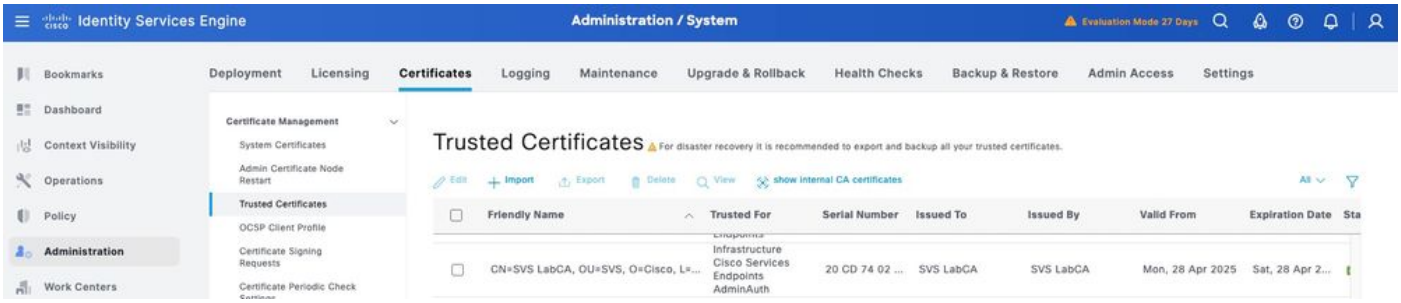
Step 1. Navigate to **Administration > System > Certificates**. Under **Trusted Certificates**, click **Import**.



Step 2. Select the **certificate** issued by the Certificate Authority (CA) that signed your TACACS Certificate Signing Request (CSR). Make sure that theTrust for authentication within ISE option is enabled.



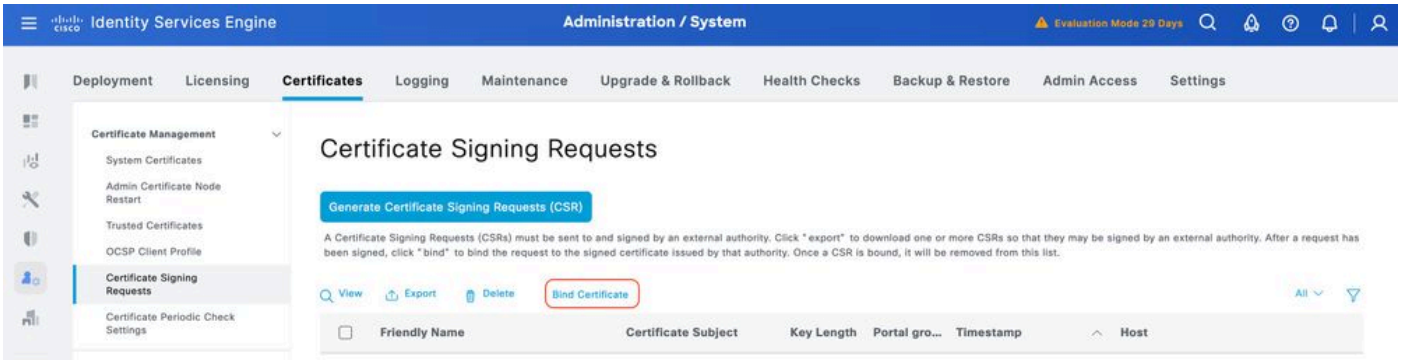
Step 3. Click **Submit**. The certificate must now appear under **Trusted Certificates**.



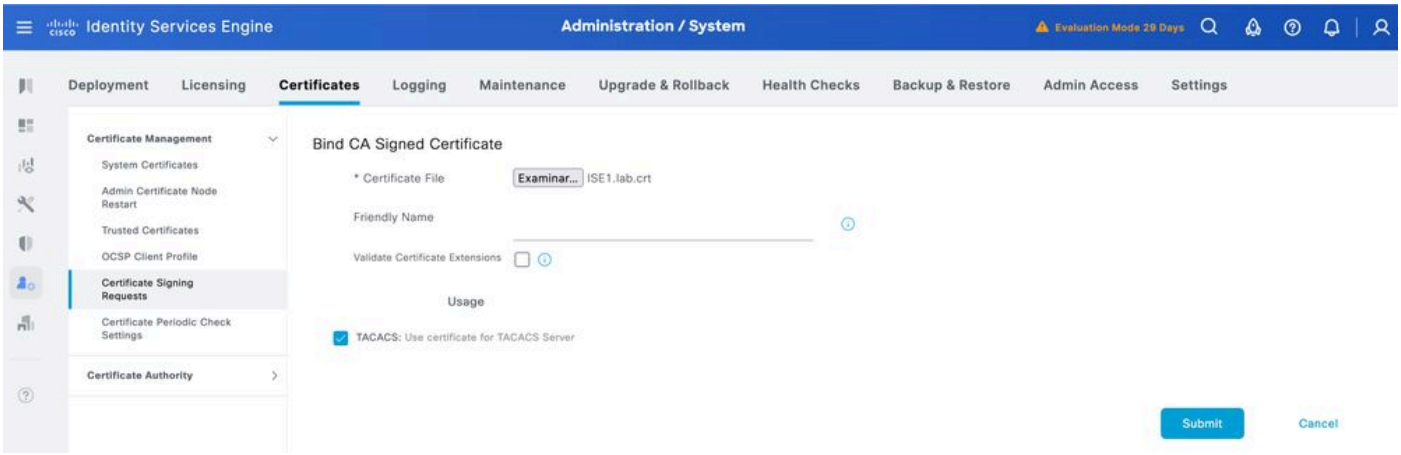
Bind the Signed Certificate Signing Request (CSR) to ISE

Once the Certificate Signing Request (CSR) is signed, you can install the signed certificate on ISE.

Step 1.Navigate to **Administration > System > Certificates**. Under **Certificate Signing Requests**, select the **TACACS CSR** generated in the previous step and click **Bind Certificate**.

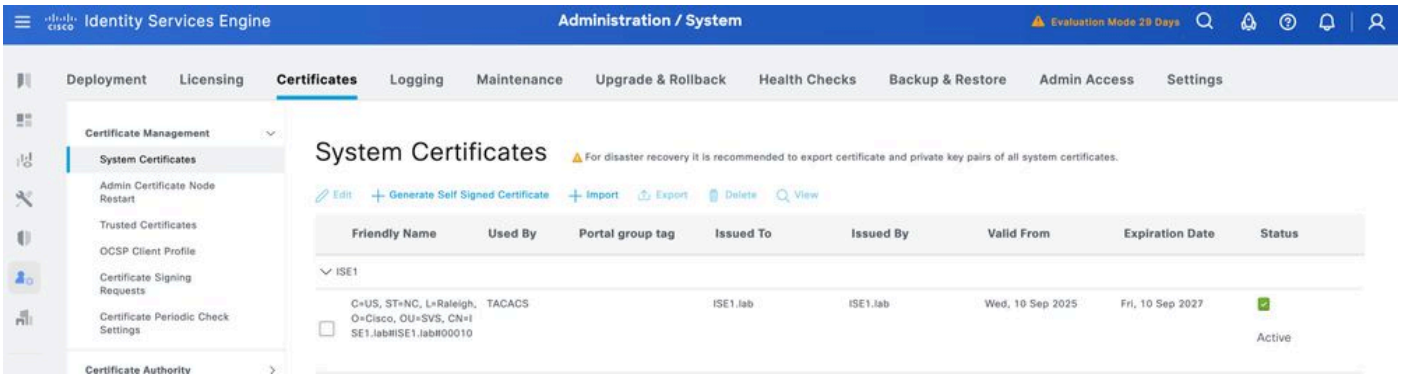


Step 2.Select the **signed certificate** and ensure the **TACACS** checkbox under **Usage** remains selected.



Step 3.Click **Submit**. If you receive a warning about replacing the existing certificate, click **Yes** to proceed.

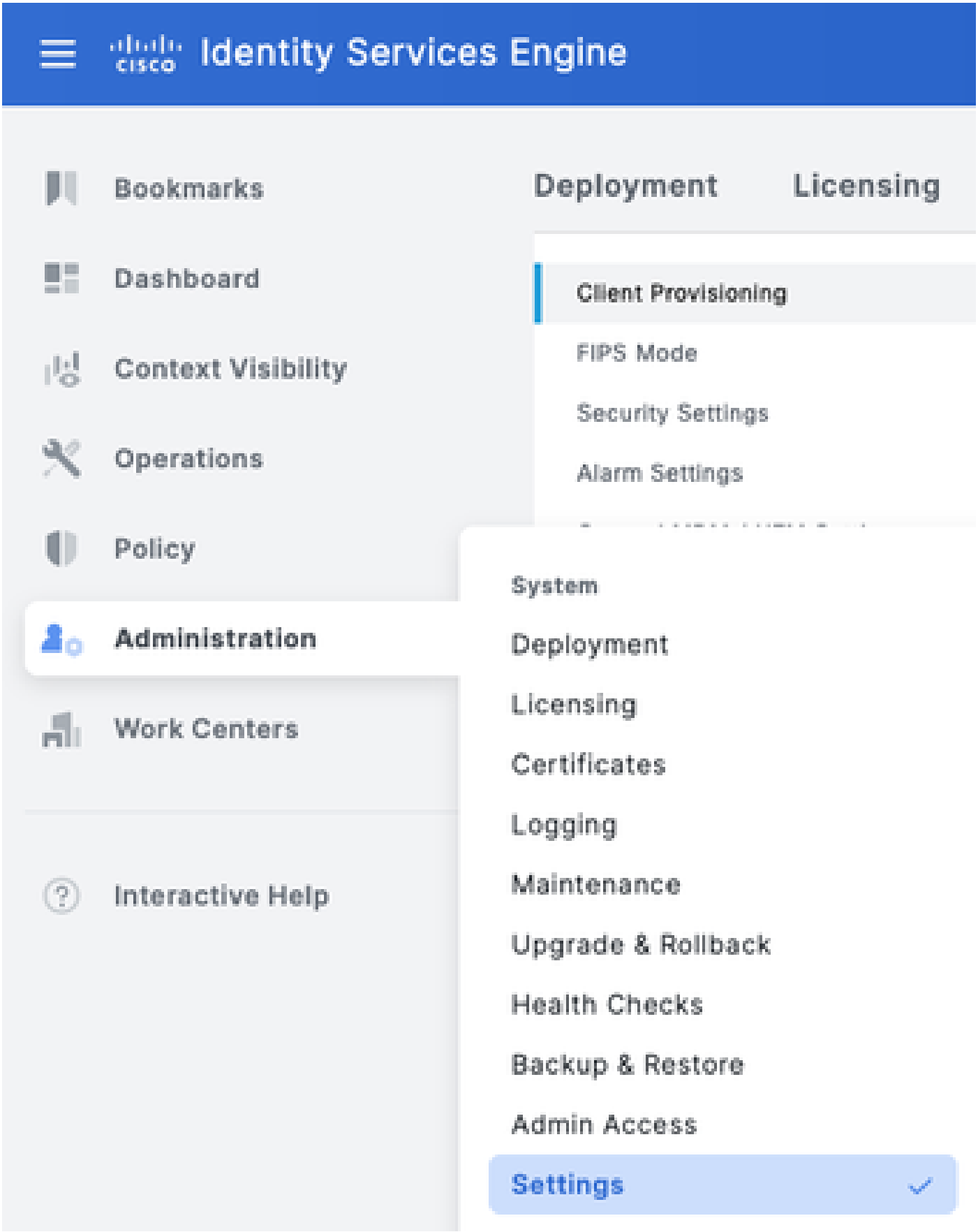
The certificate must now be correctly installed. You can verify this under **System Certificates**.



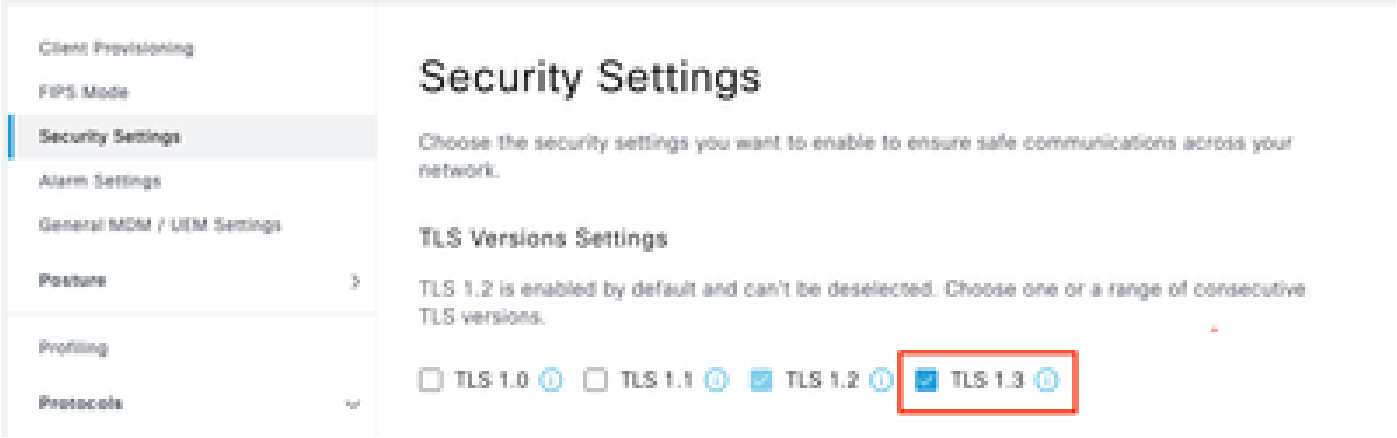
Enable TLS 1.3

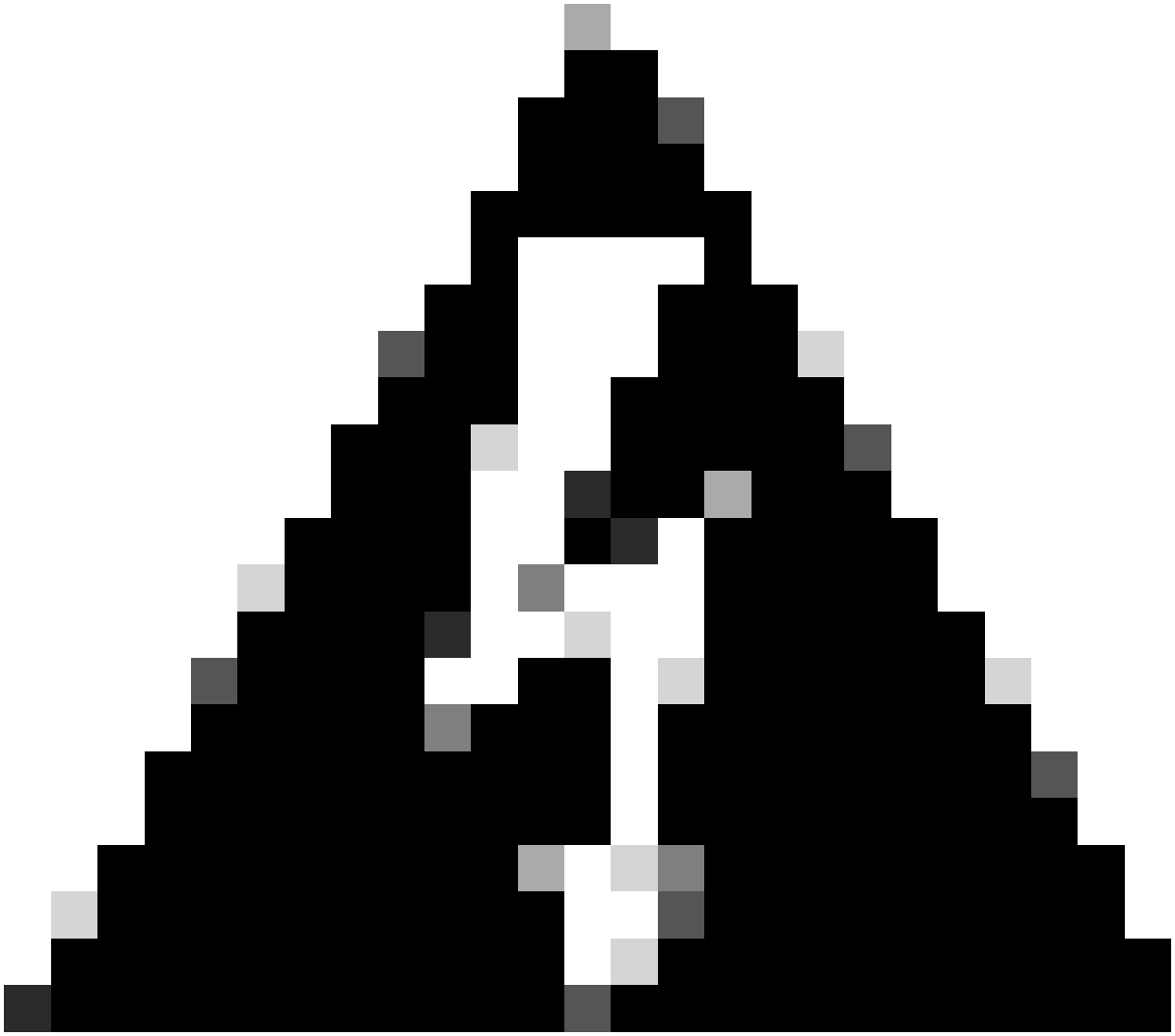
TLS 1.3 is not enabled by default in ISE 3.4.x. It must be manually enabled.

Step 1.Navigate to **Administration > System > Settings**.



Step 2.Click **Security Settings**, select the **check box** next to **TLS1.3** under TLS Version Settings, then click **Save**.





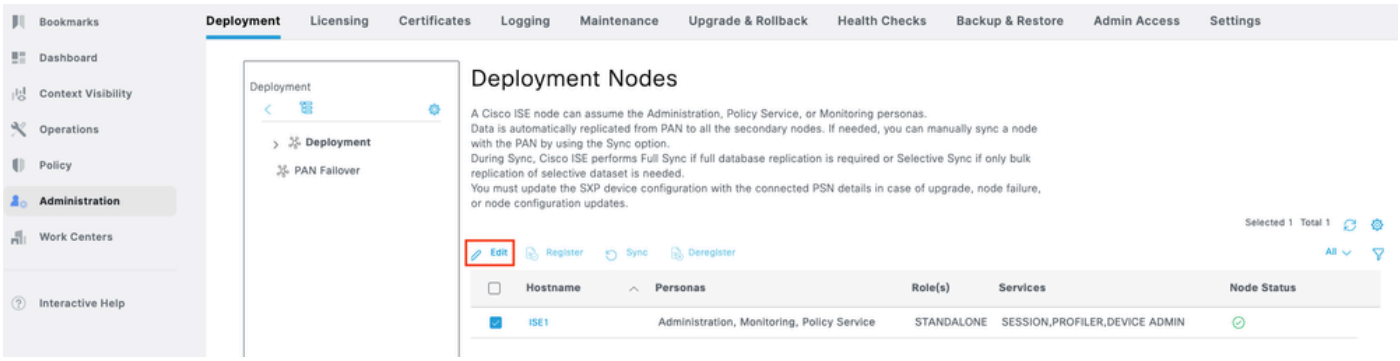
Warning: When you change the TLS version, the Cisco ISE application server restarts on all the Cisco ISE deployment machines.

Enable Device Administration on ISE

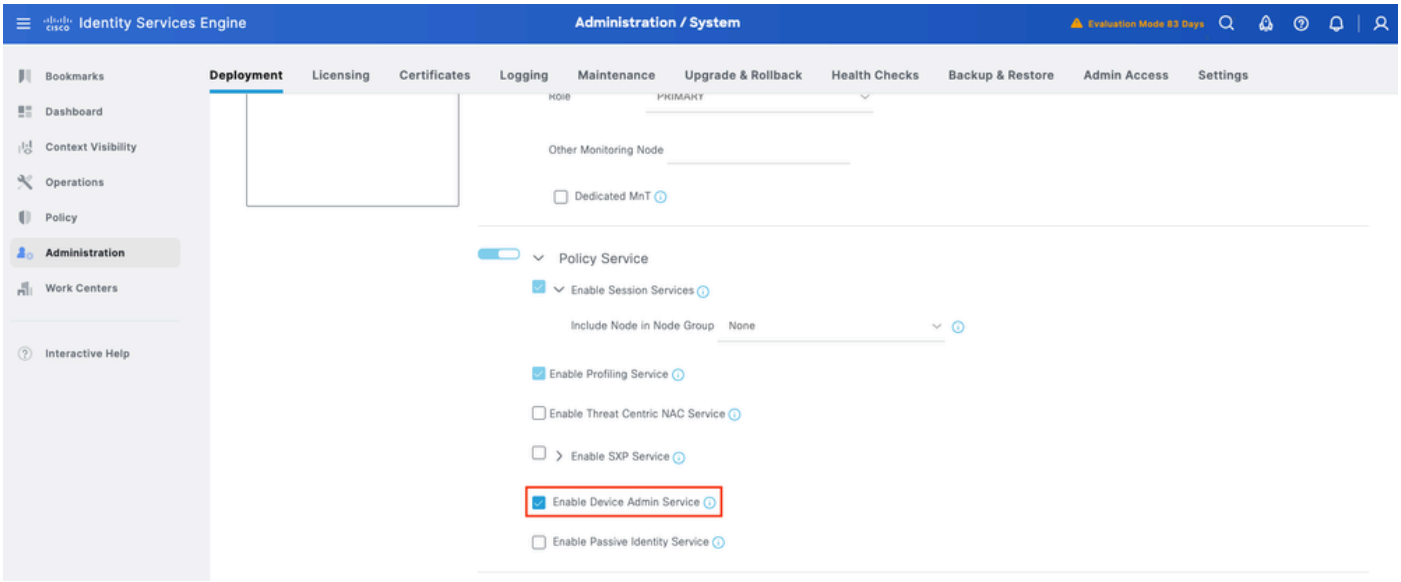
The Device Administration service (TACACS+) is not enabled by default on an ISE node. Enable

TACACS+ on a PSN node.

Step 1.Navigate to **Administration > System > Deployment**. Select the check box next to the ISE node and click**Edit**.



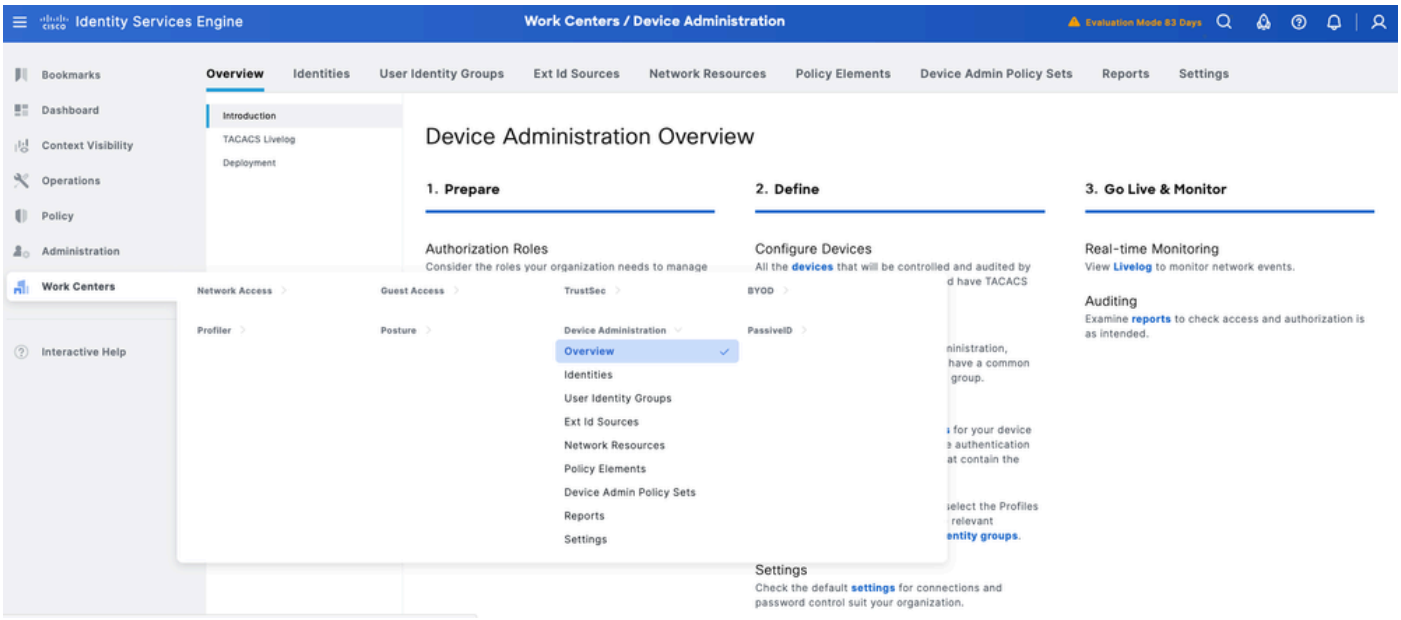
Step 2.Under **GeneralSettings**, scroll down and select the **check box** next to **Enable Device Admin Service**.



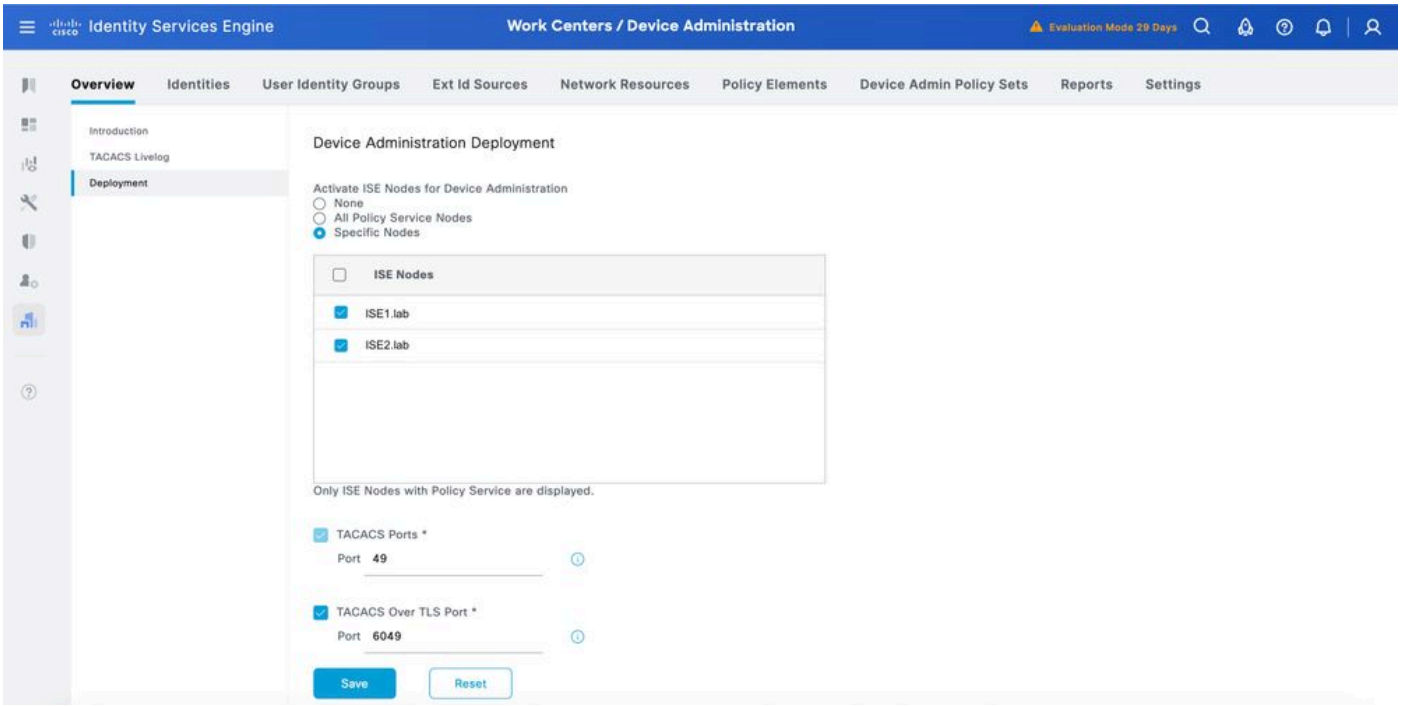
Step 3. **Save** the configuration. Device Admin Service is now enabled on ISE.

Enable TACACS Over TLS

Step 1.Navigate to **Work Centers > Device Administration > Overview**.



Step 2.Click **Deployment**. Select the **PSN nodes** where you want to enable TACACS over TLS.

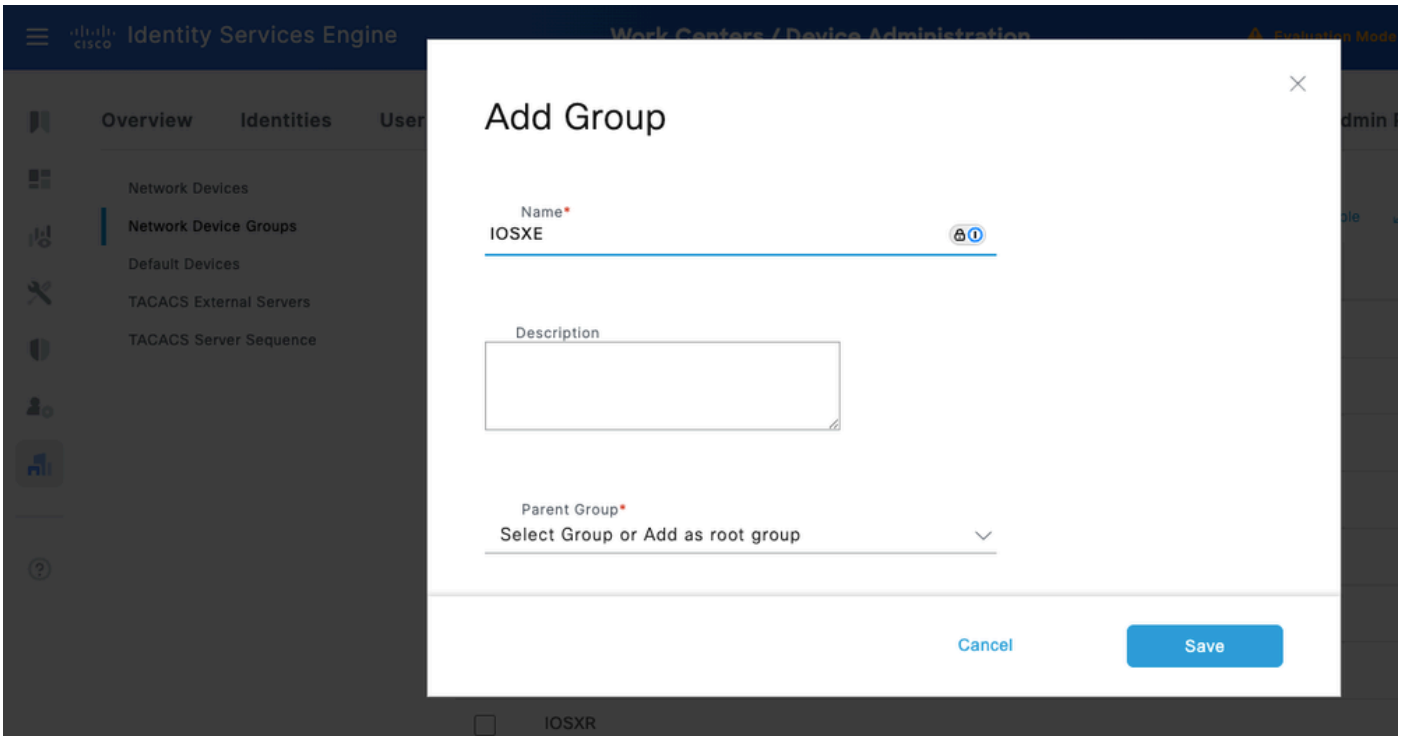


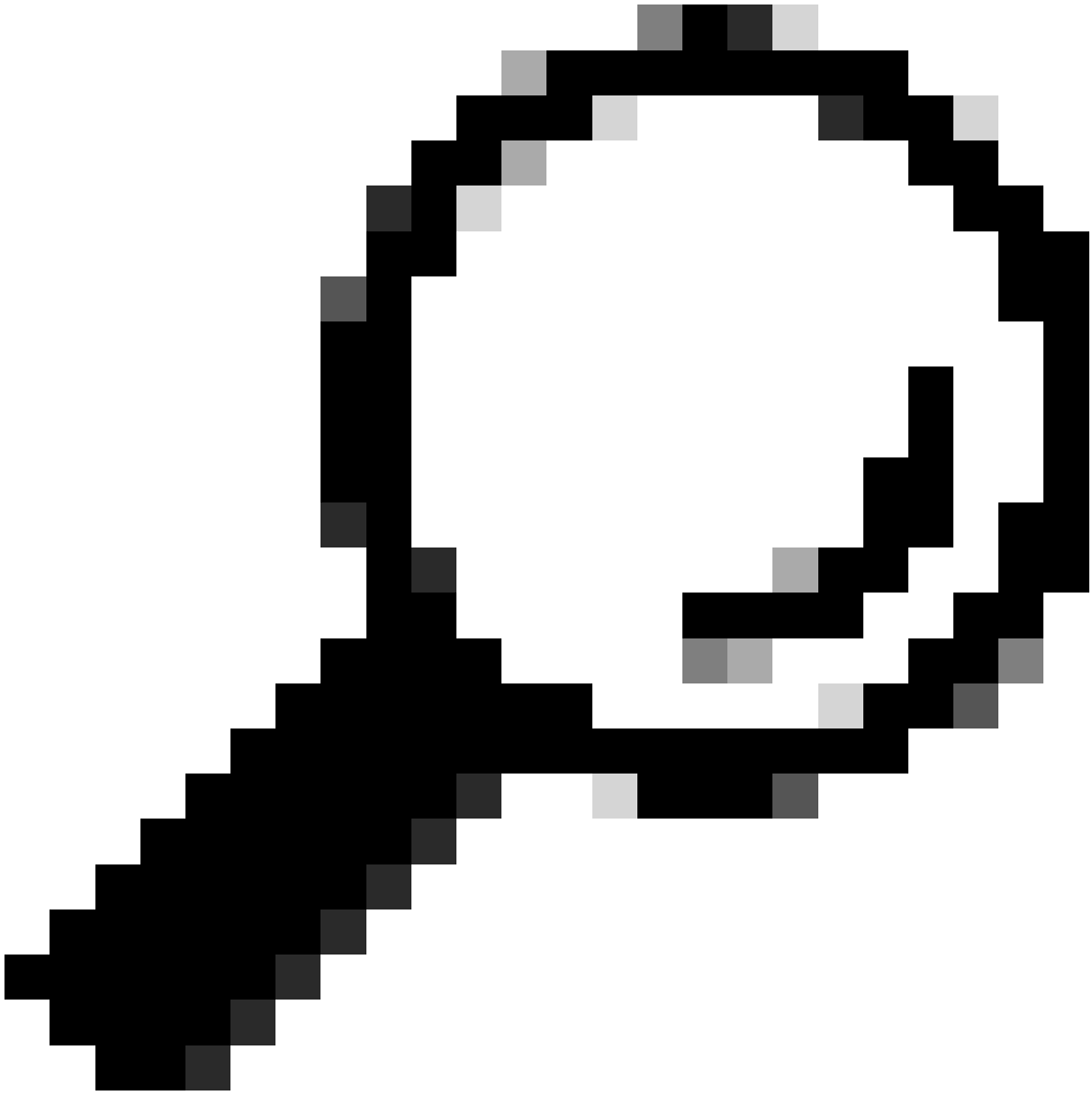
Step 3.Keep the default port **6049** or specify a different TCP port for TACACS over TLS, then click **Save**.

Create Network Device and Network Device Groups

ISE provides powerful device grouping with multiple device group hierarchies. Each hierarchy represents a distinct and independent classification of network devices.

Step 1. Navigate to **Work Centers > Device Administration > Network Resources.**Click **Network Device Groups** and create a group with the name **IOS XE**.


Identity Services Engine
Overview
Identities
Network Devices
Network Device Groups
Default Devices
TACACS External Servers
TACACS Server Sequence
Add Group
Name*
IOSXE
Description
Parent Group*
Select Group or Add as root group
Cancel
Save
IOSXR



Tip: All Device Types and All Locations are default hierarchies provided by ISE. You can add your own hierarchies and define the various components in identifying a Network Device which can be used later in the Policy Condition

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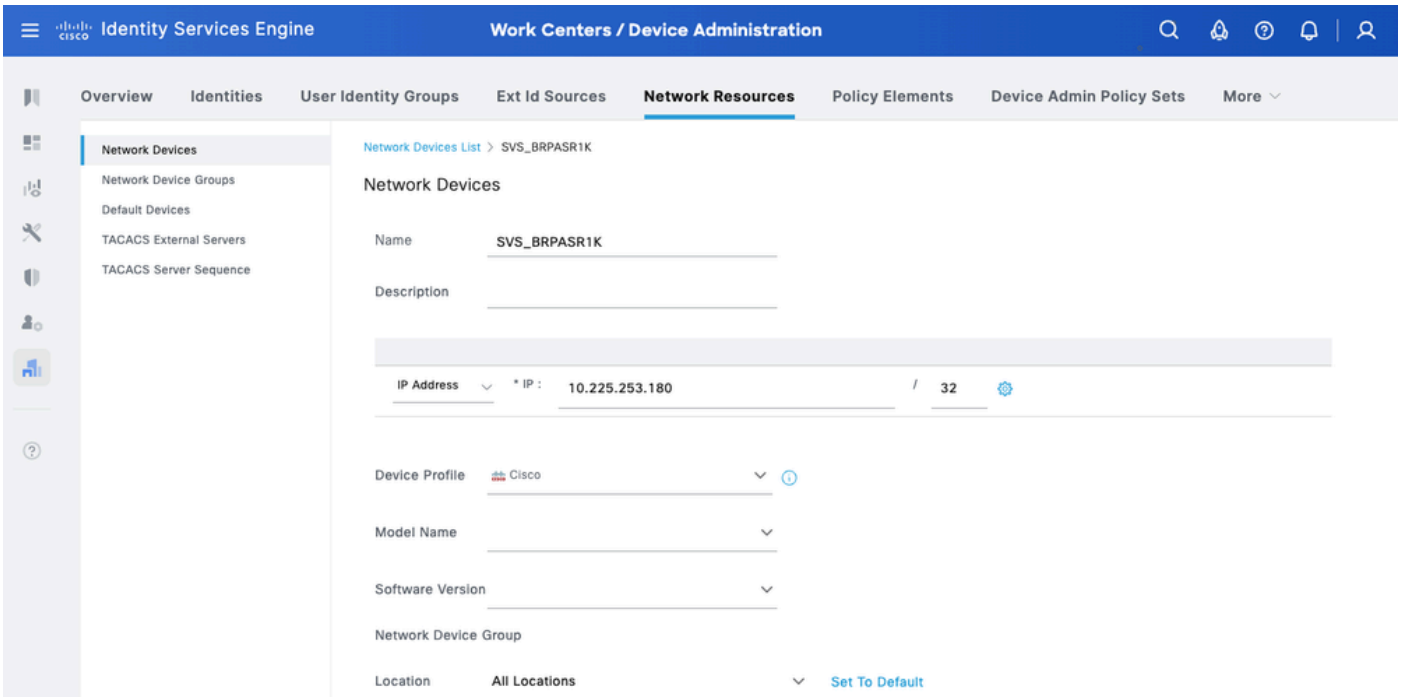
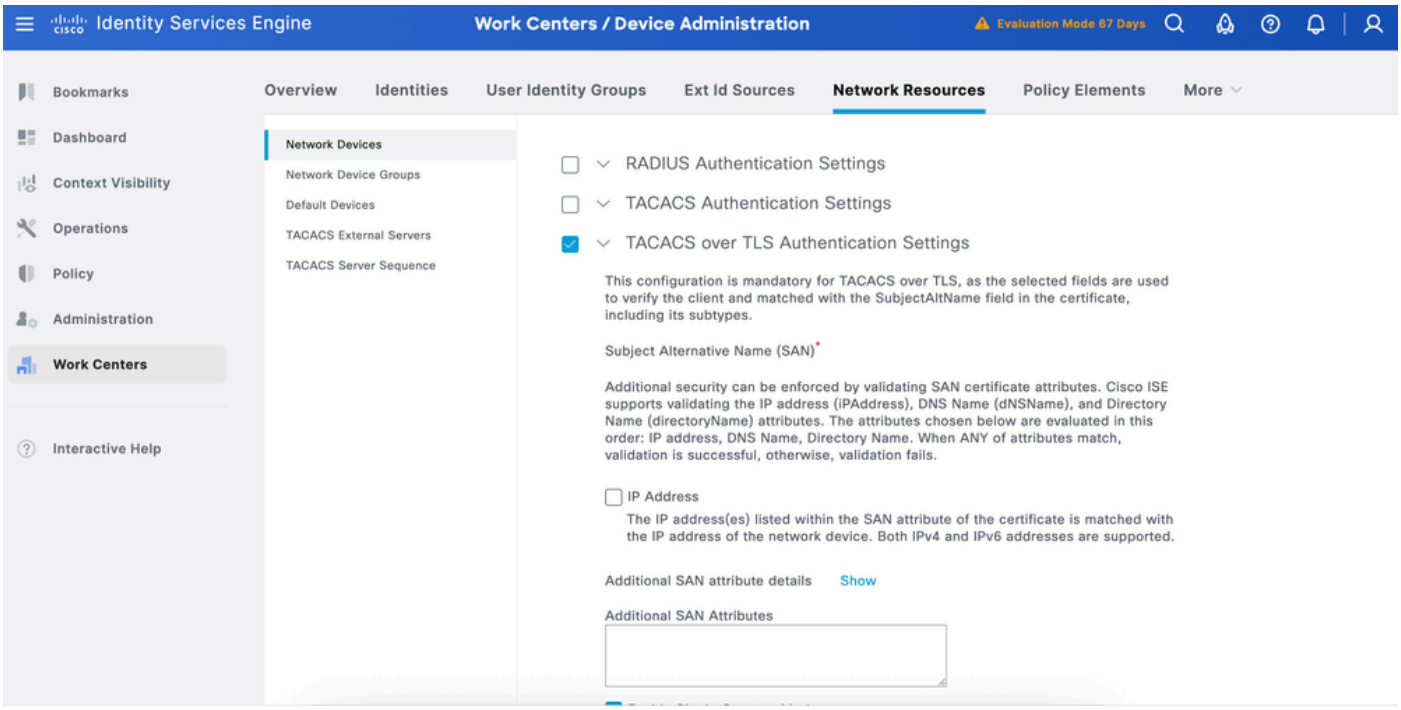
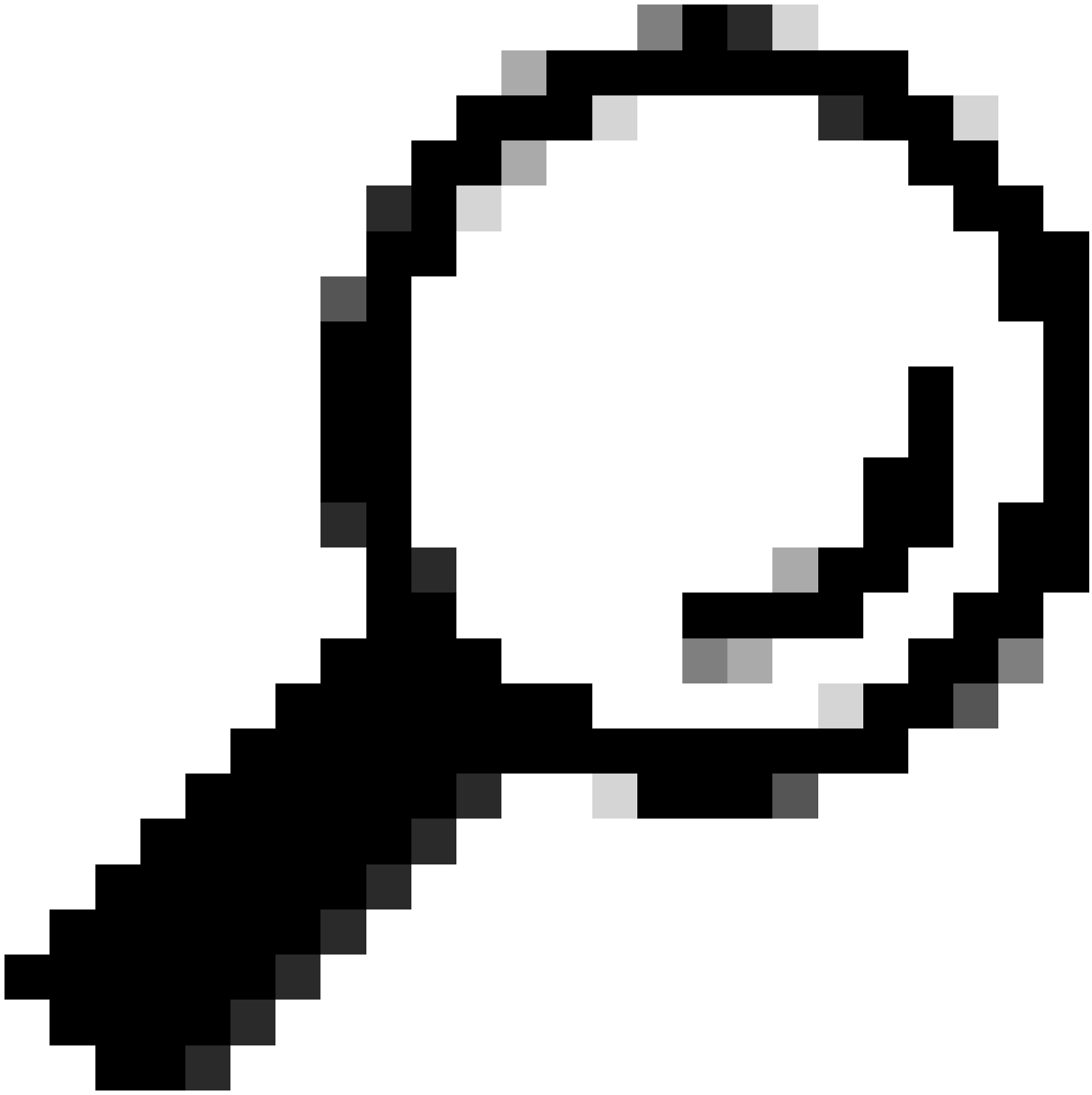
Step 2.Now, add a Cisco IOS XE device as a Network Device. Navigate to **Work Centers > Device Administration > Network Resources > Network Devices**. Click **Add** to add a new Network Device. For this test, it would be **SVS_BRPASR1K**.



Step 3.Enter the **IP address** of the Device and make sure to map the **Location** and **Device Type(IOS XE)** for the Device. Finally, enable the**TACACS+ over TLS Authentication Settings**.



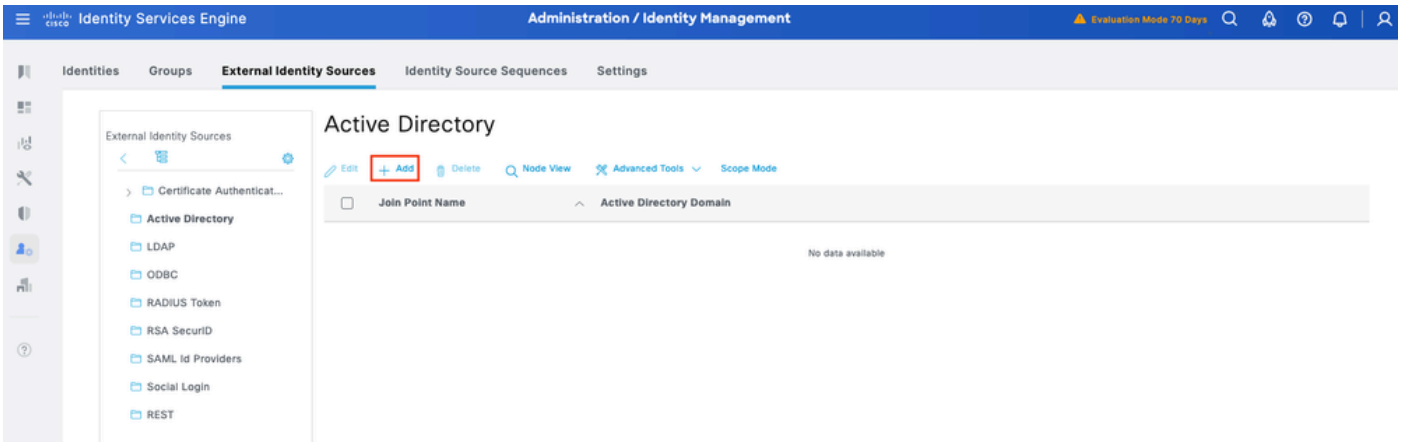


Tip: It is recommended to Enable Single Connect Mode to avoid restarting the TCP session each time a command is sent to the device.

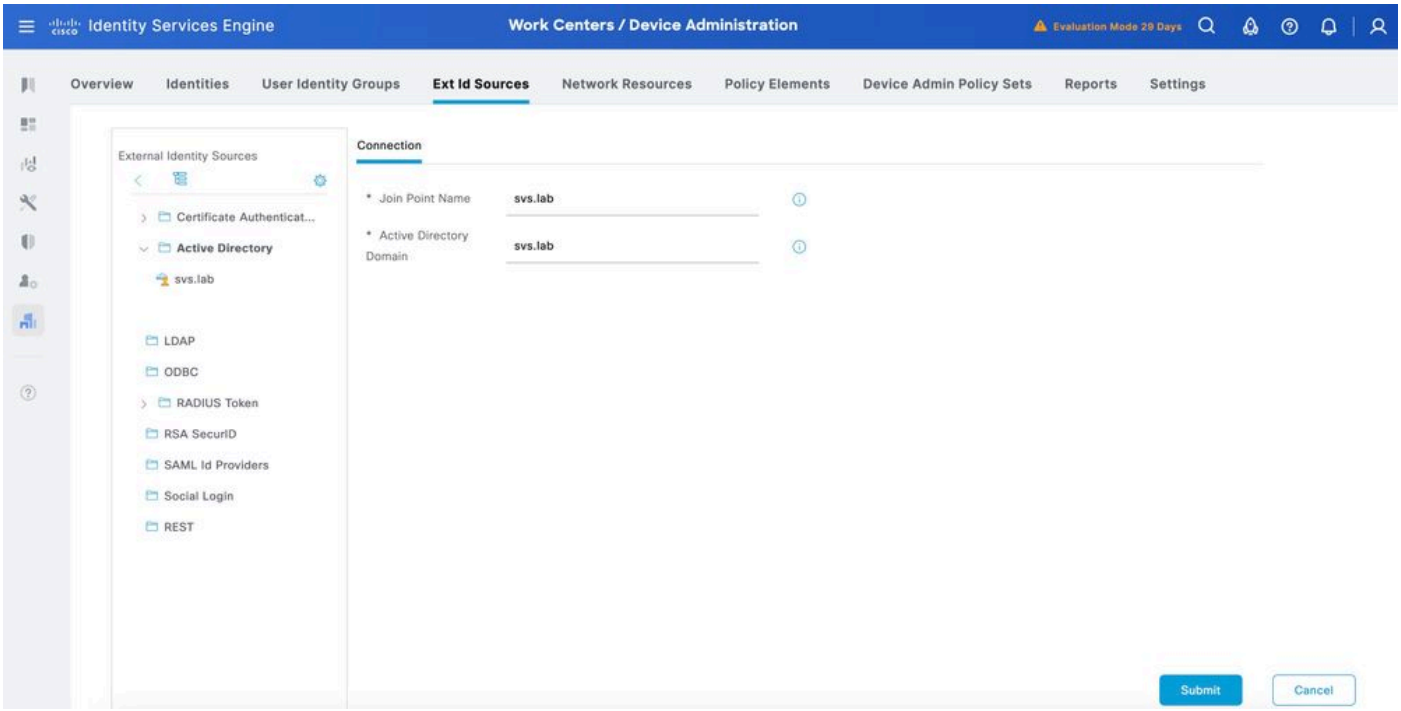
ConfigureIdentity Stores

This section defines an Identity Store for the Device Administrators, which can be the ISE Internal Users and any supported External Identity Sources. Here uses Active Directory (AD), an External Identity Source.

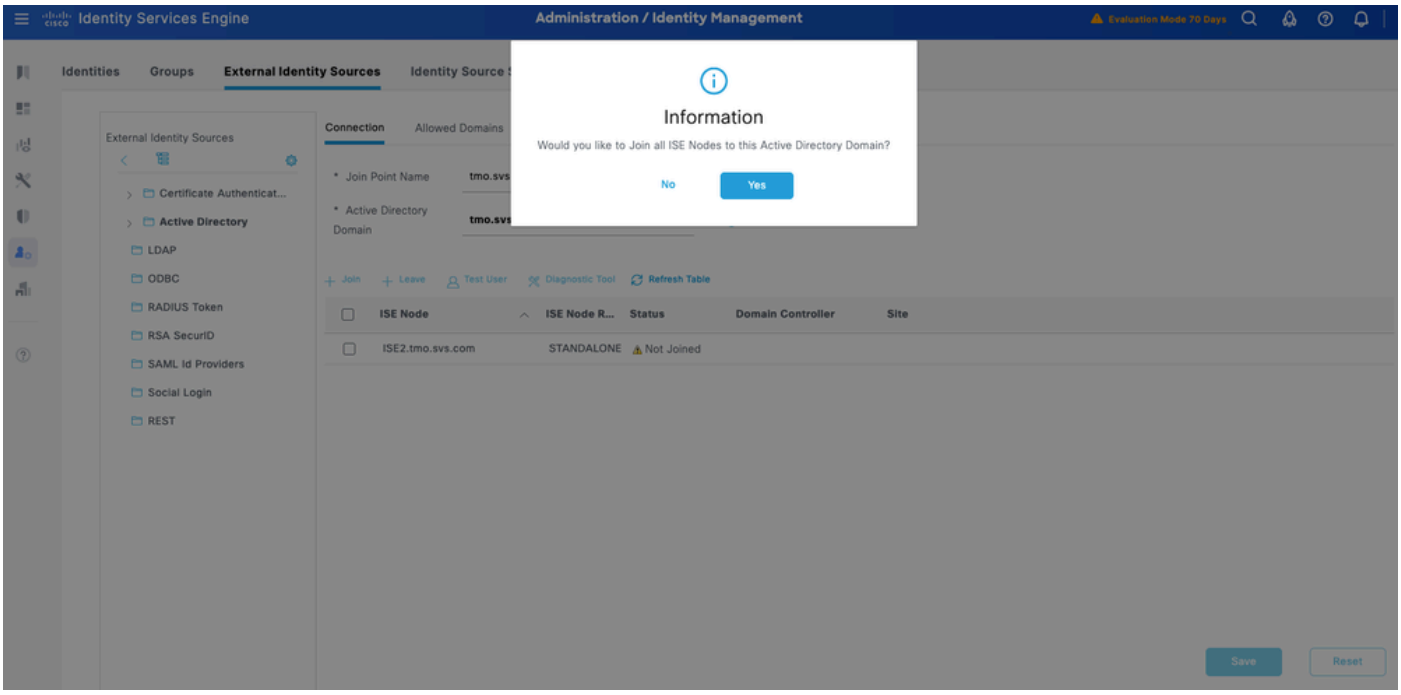
Step1. Navigate to **Administration > Identity Management > External Identity Stores > Active Directory**. Click **Add** to define a new AD Joint Point.



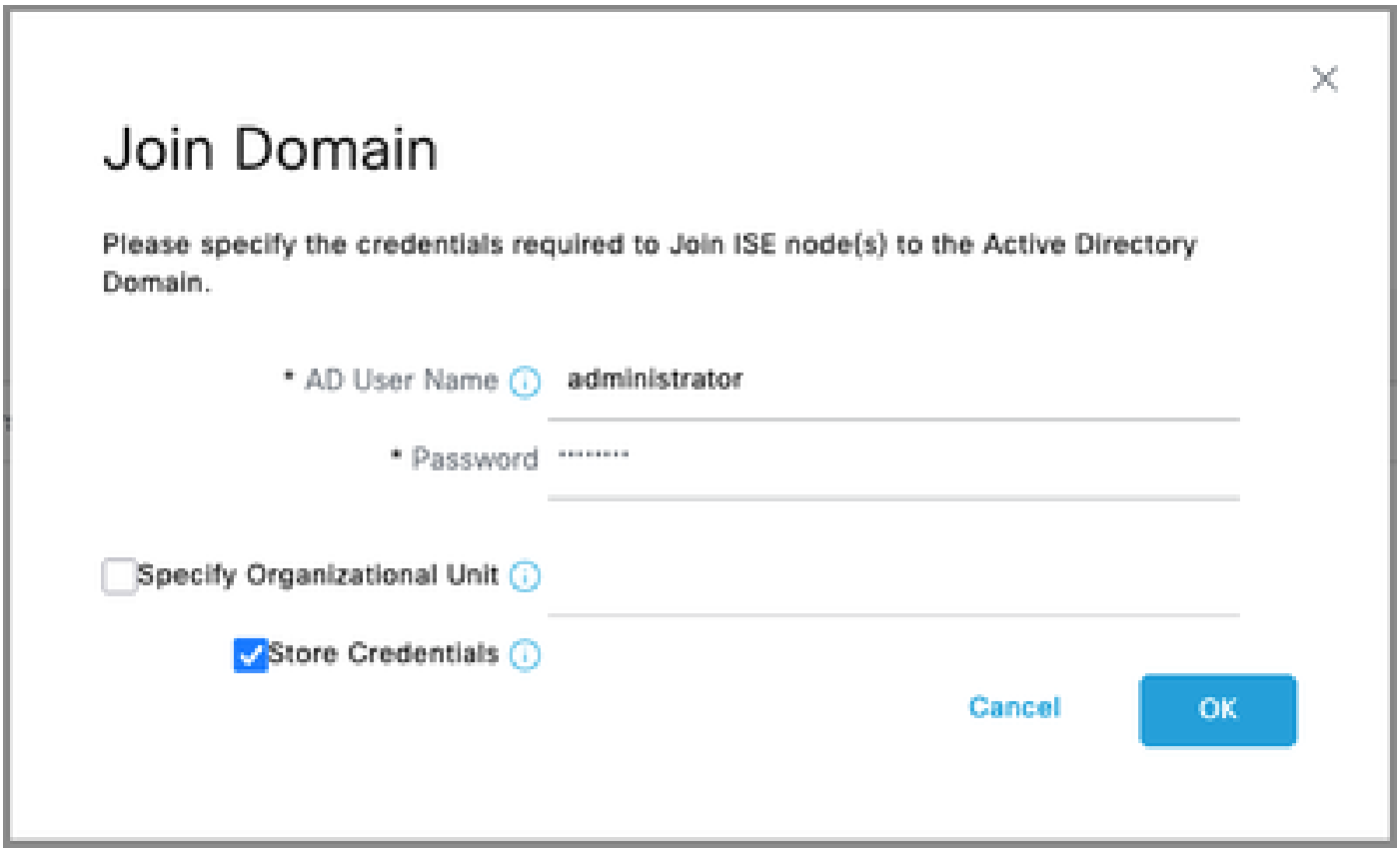
Step 2. Specify the **Join Point name** and the **AD domain name** and click **Submit**.

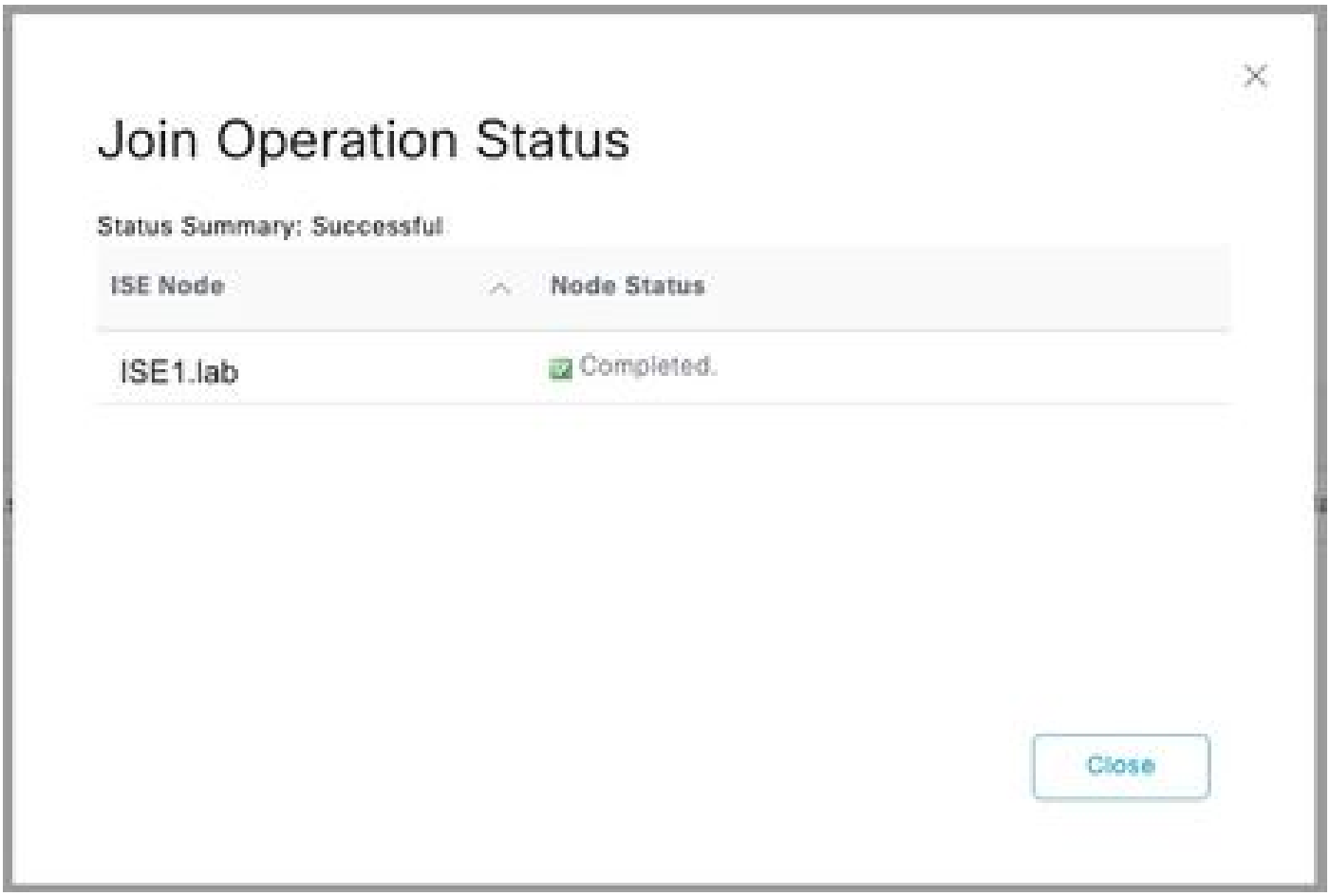


Step 3. Click **Yes** when prompted **Would you like to Join all ISE Nodes to this Active Directory Domain?**

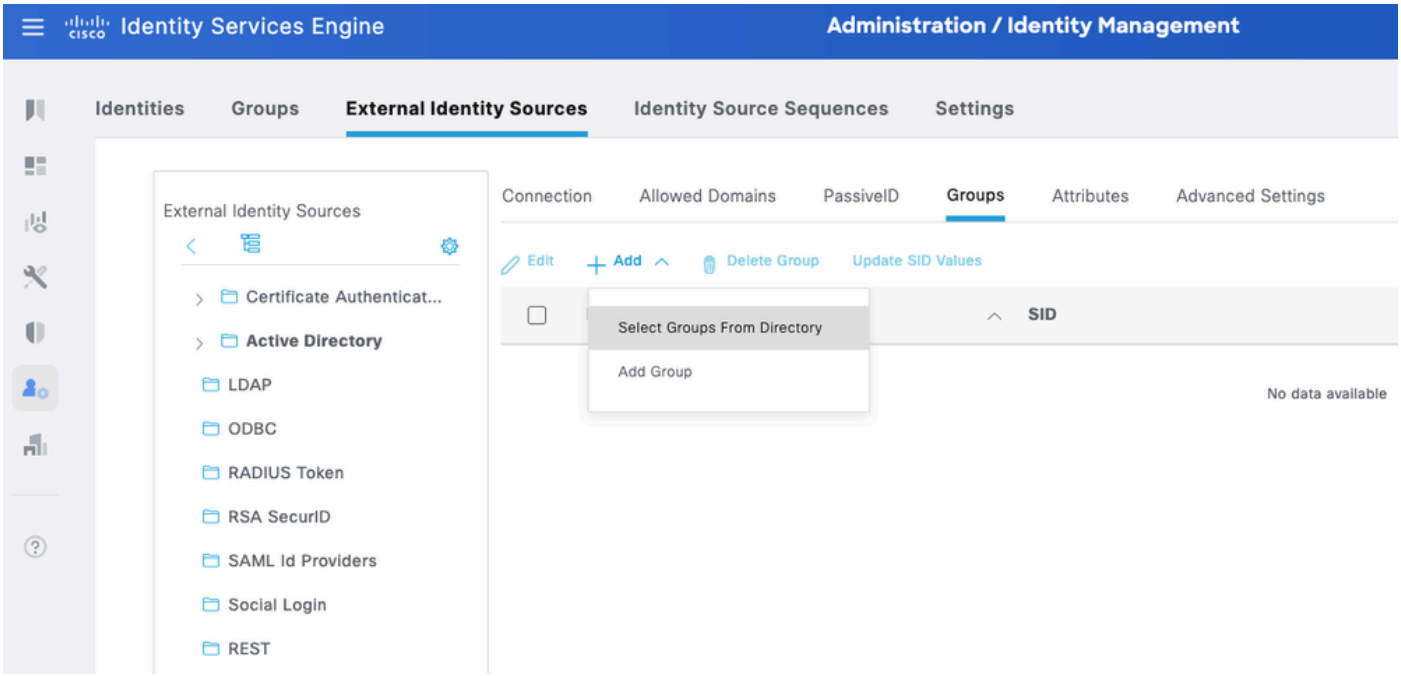


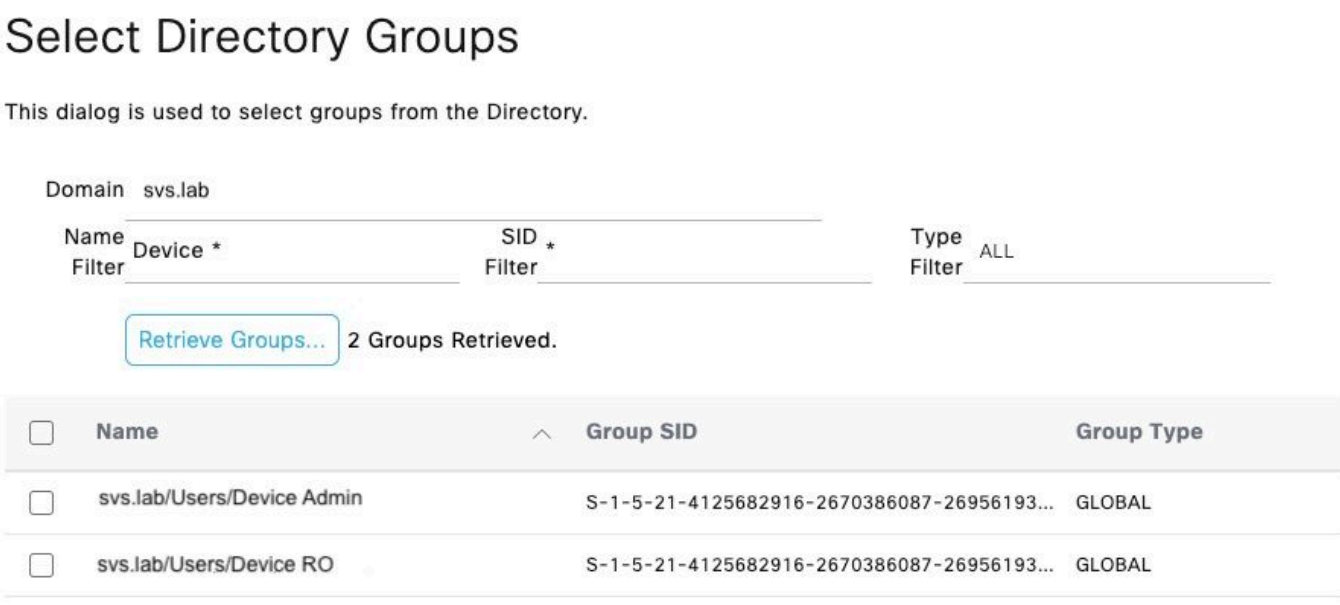
Step 4. Input the credentials with AD join privileges, and **Join** ISE to AD. Check the Status to verify it operational.

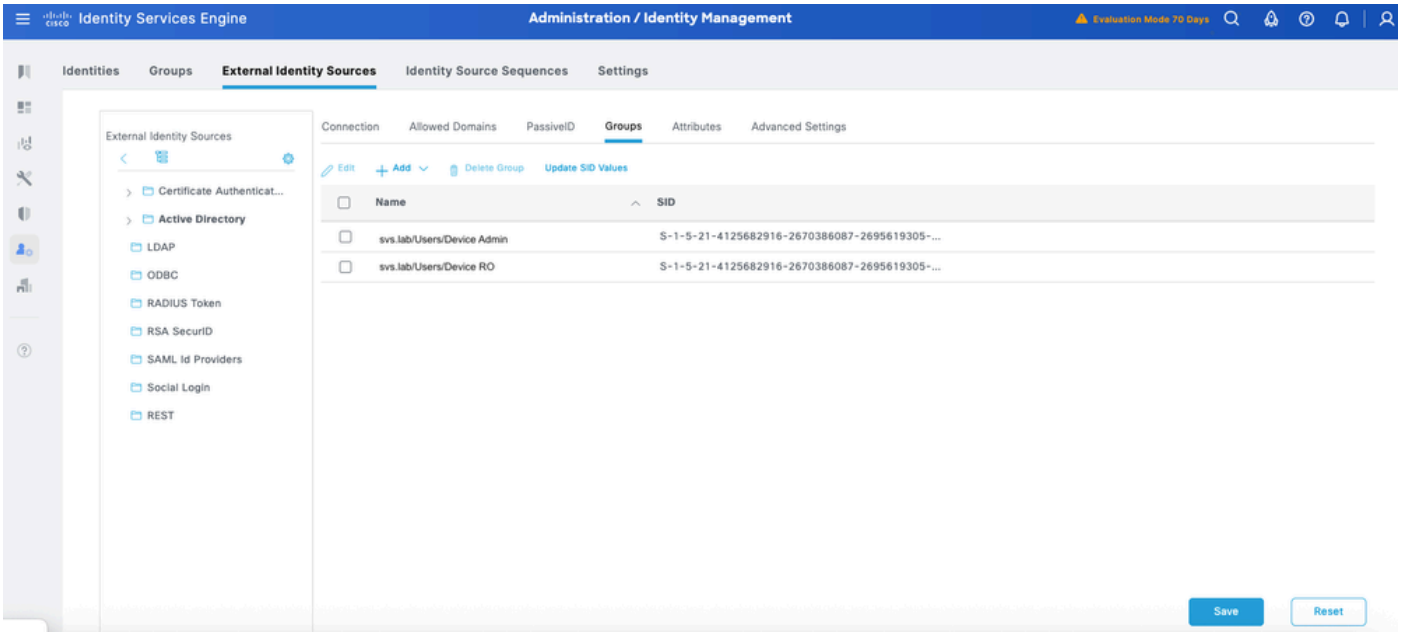




Step 5. Navigate to the **Groups** tab, and click **Add** to get all the groups needed based on which the users are authorized for the device access. This example shows the groups used in the Authorization Policy in this guide







ConfigureTACACS+ Profiles

You are going to map the TACACS+ Profiles to the two main user roles on the Cisco IOS XE devices:

- Root System Administrator – This is the highest-privileged role in the device. The user with the root system administrator role has full administrative access to all system commands and configuration capabilities.
- Operator –This role is intended for users who need read-only access to the system for monitoring and troubleshooting purposes.

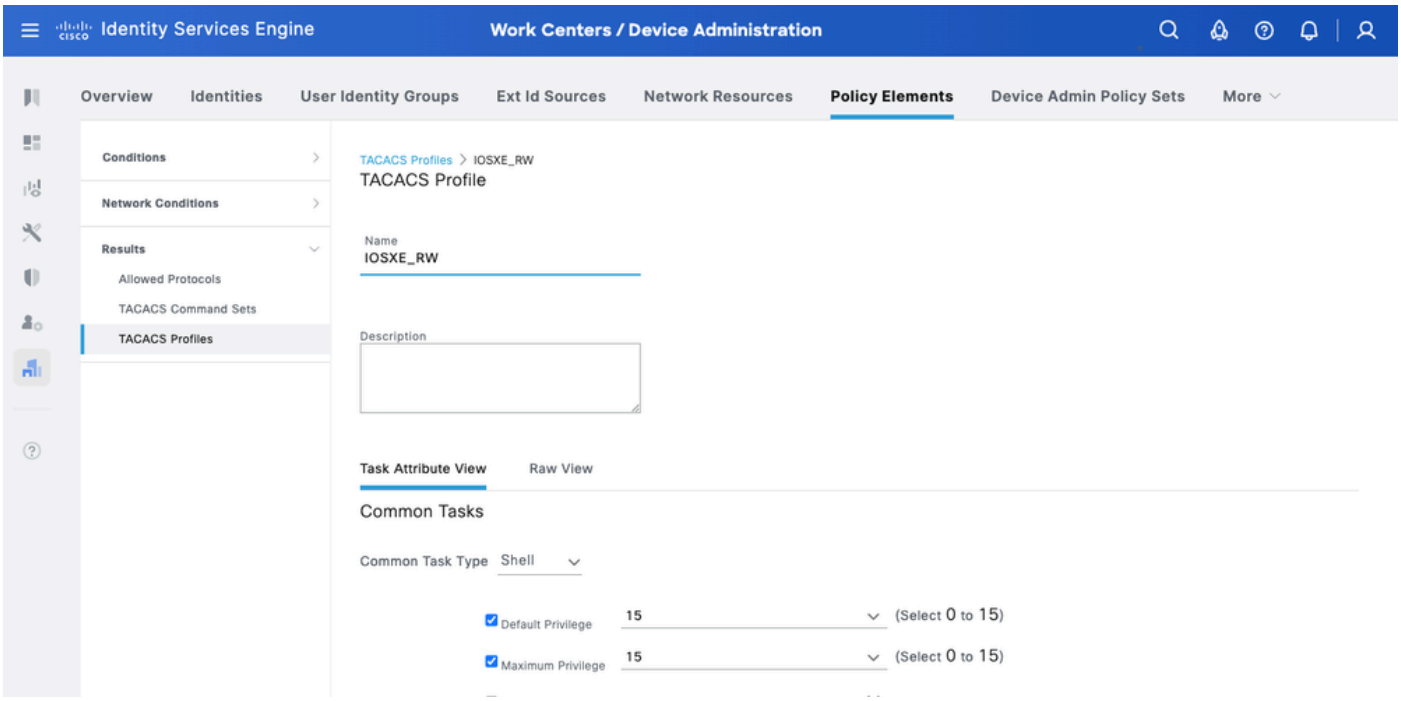
These are defined as two TACACS+ Profiles: IOS XE_RW and IOSXR_RO.

IOS XE_RW - Administrator Profile

Step 1 Navigate to **Work Centers > Device Administration > Policy Elements > Results > TACACS Profiles.** Add a new TACACS Profile and name it **IOS XE_RW**.

Step 2. Check and set the **Default Privilege** and **Maximum Privilege** as **15**.

Step 3.Confirm the config and **Save**.

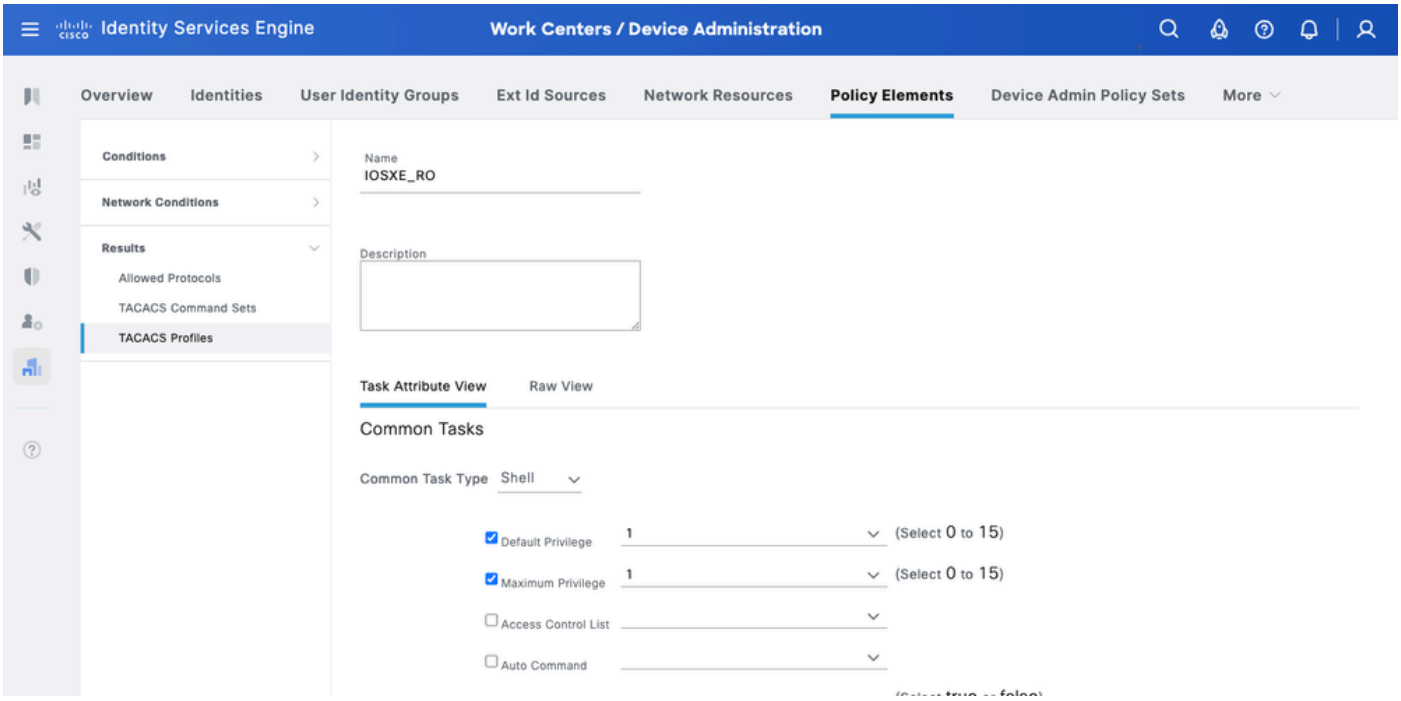


IOS XE_RO - Operator Profile

Step 1 Navigate to **Work Centers > Device Administration > Policy Elements > Results > TACACS Profiles**. Add a new **TACACS Profile** and name it **IOS XE_RO**.

Step 2. Check and set the **Default Privilege** and **Maximum Privilege** as **1**.

Step 3.Confirm the config and **Save**.



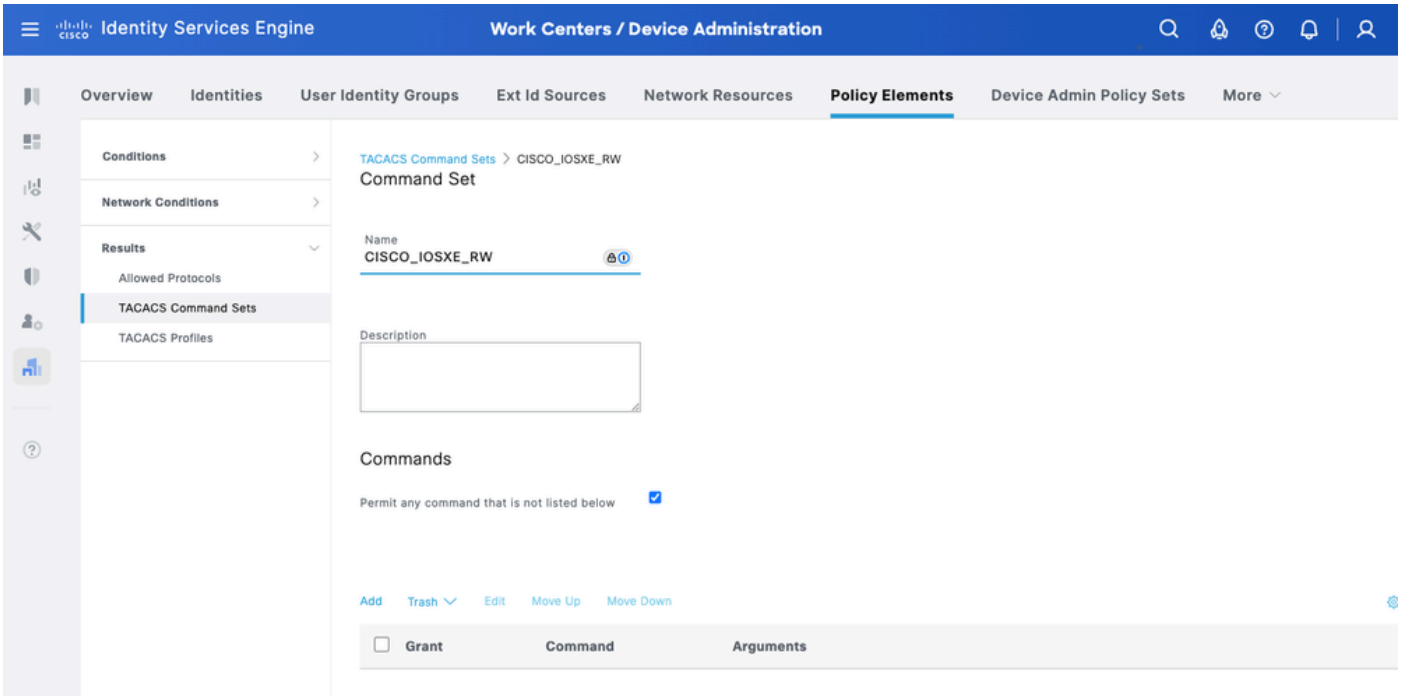
ConfigureTACACS+ Command Sets

these are defined as two TACACS+ Commands Sets: **CISCO_IOS XE_RW** and **CISCO_IOS XE_RO**.

CISCO_IOS XE_RW - Administrator Command Set

Step 1. Navigate to **Work Centers > Device Administration > Policy Elements > Results > TACACS Command Sets.** Add a new **TACACS Command Set** and name it **CISCO_IOS XE_RW**.

Step 2. Check the **Permit any command that is not listed below** checkbox (this allows any command for the administrator role) and click **Save**.



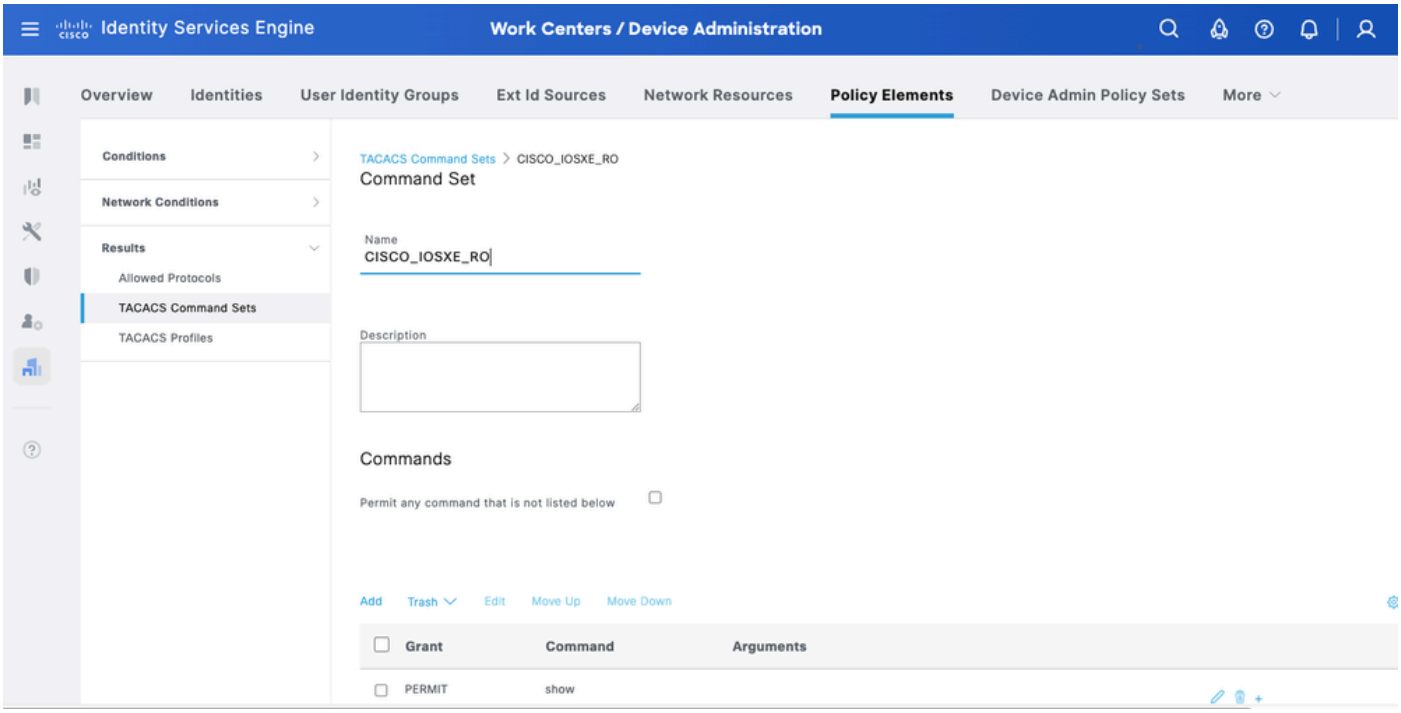
CISCO_IOS XE_RO - Operator Command Set

Step 1 From ISE UI, navigate to **Work Centers > Device Administration > Policy Elements > Results > TACACS Command Sets**. Add a new **TACACS Command Set** and name it **CISCO_IOS XE_RO**.

Step 2. In **Commands section**, add a new **command**.

Step 3. Select **Permit** from the dropdown list for **Grant** column and enter **show** on the **Command** column; and click the **check arrow**.

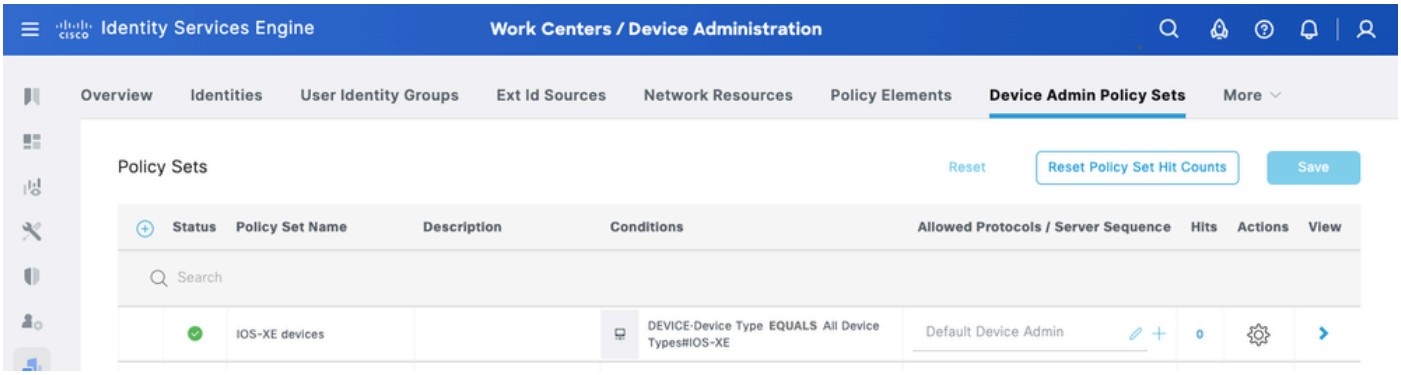
Step 4. Confirm the data and click **Save**.



ConfigureDevice Admin Policy Sets

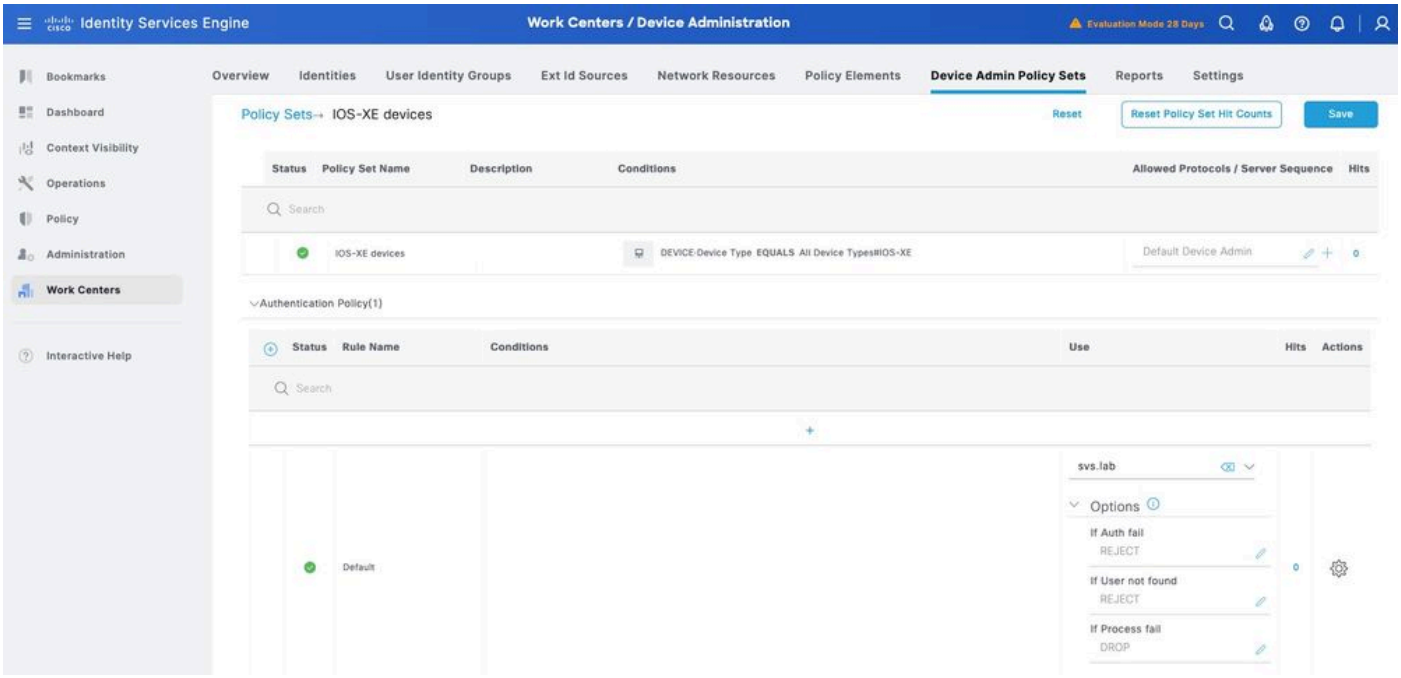
Policy Sets are enabled by default for Device Administration. Policy Sets can divide polices based on the Device Types so to ease application of TACACS profiles.

Step 1.Navigate to **Work Centers > Device Administration > Device Admin Policy Sets**. Add a new Policy Set **IOS XE Devices**. Under condition specify **DEVICE:Device Type EQUALS All Device Types#IOS XE**. Under **Allowed Protocols**, select **Default Device Admin**.



Step 2.Click **Save** and click the **right arrow** to configure this Policy Set.

Step 3.Create the **Authentication Policy**. For Authentication, you use the **AD** as the **ID Store**. Leave the default options under **If Auth fail**, **If User not found** and **If Process fail**.



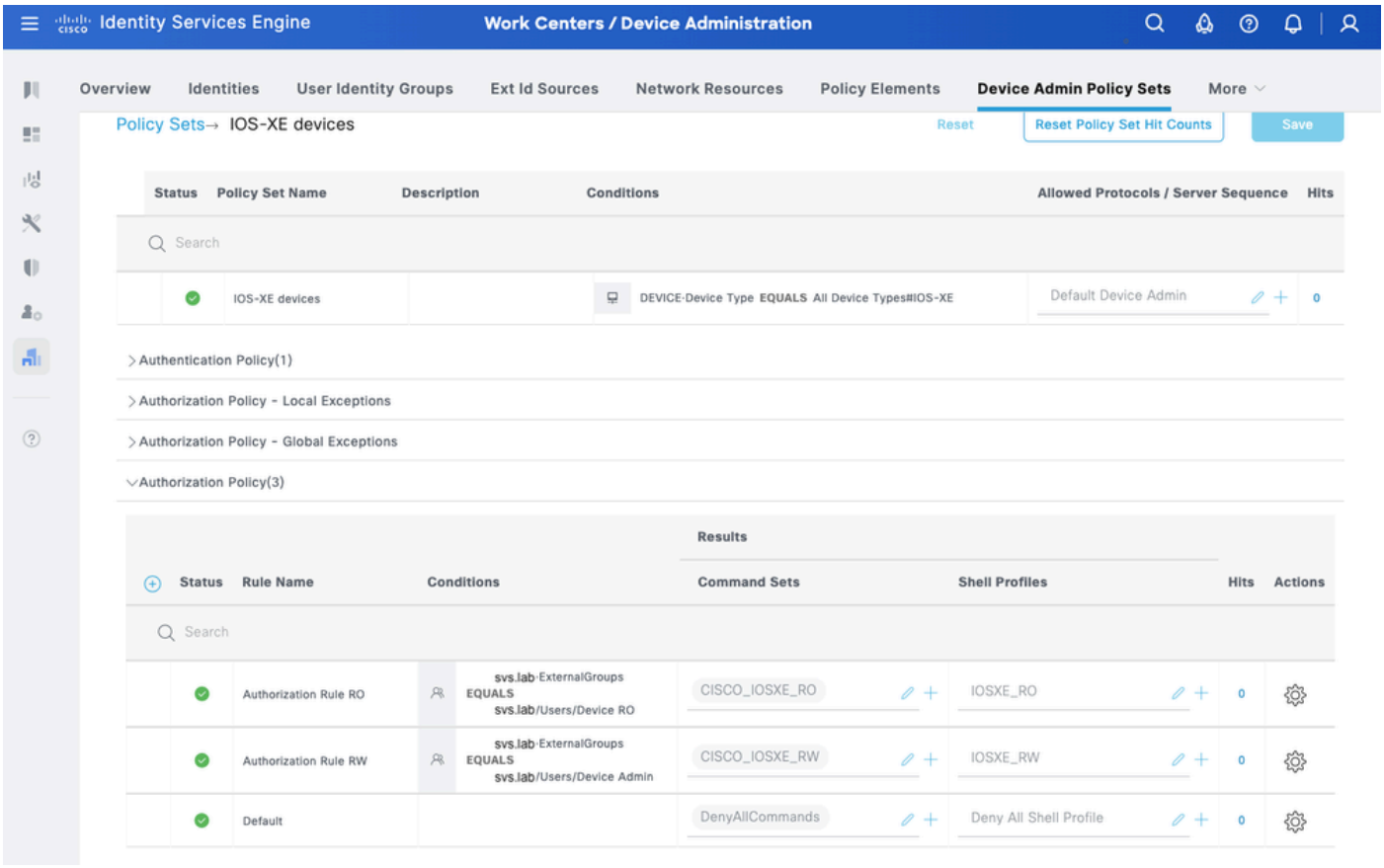
Step 4. Define the Authorization Policy.

Create the **authorization policy** based on user groups in Active Directory (AD).

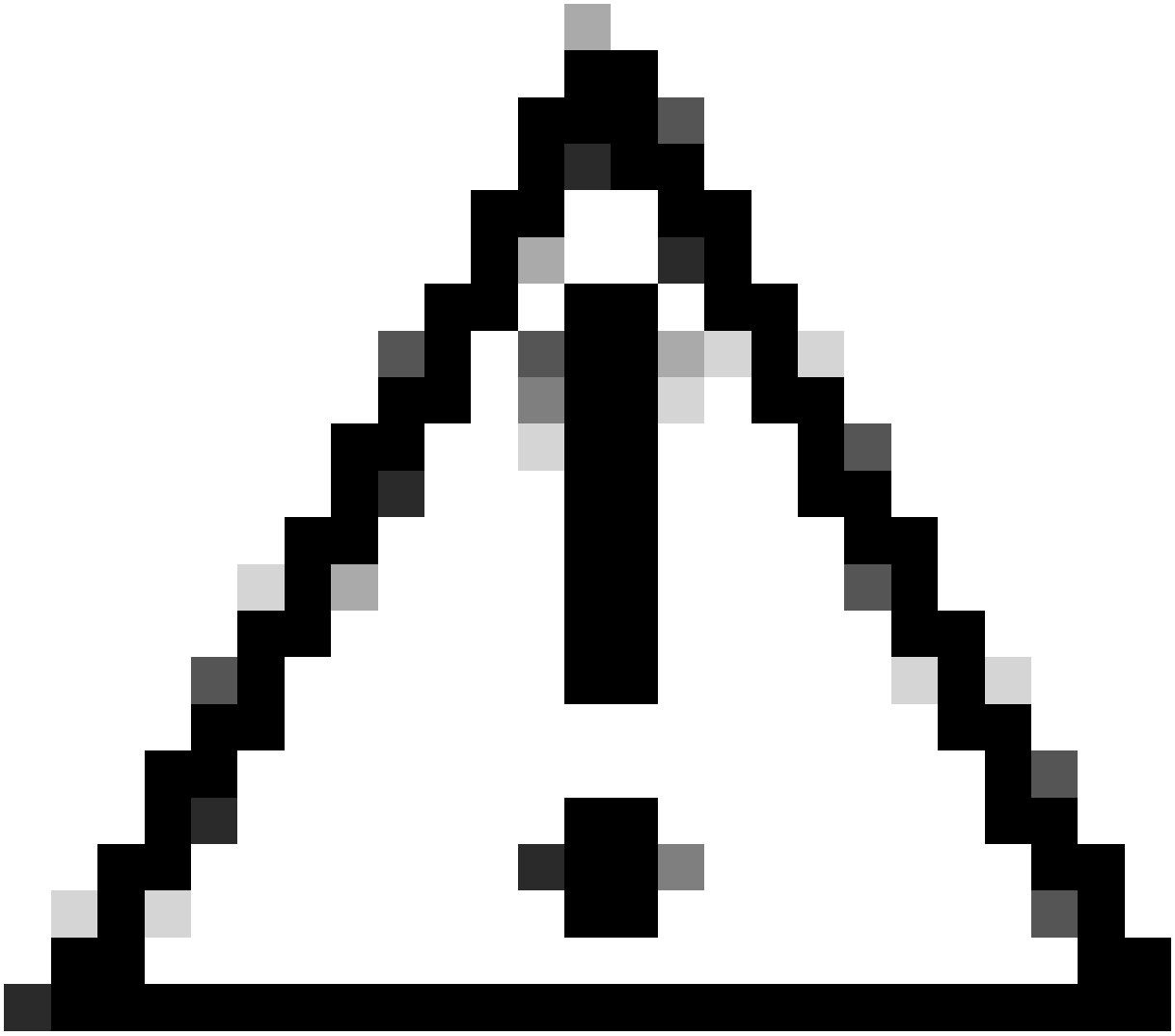
For Example:

• Users in the AD group **Device RO** are assigned the **CISCO_IOSXR_RO** Command Set and the **IOSXR_RO** Shell Profile.

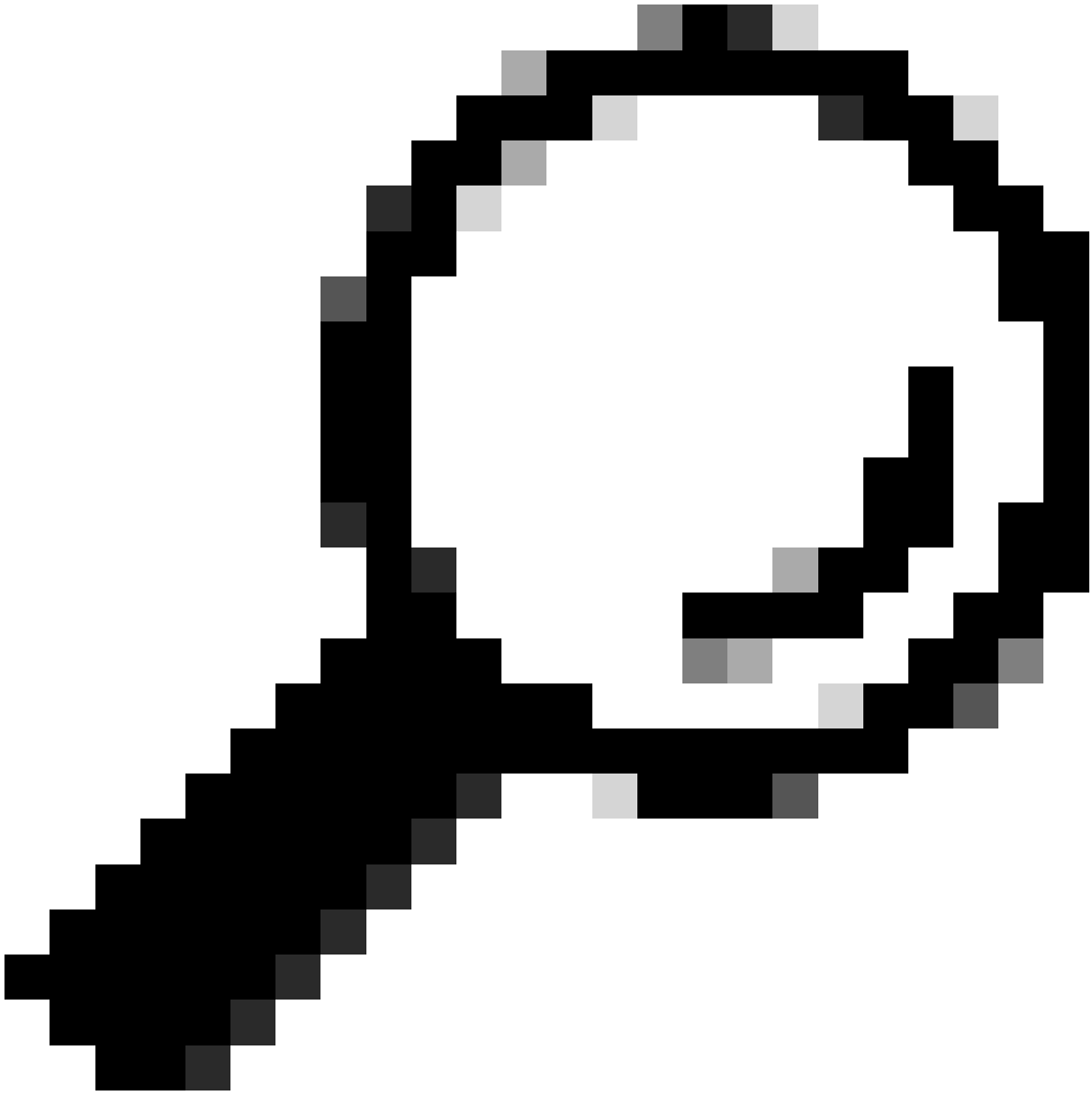
• Users in the AD group **Device Admin** are assigned the **CISCO_IOSXR_RW** Command Set and the **IOSXR_RW** Shell Profile.



Part 2 - Configure Cisco IOS XE for TACACS+ over TLS 1.3



Caution: Ensure that the console connection is reachable and functioning properly.



Tip: It is recommended to configure a temporary user and change the AAA authentication and authorization methods to use local credentials instead of TACACS while making configuration changes, to avoid being locked out of the device.

Configuration Method 1 - Device Generated Key-pair

TACACS+ Server Configuration

Step 1Configure **domain name** and generate a **key-pair** used for router trustpoint.

```
ip domain name svs.lab

crypto key generate ec keysize 256 label svs-256ec-key
```

Trustpoint Configuration

Step 1 Create **router trustpoint** and associate the key-pair.

```
crypto pki trustpoint svs_cat9k
  enrollment terminal pem
  subject-name C=US,ST=NC,L=RTP,O=Cisco,OU=SVS,CN=cat9k.svs.lab
  serial-number none
  ip-address none
  revocation-check none
  eckeypair svs-256ec-key
```

Step 2. Authenticate Trustpoint by installing **CA certificate**.

<#root>

cat9k(config)#

crypto pki authenticate svs_cat9k

Enter the base 64 encoded CA certificate.

End with a blank line or the word "quit" on a line by itself

-----BEGIN CERTIFICATE-----

MIIFlDCCA3ygAwIBAgIIIM10AsTaN/UwDQYJKoZIhvcNAQELBQAwajELMAkGA1UE
BhMCVVMxFzAVBgNVBAgTDk5vcnRoIENhcm9saW5hMRAwDgYDVQQHEwdSYWxlaWdo
MQ4wDAYDVQQKEwVDaXNjbzEMMAoGA1UECxMDU1ZTMRIwEAYDVQQDEwlTVlMgTGFi
Q0EwHhcNMjUwNDI4MTcwNTAwWhcNMzUwNDI4MTcwNTAwWjBqMQswCQYDVQQGEwJV
UzEXMBUGA1UECBMOTm9ydGggQ2Fyb2xpbmExEDAOBgNVBAcTB1JhbGVpZ2gxDjAM
BgNVBAoTBUNpc2NvMQwwCgYDVQQLEwNTVlMxEjAQBgNVBAMTCVNWUyBMYWJDQTCC
AiIwDQYJKoZIhvcNAQEBBQADggIPADCCAgoCggIBAJvZUOyn2vIn6gKbx3M7vaRq
2YjwZlzSH6EkEvxnJTy+kksiFD33GyHQepk7vfp4NFU5OtQ4HC7t/AOv9grDa3QW
VwvV4MBbJhFM3sOJ/ejgDYcMZhIAaPyOZo5WLboOkXEiKjPLatkXojB8FVrhLF3O
jMBSqwa4/Wlniy5S+7s4FFxsCf2OCOWfBAsnrs0tatIIhmcnx+VLJP7MRm8fOw4m
mutNo7IhbJSrgAFXmjlbBjMmgspObULo/wxMHdTbtPBf11HRHTkNIo3qyO4UADL2
WpoGhgT/FaxxBo2UBcnYVaP+jjRE0NYT973MCbVAAxtNVU6bEBR0z+LWniACzupm
+qh23SL43uW5A3iSw/BuU1E9p7BOe8oDNKU6gXlojKyLP/gC7j8AePO3ir+KZui8
b8X4iYn/67SbzZFhwxn3chkW4JYhQ4AImW1An2Q1+DMoZL7zRtSqQ3g9ZqRIMzQN
gJ+kQXe7QtT/u6m1MrtjE3gAEVpL334rTIxy9hpKZIkB86t2ZA3JX8CLsbCa13sA
z1XCoONX+6a1ekmXuAOI+t3c1sNbN2AtFi4cJovTA01xh6OI4QnK+MNQKpTjt/E4
ydHl0rrurXsZummj9QBnkX4pqY7cDLHhdMKpbjDwg7jVLl783nTc9wYptQEPi5sw
83g9EMgKV0ARIiVUa/qlAgMBAAGjPjA8MAwGA1UdEwQFMAMBAf8wEQYJYIZIAYb4
QgEBBAQDAgAHMBkGCWCGSAGG+EIBDQQMFgpTVlMgTGFiIENBMA0GCSqGSIb3DQEB
CwUAA4ICAQAIT3O8oL2L6j/7Kk9VdcouuaBsN9o2pNEk3KXeZ8ykarNoxa87sFYr

```
AwXIwfAtk8uEHfnWu1QcZ3LkEJM9rHVCZuKsYd3D6qojo54HTpxRLgo5oKOdGayi
iSEkSSX9qyfLfINHR2JSVqJU6jLsy86X7q7RmIPMS7XfHzuddFNI4YDoXRX67X+v
O+ja6zTQqjO6lqJhmrSkyFbYf/ZTpe4d1OzJsZjNsNOr8bF9nOA/7qNZLp3Z3cpU
PUOKdbiSvRqnPw3e8TfITVmAzcx8COI2SrYFMSUazolVBvDy+xRKxyAtMbneGz6n
YdykCimThCKoKwp/pWpYBEqIEOf5ay1PKURO/8aj/B7aluJapXkmnj5qPeGhNOpB
Q9r14reov4so2EspkXS7CrH9yGfpIyTprokz1UvZBZ8vloI7YZmjFmem+5rT6Gnk
eU/lX7nV61SYG5W5K+I8uaKuyBHOMn7Amy3DYL5c5GJBqxpSZERbLXV+Q1tIgRU8
8ggzlPOdsS/i6Lo7ypYXOeB9HgVDCkzQsLXQuHGj/2WsgPgdRcjkvnyURk4Jx+Ib
xDrmo7eOXPpSW4l72a6Kl8CR3U2Cr4wsuvndPEq/qd2NRSBWffFOXE/AJHQG7STT
HaXLU9r2Ko6O3oecu8ysGTwLlIt/9T1/FOb0xZRugWcpJrVoTgDGuA==

-----END CERTIFICATE-----

Certificate has the following attributes:
   Fingerprint MD5: D9C4O4B2 EC08A26O EC3539E7 F54ED17D
   Fingerprint SHA1: OEB181E9 5A3ED78O 3BC5A8O5 9A854A95 C83AC737

% Do you accept this certificate? [yes/no]:
```

yes

```
Trustpoint CA certificate accepted.
% Certificate successfully imported

cat9k(config)#
```

Step 3. Generate **Certificate Signing Request (CSR)**.

```
<#root>

cat9k(config)#
```

crypto pki enroll svs_cat9k

```
% Start certificate enrollment ..

% The subject name in the certificate will include: C=US,ST=NC,L=RTP,O=Cisco,OU=SVS,CN=cat9k.svs.lab
% The subject name in the certificate will include: cat9k.svs.lab
Display Certificate Request to terminal? [yes/no]:
```

yes

```
Certificate Request follows:

-----BEGIN CERTIFICATE REQUEST-----
MIIBfDCCASMCAQAwgYQxGjAYBgNVBAMTEWNhdDlrLnRtby5zdnMuY29tMQwwCgYD
VQQLEwNTVlMxDjAMBgNVBAoTBUNpc2NvMQwwCgYDVQQHEwNSVFAxCzAJBgNVBAgT
Ak5DMQswCQYDVQQGEwJVUzEgMB4GCSqGSIb3DQEJAhYRY2FOOWsudG1vLnN2cy5j
b2OwWTATBgcqhkjOPQIBBggqhkjOPQMBBwNCAATpYE7atscrtl4ddevCh3UgxjYi
4N4oBGWrpJBctKy4so8V5i6RXDt7kHgPzp14Qnf2ObcXVODE1wtTAHHBrIXqoDww
OgYJKoZIhvcNAQkOMSOwKzAcBgNVHREEFTATghFjYXQ5ay5ObW8uc3ZzLmNvbTAL
BgNVHQ8EBAMCB4AwCgYIKoZIzj0EAwQDRwAwRAIgZqP2QTwM3ZZrmIphJ7+jSTER
4OkTx2DiVs1c1Xf+vR4CIBcSb18DIYz84DmgMHUaf778/cmpe9cWakvdaxMWseBH
-----END CERTIFICATE REQUEST-----

---End - This line not part of the certificate request---

Redisplay enrollment request? [yes/no]:
```

```
no

cat9k(config)#
```

Step 4. Import **CA signed certificate**.

<#root>

```
cat9k(config)#

crypto pki import svs_cat9k certificate



Enter the base 64 encoded certificate.
End with a blank line or the word "quit" on a line by itself

-----BEGIN CERTIFICATE-----
MIID8zCCAdugAwIBAgIIKfdYWg5WpskwDQYJKoZIhvcNAQELBQAwajELMAkGA1UE
BhMCVVMxFzAVBgNVBAgTDk5vcnRoIENhcm9saW5hMRAwDgYDVQQHEwdSYWxlaWdo
MQ4wDAYDVQQKEwVDaXNjbzEMMAoGA1UECxMDU1ZTMRIwEAYDVQQDEwlTVlMgTGFi
QOEwHhcNMjUwNTE0MTUxMjAwWhcNMjYwNTE0MTUxMjAwWjCBhDEaMBgGA1UEAxMR
Y2F0OWsudG1vLnN2cy5jb20xDDAKBgNVBAsTA1NWUzEOMAwGA1UEChMFQ2lzY28x
DDAKBgNVBAcTA1JUUDELMAkGA1UECBMCTkMxCzAJBgNVBAYTAlVTMSAwHgYJKoZI
hvcNAQkCFhFjYXQ5ay5ObW8uc3ZzLmNvbTBZMBMGByqGSM49AgEGCCqGSM49AwEH
A0IABOlgTtq2xyu2Xh1168KHdSDGNiLg3igEZaukkFyOrLiyjxXmLpFcO3uQeA/O
nXhCd/bRtxdU4MTXC1MAccGsheqjTTBLMB4GCWCGSAGG+EIBDQQRFg94Y2EgY2Vy
dGlmaWNhdGUwHAYDVR0RBBUwE4IRY2FOOWsudG1vLnN2cy5jb2OwCwYDVR0PBAQD
AgeAMA0GCSqGSIb3DQEBCwUAA4ICAQBObgKVykeyVC9UsvuuOAUsGaZHGwy2H9Yd
m5vIaui6PJczkCzIoAIghHPGQhIgpEcRqtGyXPZ2r8TCJP11WXNN/G73sFyWAhzY
RtmIM5KIojiDHLtifPayxv9juDuOZRx+wYR2PIQ5eLv1bafg7K8E82sqOCfOtcPr
OcONU8UCxqObdOgu4XsdBN1+wcWFqeQSDLmP7nxvhOOm/LXwCWUHwgVioOAuU2Fe
k5NthtvdxNAhRAImQdTyq6u/yB7vwTwJHcRiJc5USsyzCsTBb6RvL+HsXqBgXGc5
lxCSoLtYOdUxFIpJyK2MOZBY2zq2cNSc8Xbso5/OEQmnHtpWPvij4rSPUhQSY+4m
Qq2Sn3iqf4mGh/AO8T4iXfWDWfNezh7ZxMsCSCK/ZRlELZ2hj6OfzwX1H27Uf8XU
ecrOWx+WzRn7LVRCaGQzFkukfi8S4DLLNtxnNHfsLBVX5yHXCLEL+CQ7n8Z/pxcB
VVrPitwN3ZbO9poZyWiRLTnBsb42xNaWiL9bjQznAOiTDfmfFFourBsaAioz7ouY
2r1Mh+OpE83Uu+4lOTMawDgGiEv7iaiJ6xWc95EC+AdmOx3FvBXMtIM9qr7WwHW6
3C2hVYHJH254elV5+H8iiz7rovEPm8ZDsnvYpJn4Km3iDvBNqp/vvAHOFcyXrvG6
3i/1b9erGQ==
-----END CERTIFICATE-----

% Router Certificate successfully imported

cat9k(config)#
```

TACACS & AAA with TLS Configuration

Step 1. Create **TACACSS server** and **AAA groups**, associate the client (router) trustpoint.

```
tacacs server svs_tacacs
 address ipv4 10.225.253.209
 single-connection
 tls port 6049
```

```
 tls idle-timeout 60
 tls connection-timeout 60
 tls trustpoint client svs_cat9k
 tls ip tacacs source-interface GigabitEthernet0/0
 tls ip vrf forwarding Mgmt-vrf
!
aaa group server tacacs+ svs_tls
 server name svs_tacacs
 ip vrf forwarding Mgmt-vrf
!
tacacs-server directed-request
```

Step 2. Configure AAA methods.

```
aaa authentication login default group svs_tls local enable
aaa authentication login console local enable
aaa authentication enable default group svs_tls enable
aaa authorization config-commands
aaa authorization exec default group svs_tls local if-authenticated
aaa authorization commands 1 default group svs_tls local if-authenticated
aaa authorization commands 15 default group svs_tls
aaa accounting exec default start-stop group svs_tls
aaa accounting commands 1 default start-stop group svs_tls
aaa accounting commands 15 default start-stop group svs_tls
aaa session-id common
```

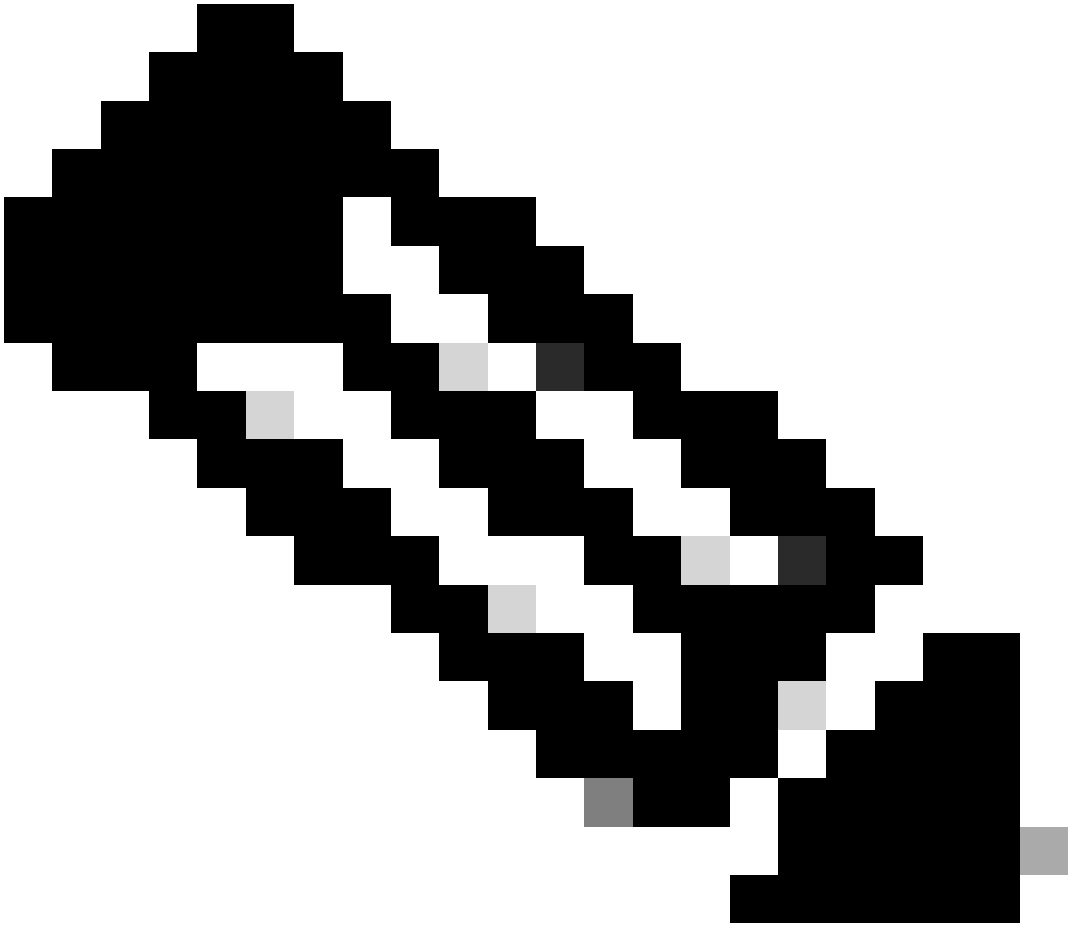
Configuration Method 2 - CA Generated Key-Pair

If you are importing the keys as well as device and CA certificates directly in a PKCS#12 format instead of CSR method, you can use the this method.

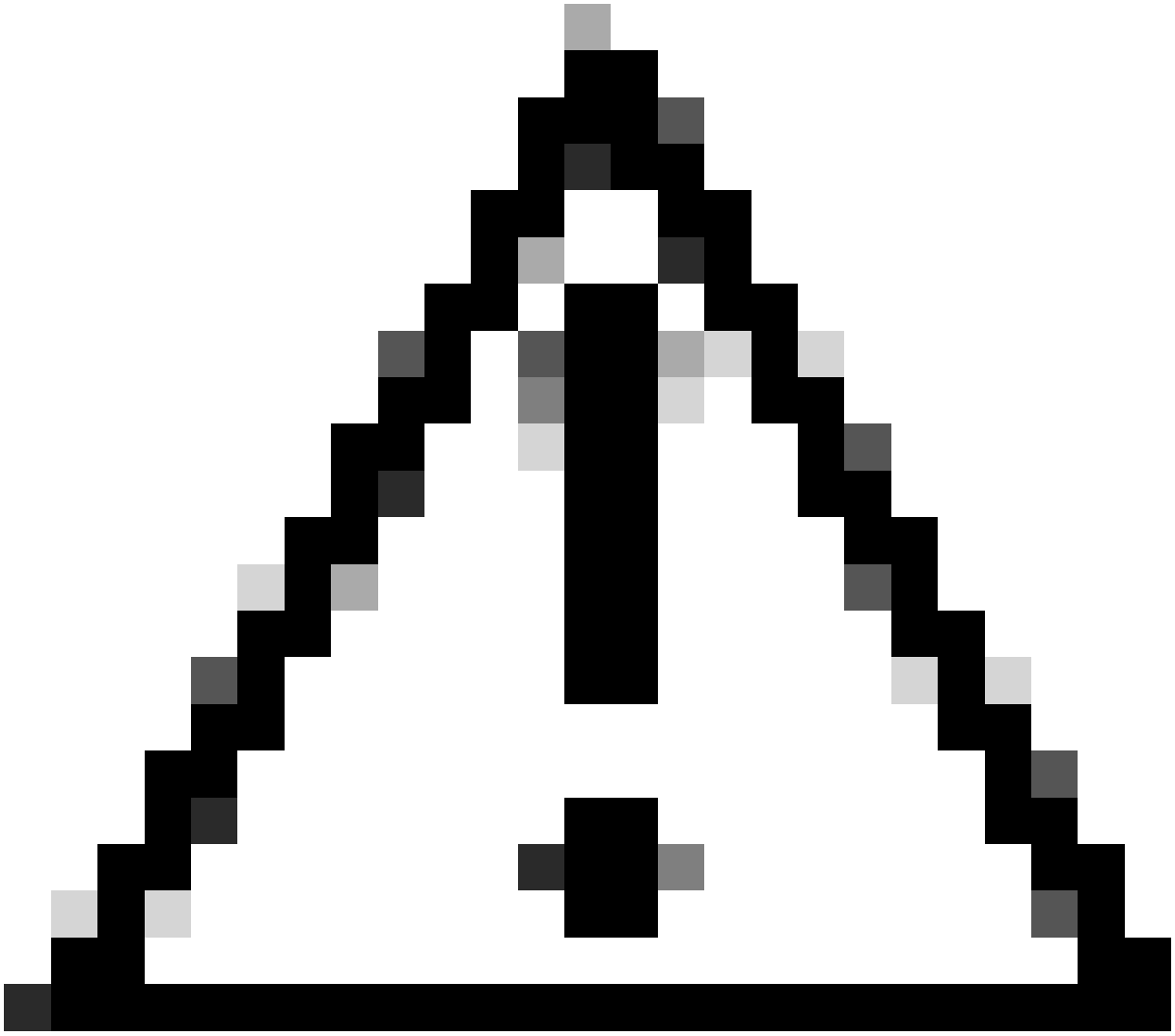
Step 1. Create **client trustpoint**.

```
cat9k(config)#crypto pki trustpoint svs_cat9k_25jun17
cat9k(ca-trustpoint)#revocation-check none
```

Step 2. Copy the **PKCS#12 file** into bootflash.



Note: Ensure that PKCS#12 file contains the complete certificate chain and the private key as encrypted file.



Caution: Keys in the imported PKCS#12 must be of RSA (E.g.: RSA 2048) type, not ECC.

<#root>

```
cat9k#
```

```
copy sftp bootflash: vrf Mgmt-vrf


Address or name of remote host [10.225.253.247]?
Source username [svs-user]?
Source filename [cat9k.svs.lab.pfx]? /home/svs-user/upload/cat9k-25jun17.pfx
Destination filename [cat9k-25jun17.pfx]?
Password:
!
2960 bytes copied in 3.022 secs (979 bytes/sec)
```

Step 3. Import the **PKCS#12 file** using the import command.

<#root>

```
cat9k#
```

crypto pki import svs_cat9k_25jun17 pkcs12 bootflash:cat9k-25jun17.pfx

```
 password C1sco.123
% Importing pkcs12...Reading file from bootflash:cat9k-25jun17.pfx
CRYPTO_PKI: Imported PKCS12 file successfully.
cat9k#

cat9k#
```

show crypto pki certificates svs_cat9k_25jun17

```
Certificate
  Status: Available
  Certificate Serial Number (hex): 586OBF33A2O33365
  Certificate Usage: General Purpose
  Issuer:
    cn=SVS LabCA
    ou=SVS
    o=Cisco
    l=Raleigh
    st=North Carolina
    c=US
  Subject:
    Name: cat9k.svs.lab
    e=pkalkur@cisco.com
    cn=cat9k.svs.lab
    ou=svs
    o=cisco
    l=rtp
    st=nc
    c=us
  Validity Date:
    start date: 17:56:OO UTC Jun 17 2025
    end   date: 17:56:OO UTC Jun 17 2026
  Associated Trustpoints: svs_cat9k_25jun17

CA Certificate
  Status: Available
  Certificate Serial Number (hex): 2OCD74O2C4DA37F5
  Certificate Usage: General Purpose
  Issuer:
    cn=SVS LabCA
    ou=SVS
    o=Cisco
    l=Raleigh
    st=North Carolina
    c=US
  Subject:
    cn=SVS LabCA
    ou=SVS
    o=Cisco
    l=Raleigh
    st=North Carolina
    c=US
  Validity Date:
    start date: 17:05:OO UTC Apr 28 2025
    end   date: 17:05:OO UTC Apr 28 2035
  Associated Trustpoints: svs_cat9k_25jun17 svs_cat9k
  Storage: nvram:SVSLabCA#37F5CA.cer
```

TACACS & AAA with TLS Configuration

Step 1. Create **TACACS server** and **AAA groups**, associate the client (router) trustpoint.

```
tacacs server svs_tacacs
 address ipv4 10.225.253.209
 single-connection
 tls port 6049
 tls idle-timeout 60
 tls connection-timeout 60
 tls trustpoint client svs_cat9k
 tls ip tacacs source-interface GigabitEthernet0/0
 tls ip vrf forwarding Mgmt-vrf
!
aaa group server tacacs+ svs_tls
 server name svs_tacacs
 ip vrf forwarding Mgmt-vrf
!
tacacs-server directed-request
```

Step 2. Configure AAA methods.

```
aaa authentication login default group svs_tls local enable
aaa authentication login console local enable
aaa authentication enable default group svs_tls enable
aaa authorization config-commands
aaa authorization exec default group svs_tls local if-authenticated
aaa authorization commands 1 default group svs_tls local if-authenticated
aaa authorization commands 15 default group svs_tls
aaa accounting exec default start-stop group svs_tls
aaa accounting commands 1 default start-stop group svs_tls
aaa accounting commands 15 default start-stop group svs_tls
aaa session-id common
```

Verification

Verify the configuration.

```
show tacacs
show crypto pki certificates <>
show crypto pki trustpoints <>
```

Debug for AAA & TACACS+.

```
debug aaa authentication
debug aaa authorization
```

```
debug aaa accounting
debug aaa subsys
debug aaa protocol local
debug tacacs authentication
debug tacacs authorization
debug tacacs accounting
debug tacacs events
debug tacacs packet
debug tacacs
debug tacacs secure

! Below debugs will be needed only if there is any issue with SSL Handshake
debug ip tcp transactions
debug ip tcp packet
debug crypto pki transactions
debug crypto pki API
debug crypto pki messages
debug crypto pki server
debug ssl openssl errors
debug ssl openssl msg
debug ssl openssl states
clear logging
```