Configure AnyConnect Flexvpn with EAP and DUO Authentication

Contents

Introduction

This document describes how to configure external two-factor authentication for AnyConnect IPSec connection to a Cisco IOS® XE router.

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Prerequisites

Requirements

Cisco recommends that you have knowledge of these topics:

- Experience with RA VPN configuration on a router
- Identity Services Engine (ISE) administration

Components Used

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

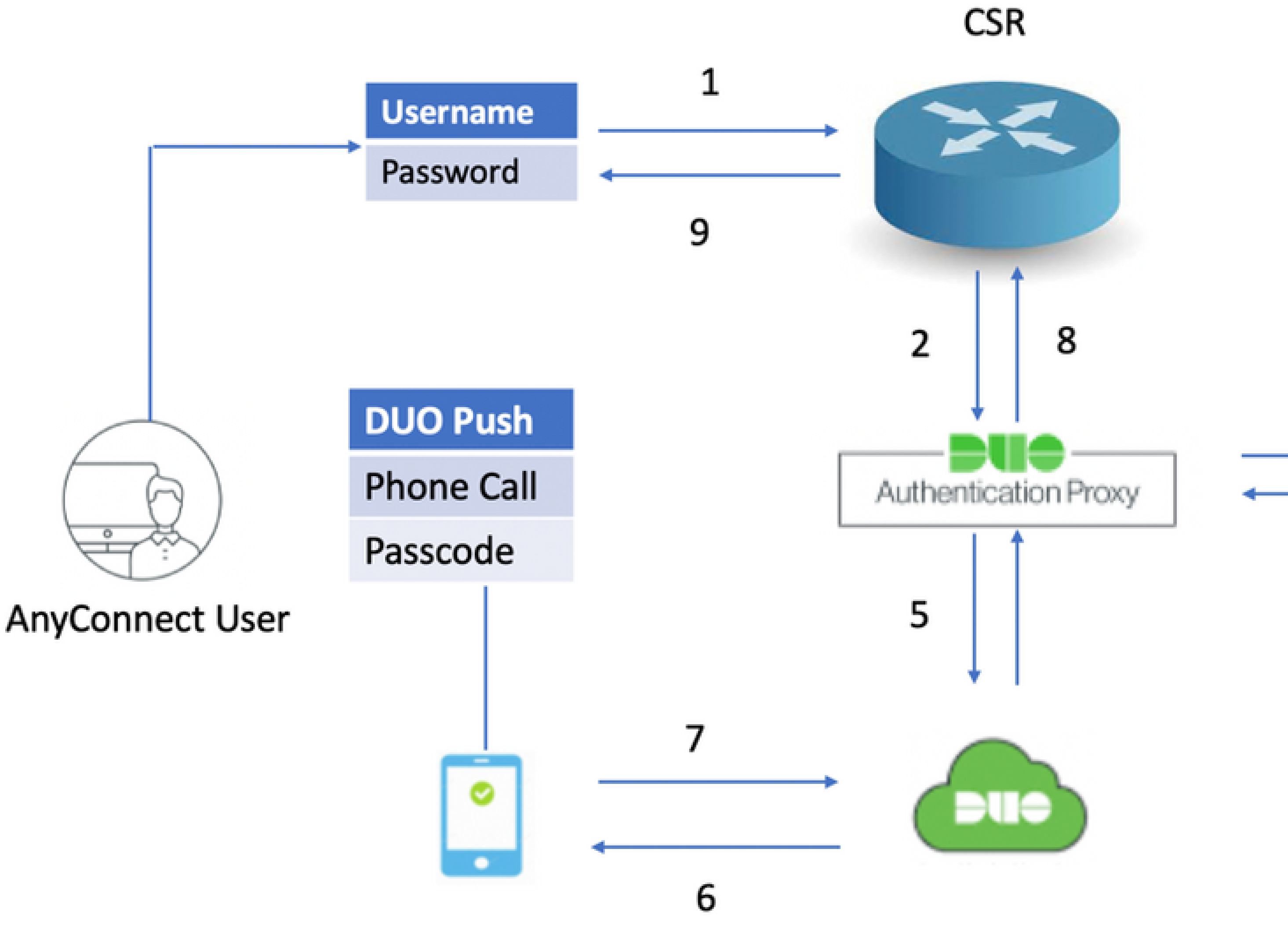
- Cisco Catalyst 8000V (C8000V) running version 17.10.01a
- Ciscoâ€¯AnyConnectâ€¯Secure Mobility Clientâ€¯version4.10.04071
- Cisco ISE running versionâ€¯3.1.0
- Duo Authentication proxy server (windows 10 or any Linux PC)
- Duo web account
- Client PC with AnyConnnect installed

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.

Authentication Flow

AnyConnect user authenticates with a username and password on the ISE server. The Duo Authentication Proxy server also sends an additional authentication in the form of a push notification to the mobile device of the user.

Flow Diagram



Authentication Flow Diagram

Communication Process

1. The user initiates a RAVPN connection to the C8000V and provides a username and password for Primary Authentication.
2. The C8000V sends an authentication request to the Duo Authentication Proxy.
3. Duo Authentication Proxy then sends the primary request to the Active Directory or RADIUS server.
4. The authentication response is sent back to the Authentication Proxy.
5. Once the primary authentication is successful then the Duo authentication proxy requests secondary authentication via the Duo server.
6. The Duo service then authenticates the user, depending on the secondary authentication method (push, phone call, passcode).
7. Duo authentication proxy receives the authentication response.
8. The response is sent to the C8000V.
9. If successful, the AnyConnect connection is established.

Configure

In order to complete the configuration, take into consideration these sections.

Configuration Steps on C8000V (VPN Headend)

1. Configure the RADIUS server. The IP address of the RADIUS server must be the IP of the Duo Authentic

```
â€¯address ipv4 10.197.243.97 auth-port 1812 acct-port 1813
â€¯timeout 120
â€¯key cisco
```

2. Configure the RADIUS server as aaa authentication and authorization as local.

```
aaa new-model
aaa group server radius FlexVPN_auth_server
â€¯server name rad_server
aaa authentication login FlexVPN_auth group FlexVPN_auth_server
aaa authorization network FlexVPN_authz localâ€¯
```

3. Create a Trustpoint in order to install the identity certificate, if not already present for local authentication. You can refer to Certificate Enrollment for a PKI for more details on the certificate creation.

```
crypto pki trustpoint TP_AnyConnect
enrollment url http://x.x.x.x:80/certsrv/mscep/mscep.dll
usage ike
serial-number none
fqdn flexvpn-C8000V.cisco.com
ip-address none
subject-name cn=flexvpn-C8000V.cisco.com
revocation-check none
rsakeypair AnyConnect
```

4. (Optional) Configure a standard access list to be used for the split tunnel. This access list consists of the destination networks that can be accessed through the VPN tunnel. By default, all the traffic passes through the VPN tunnel if the split tunnel is not configured.

```
ip access-list standard split-tunnel-acl
â€¯10 permit 192.168.11.0 0.0.0.255
 20 permit 192.168.12.0 0.0.0.255
```

5. Create an IPv4 address pool.

```
ip local pool SSLVPN_POOL 192.168.13.1 192.168.13.10
```

The IP address pool created assigns an IPv4 address to the AnyConnect client during a successful AnyConnect connection.

6. Configure an authorization policy.

```
crypto ikev2 authorization policy ikev2-authz-policyâ€¯
â€¯pool SSLVPN_POOL
â€¯dns 10.106.60.12
â€¯route set access-list split-tunnel-acl
```

The IP pool, DNS, split-tunnel list, and so on, are specified under the authorization policy.

> **Note**: If the custom IKEv2 authorization policy is not configured, then the default authorization policy called 'default' is used for authorization. The attributes specified under the IKEv2 authorization policy can also be pushed via the RADIUS server.

7. Configure an IKEv2 proposal and policy.

```
crypto ikev2 proposal FlexVPN_IKEv2_Proposal
â€¯encryption aes-cbc-128
â€¯integrity sha384
â€¯group 19

crypto ikev2 policy FlexVPN_IKEv2_Policy
match fvrf any
proposal FlexVPN_IKEv2_Proposal
```

8. Upload the AnyConnect client profile to the bootflash of the router and define the profile as given:

```
crypto vpn anyconnect profile Client_Profile bootflash:/Client_Profile.xml
```

9. Disable HTTP secure server.

```
no ip http secure-server
```

10. Configure the SSL policy and specify the WAN IP of the router as the local address for downloading the profile.

```
crypto ssl policy ssl-server
  pki trustpoint TP_AnyConnect sign
  ip address local <wan ip> port 443
```

11. Configure a Virtual template from which the virtual-access interfaces are cloned

```
interface Virtual-Template20 type tunnel
â€¯ip unnumbered GigabitEthernet1
```

The unnumbered command gets the IP address from the interface configured (GigabitEthernet1).

13. Configure an IKEv2 profile that contains all the connection-related information.

```
crypto ikev2 profile Flexvpn_ikev2_Profile
â€¯match identity remote any
â€¯authentication local rsa-sig
â€¯authentication remote eap query-identity
â€¯pki trustpoint TP_AnyConnect
â€¯dpd 60 2 on-demand
â€¯aaa authentication eap FlexVPN_auth
 aaa authorization group eap list FlexVPN_authz ikev2-authz-policy
 aaa authorization user eap cachedâ€¯
 virtual-template 20 mode auto
 anyconnect profile Client_Profile
```

These are used in the IKEv2 profile:

- match identity remote any - Refers to the identity of the client. Here 'any' is configured so that any client with the right credentials can connect
- authentication remote - Mentions that EAP protocol must be used for client authentication
- authentication local - Mentions that certificates must be used for local authentication
- aaa authentication eap - During EAP authentication, the RADIUS server FlexVPN_auth is used
- aaa authorization group eap list - During the authorization, the network list FlexVPN_authzis used with the authorization policy ikev2-authz-policy
- aaa authorization user eap cached- Enables implicit user authorization
- virtual-template 20 mode auto - Defines which virtual template to clone
- anyconnect profile Client_Profile - The client profile defined in Step 8. is applied here to this IKEv2 profile

14. Configure a transform set and an IPSec profile.

```
crypto ipsec transform-set TS esp-gcm 256â€¯
â€¯mode tunnel

crypto ipsec profile Flexvpn_IPsec_Profile
â€¯set transform-set TSâ€¯
â€¯set ikev2-profile Flexvpn_ikev2_Profile
```

15. Add the IPSec profile to the Virtual template.

```
interface Virtual-Template20 type tunnel
â€¯tunnel mode ipsec ipv4
 tunnel protection ipsec profile Flexvpn_IPsec_Profile
```

Snippet of the Client Profile (XML Profile)

Prior to Cisco IOS XE 16.9.1, automatic profile downloads from the headend is not available. Post 16.9.1, it is possible to download the profile from the headend.

<#root>

```
!
!
<ClientInitialization>
<UseStartBeforeLogon UserControllable="true">false</UseStartBeforeLogon>
<AutomaticCertSelection UserControllable="true">true</AutomaticCertSelection>
<ShowPreConnectMessage>false</ShowPreConnectMessage>
<CertificateStore>All</CertificateStore>
<CertificateStoreMac>All</CertificateStoreMac>
<CertificateStoreOverride>false</CertificateStoreOverride>
<ProxySettings>Native</ProxySettings>
<AllowLocalProxyConnections>false</AllowLocalProxyConnections>
<AuthenticationTimeout>30</AuthenticationTimeout>
<AutoConnectOnStart UserControllable="true">false</AutoConnectOnStart>
<MinimizeOnConnect UserControllable="true">true</MinimizeOnConnect>
<LocalLanAccess UserControllable="true">false</LocalLanAccess>
<DisableCaptivePortalDetection UserControllable="false">false</DisableCaptivePortalDetection>
<ClearSmartcardPin UserControllable="true">true</ClearSmartcardPin>
<IPProtocolSupport>IPv4,IPv6</IPProtocolSupport>
<AutoReconnect UserControllable="false">true
<AutoReconnectBehavior UserControllable="false">ReconnectAfterResume</AutoReconnectBehavior>
</AutoReconnect>
<SuspendOnConnectedStandby>false</SuspendOnConnectedStandby>
<AutoUpdate UserControllable="false">true</AutoUpdate>
<RSASecurIDIntegration UserControllable="false">Automatic</RSASecurIDIntegration>
<WindowsLogonEnforcement>SingleLocalLogon</WindowsLogonEnforcement>
<LinuxLogonEnforcement>SingleLocalLogon</LinuxLogonEnforcement>
<WindowsVPNEstablishment>AllowRemoteUsers</WindowsVPNEstablishment>
<LinuxVPNEstablishment>LocalUsersOnly</LinuxVPNEstablishment>
<AutomaticVPNPolicy>false</AutomaticVPNPolicy>
<PPPExclusion UserControllable="false">Automatic
<PPPExclusionServerIP UserControllable="false"></PPPExclusionServerIP>
</PPPExclusion>
<EnableScripting UserControllable="false">false</EnableScripting>
<EnableAutomaticServerSelection UserControllable="true">false
<AutoServerSelectionImprovement>20</AutoServerSelectionImprovement>
<AutoServerSelectionSuspendTime>4</AutoServerSelectionSuspendTime>
</EnableAutomaticServerSelection>
<RetainVpnOnLogoff>false
</RetainVpnOnLogoff>
<CaptivePortalRemediationBrowserFailover>false</CaptivePortalRemediationBrowserFailover>
<AllowManualHostInput>true</AllowManualHostInput>
</ClientInitialization>
<ServerList>
```

```
<HostEntry>
<HostName>FlexVPN</HostName>
<HostAddress>

flexvpn-csr.cisco.com

</HostAddress>
<PrimaryProtocol>IPsec
<StandardAuthenticationOnly>true
<AuthMethodDuringIKENegotiation>

EAP

-

MD5

</AuthMethodDuringIKENegotiation>
</StandardAuthenticationOnly>
</PrimaryProtocol>
</HostEntry>
</ServerList>
```

Configuration Steps on DUO Authentication Proxy

> **Note**: Duo Authentication Proxy supports MS-CHAPv2 only with RADIUS authentication.

Step 1. Download and Install Duo Authentication Proxy Server.

Log in to the Windows machine and install the Duo Authentication Proxy server.

It is recommended to use a system with at least 1 CPU, 200 MB disk space, and 4 GB RAM.

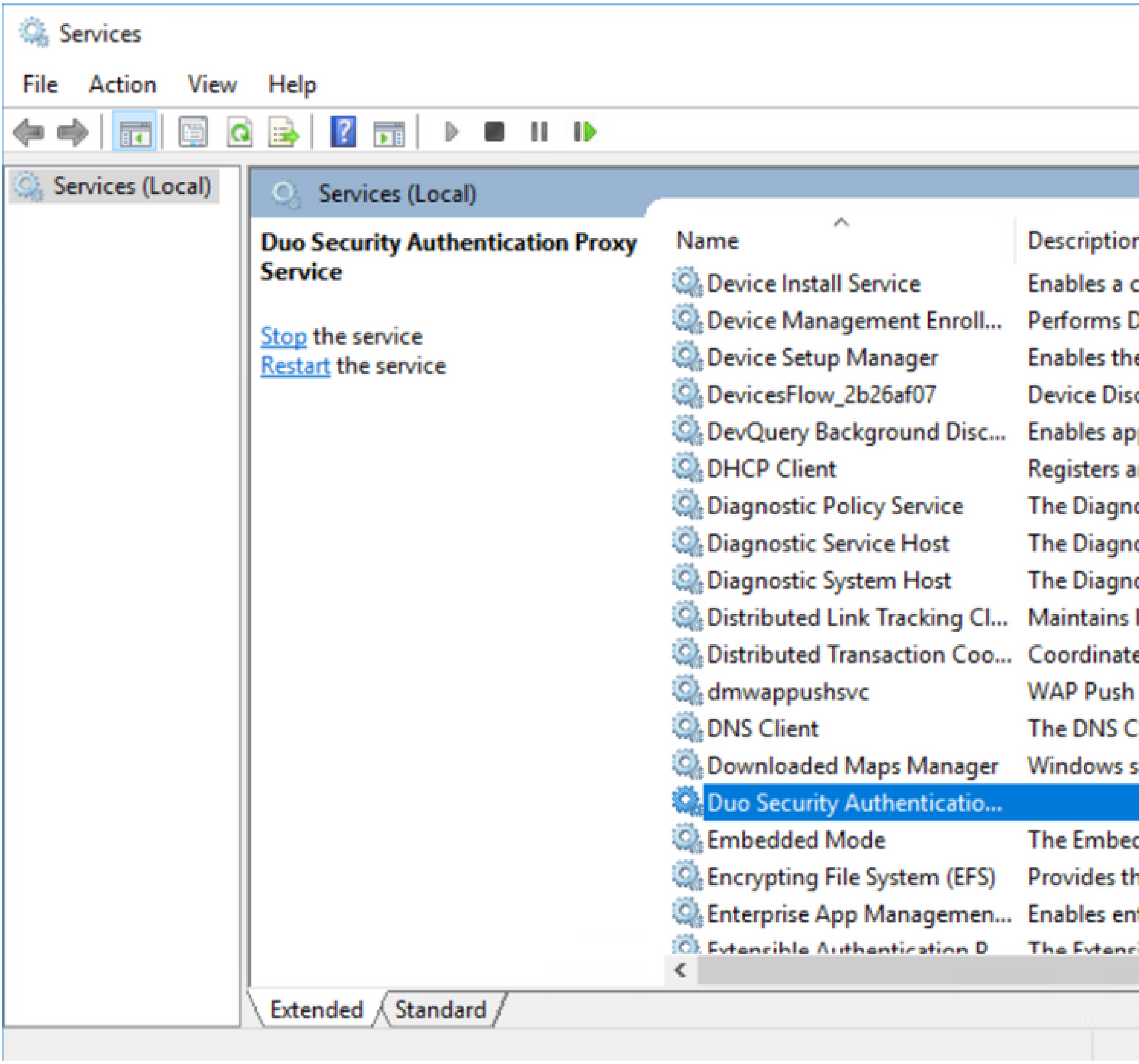
Step 2. Navigate to C:\Program Files\Duo Security Authentication Proxy\conf\ and open authproxy.cfg in order to configure the authentication proxy with the appropriate details.

```
[radius_client]
host=10.197.243.116
secret=cisco
```

> **Note**: Here '10.197.243.116' is the IP address of the ISE server and 'cisco' is the password configured in order to validate the primary authentication.

Once you have made these changes, save the file.

Step 3. Open Windows Services console (services.msc). And restart Duo Security Authentication Proxy Service.



Duo Security Authentication Proxy Service

Stop the service
Restart the service

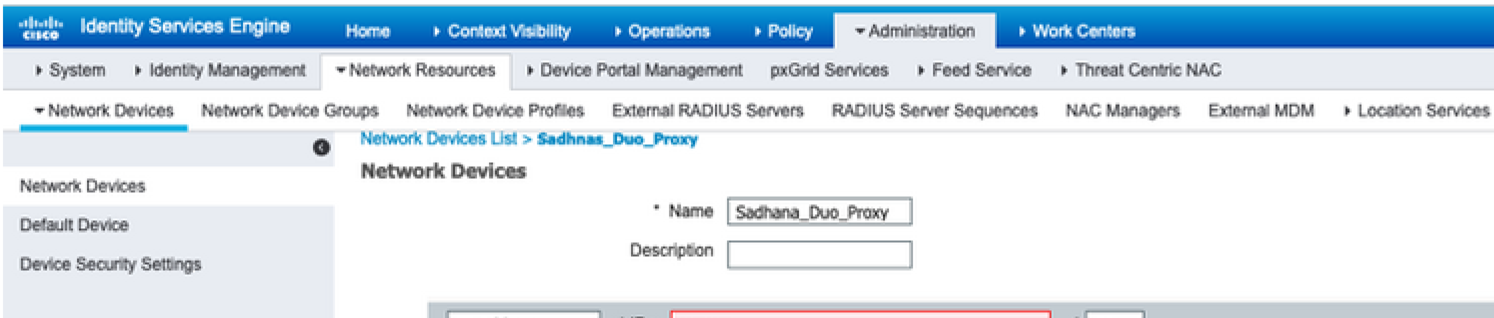
Name	Description
Device Install Service	Enables a c
Device Management Enroll...	Performs D
Device Setup Manager	Enables the
DevicesFlow_2b26af07	Device Disc
DevQuery Background Disc...	Enables ap
DHCP Client	Registers a
Diagnostic Policy Service	The Diagno
Diagnostic Service Host	The Diagno
Diagnostic System Host	The Diagno
Distributed Link Tracking Cl...	Maintains l
Distributed Transaction Coo...	Coordinate
dmwappushsvc	WAP Push
DNS Client	The DNS C
Downloaded Maps Manager	Windows s
Duo Security Authenticatio...	
Embedded Mode	The Embed
Encrypting File System (EFS)	Provides th
Enterprise App Managemen...	Enables en
Extensible Authentication P...	The Extensi

Duo Security Authentication Proxy Service

Configuration Steps on ISE

Step 1. Navigate to **Administration** > **Network Devices,â€¯**and clickAdd **â€¯**in order to configure the network device.

> **Note**: Replace x.x.x.x with the IP address of your Duo Authentication Proxy server.



Network Devices List > Sadhnas_Duo_Proxy

Network Devices

* Name Sadhana_Duo_Proxy

Description

```
ikey=xxxxxxxx
skey=xxxxxxxv1zG
api_host=xxxxxxxx
radius_ip_1=10.106.54.143
radius_secret_1=cisco
failmode=safe
client=radius_client
port=1812
```

> **Note**: The ikey, skey, and api_host must be copied from the Duo server when you configure the server, and '10.106.54.143' is the IP address of the C8000V router, and 'cisco' is the key configured on the router under the radius server configuration.

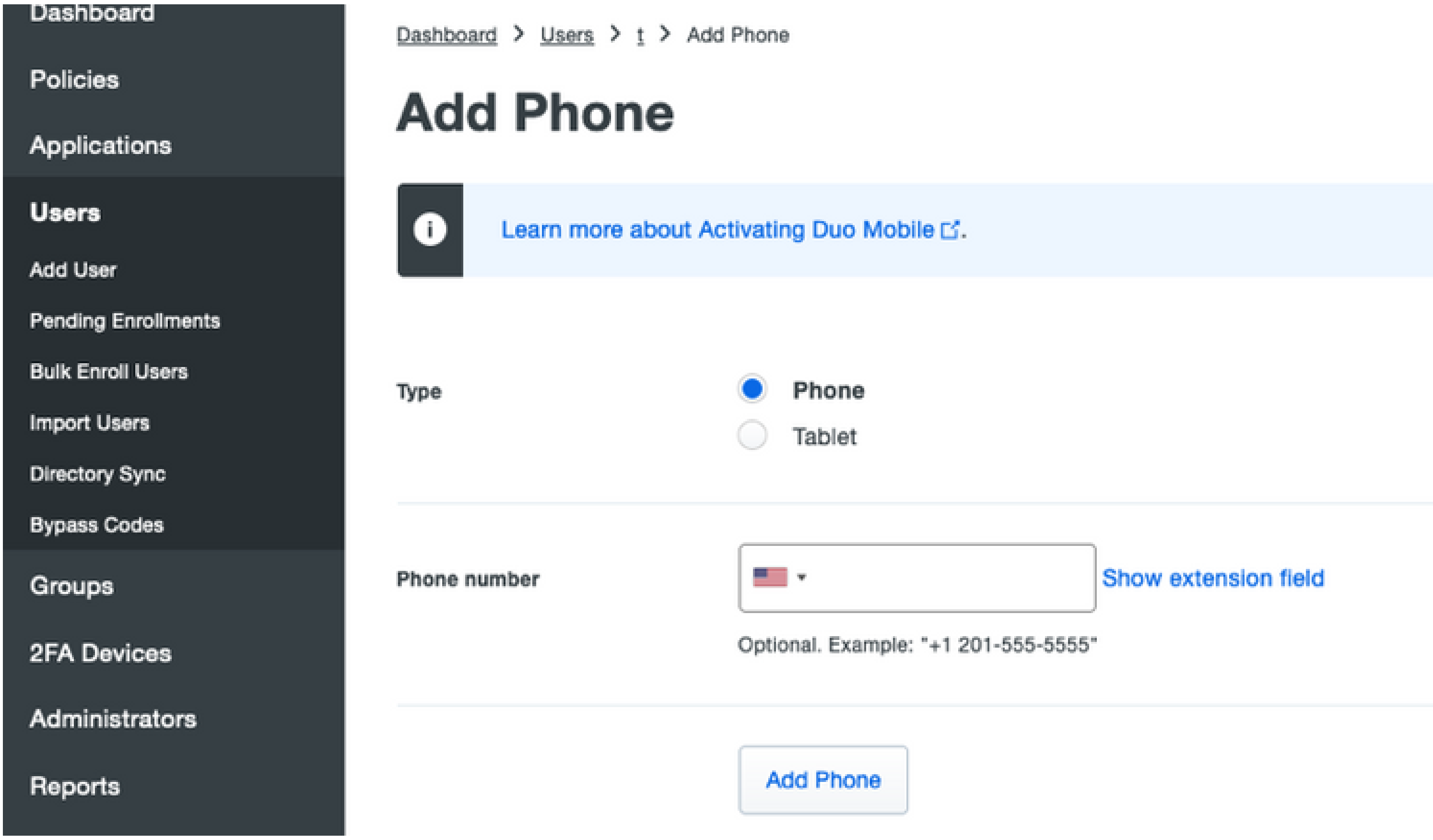
Once you have made these changes, save the file again and restart Duo Security Authentication Proxy Service (in services.msc)**.**

Step 3. Create Users on DUO for Secondary Authentication.

Navigate toâ€¯Users > Add Userand type the username.

> **Note**: The username must match the primary authentication username.

Click Add User. Once created, under Phones, click Add Phone, enter the Phone number, and click Add Phone.



Dashboard > Users > t > Add Phone

Add Phone

Learn more about Activating Duo Mobile.

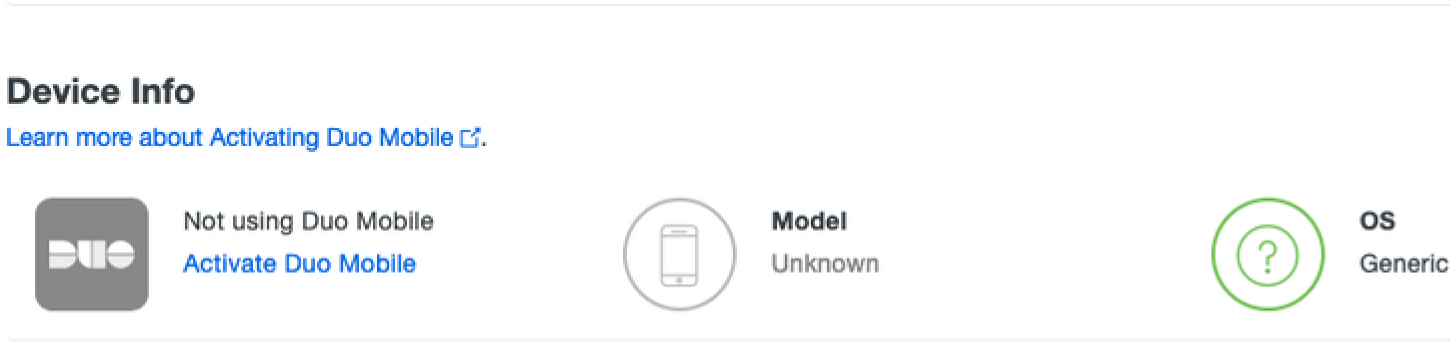
Type ● Phone ○ Tablet

Phone number Show extension field

Optional. Example: "+1 201-555-5555"

DUO - Add Phone

Choose the Type of authentication.



Device Info

Learn more about Activating Duo Mobile.

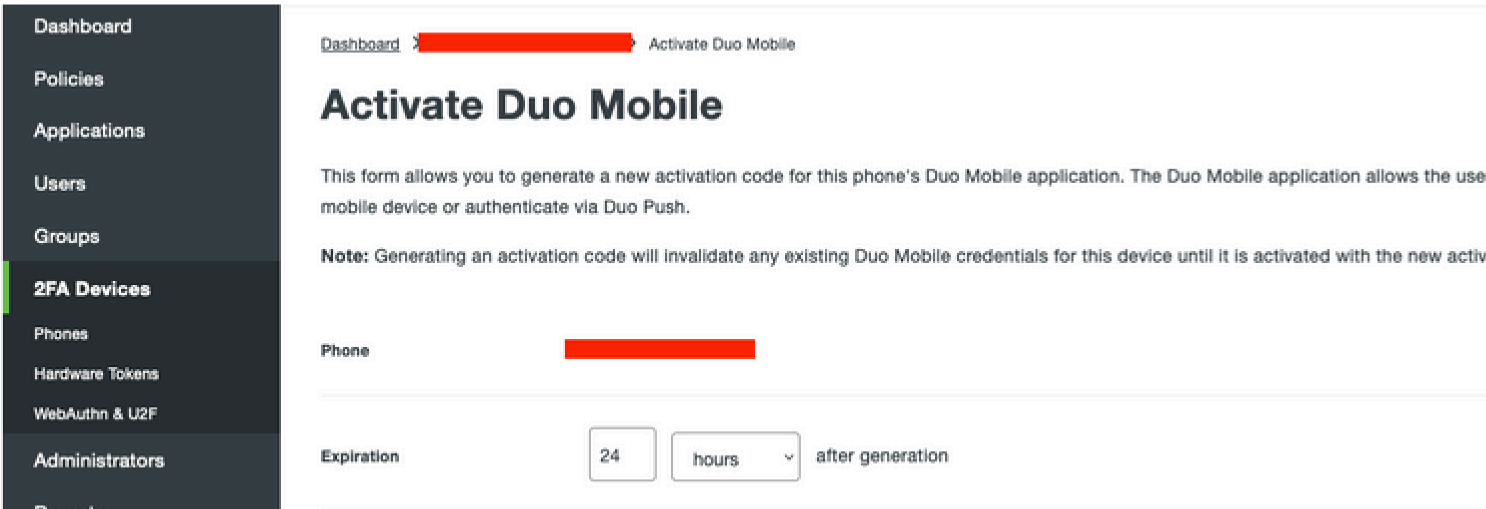
Not using Duo Mobile
Activate Duo Mobile

Model
Unknown

OS
Generic

DUO - Device Info

Choose Generate Duo Mobile Activation Code.



Dashboard [redacted] Activate Duo Mobile

Activate Duo Mobile

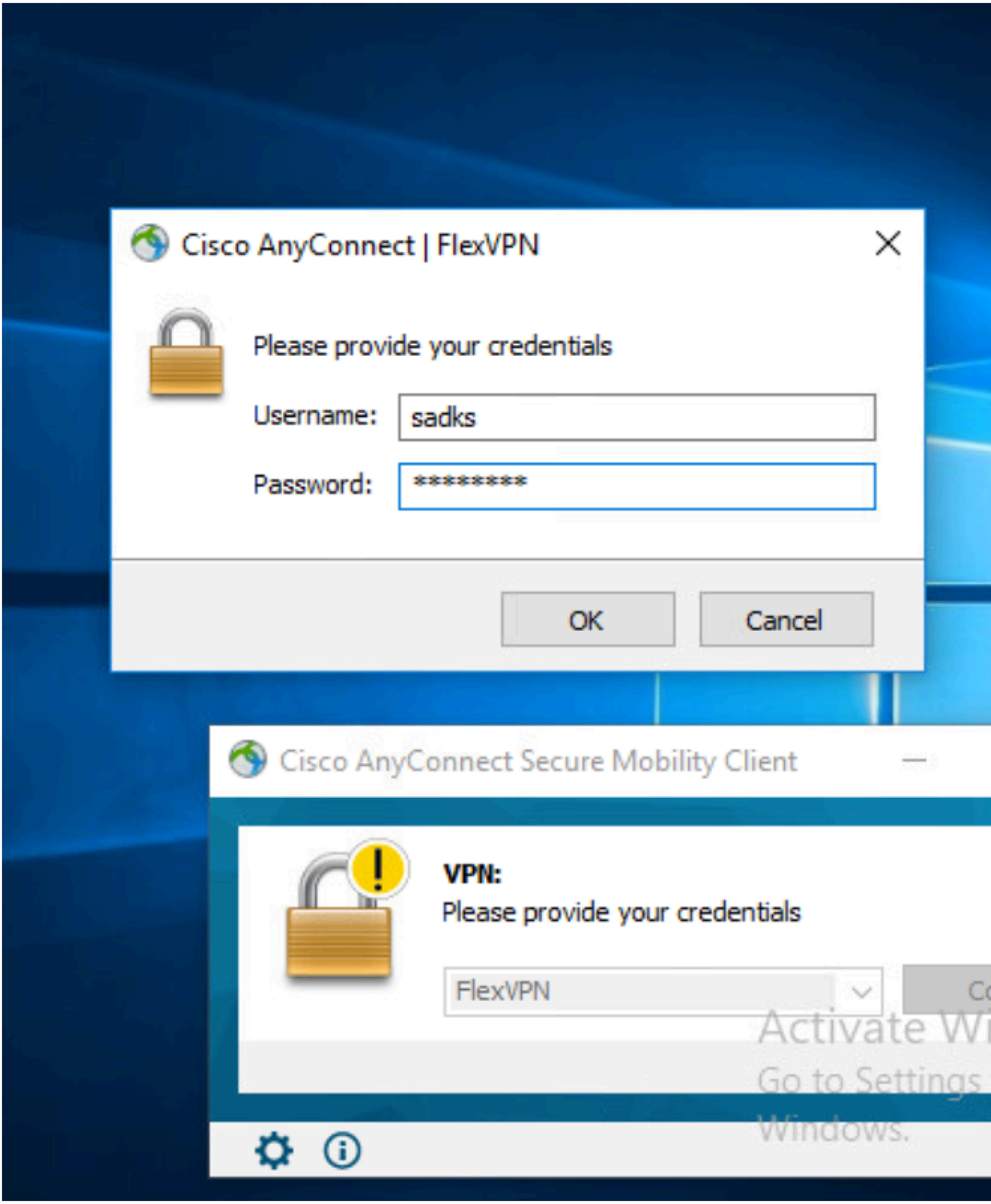
This form allows you to generate a new activation code for this phone's Duo Mobile application. The Duo Mobile application allows the use mobile device or authenticate via Duo Push.

Note: Generating an activation code will invalidate any existing Duo Mobile credentials for this device until it is activated with the new activ

Phone [redacted]

Expiration 24 hours after generation

Type in the username and password for the primary authentication.


Cisco AnyConnect | FlexVPN
OK
Cancel
Cisco AnyConnect Secure Mobility Client
Activate Wi
Go to Settings
Windows.

Please provide your credentials

Username: sadks

Password: *********

VPN:
Please provide your credentials

FlexVPN

AnyConnect Connection

Then, accept the DUO pushes on the mobile.

<#root>

```
R1#sh crypto ikev2 sa detailedâ€¯
â€¯IPv4 Crypto IKEv2â€¯ SAâ€¯

Tunnel-id Local â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ Remoteâ€¯ â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ fvrf/ivrfâ€¯ â€¯ â
1 â€¯ â€¯ â€¯ â€¯ 10.106.54.143/4500â€¯ â€¯ 10.197.243.98/54198 â€¯ none/noneâ€¯ â€¯ â€¯ â€¯ â€¯ â€¯

READY

 â€¯
â€¯ â€¯ â€¯ Encr: AES-CBC, keysize: 256, PRF: SHA384, Hash: SHA384, DH Grp:19, Auth sign: RSA, Auth veri
â€¯ â€¯ â€¯ Life/Active Time: 86400/147 sec
â€¯ â€¯ â€¯ CE id: 1108, Session-id: 15
â€¯ â€¯ â€¯ Status Description: Negotiation done
â€¯ â€¯ â€¯ Local spi: 81094D322A295C92 â€¯ â€¯ â€¯ Remote spi: 802F3CC9E1C33C2F
â€¯ â€¯ â€¯ Local id: 10.106.54.143
â€¯ â€¯ â€¯ Remote id: cisco.com
â€¯ â€¯ â€¯ Remote EAP id:

sadks

                                                                                           //

AnyConnect username


â€¯ â€¯ â€¯ Local req msg id:â€¯ 0â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ Remote req msg id:â€¯ 10 â€¯ â€¯ â€¯ â€¯
â€¯ â€¯ â€¯ Local next msg id: 0â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ Remote next msg id: 10 â€¯ â€¯ â€¯ â€¯
â€¯ â€¯ â€¯ Local req queued:â€¯ 0â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ Remote req queued:â€¯ 10 â€¯ â€¯ â€¯ â€¯
â€¯ â€¯ â€¯ Local window:â€¯ â€¯ â€¯ 5â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ â€¯ Remote window:â€¯ â€¯ â€¯ 1â€¯ â€¯ â€
â€¯ â€¯ â€¯ DPD configured for 60 seconds, retry 2
â€¯ â€¯ â€¯ Fragmentation notâ€¯ configured.
â€¯ â€¯ â€¯ Dynamic Route Update: disabled
â€¯ â€¯ â€¯ Extended Authentication not configured.
â€¯ â€¯ â€¯ NAT-T is detectedâ€¯ outside
â€¯ â€¯ â€¯ Cisco Trust Security SGT is disabled
â€¯ â€¯ â€¯

Assigned host addr: 192.168.13.5

                                                                            //Assigned IP address from t


â€¯ â€¯ â€¯ Initiator of SA : No
```

2. Crypto session detail for the vpn session

<#root>

```
R1#sh crypto sessionâ€¯ detailâ€¯
Crypto session current status
Code: C - IKE Configuration mode, D - Dead Peer Detectionâ€¯ â€¯ â€¯
K - Keepalives, N - NAT-traversal, T - cTCP encapsulationâ€¯ â€¯ â€¯
X - IKE Extended Authentication, F - IKE Fragmentation
R - IKE Auto Reconnect, U - IKE Dynamic Route Update
S - SIP VPN
```

```
Interface: Virtual-Access2
Profile:
```

FlexVPN

-

ikev2_Profile

Uptime: 00:01:07

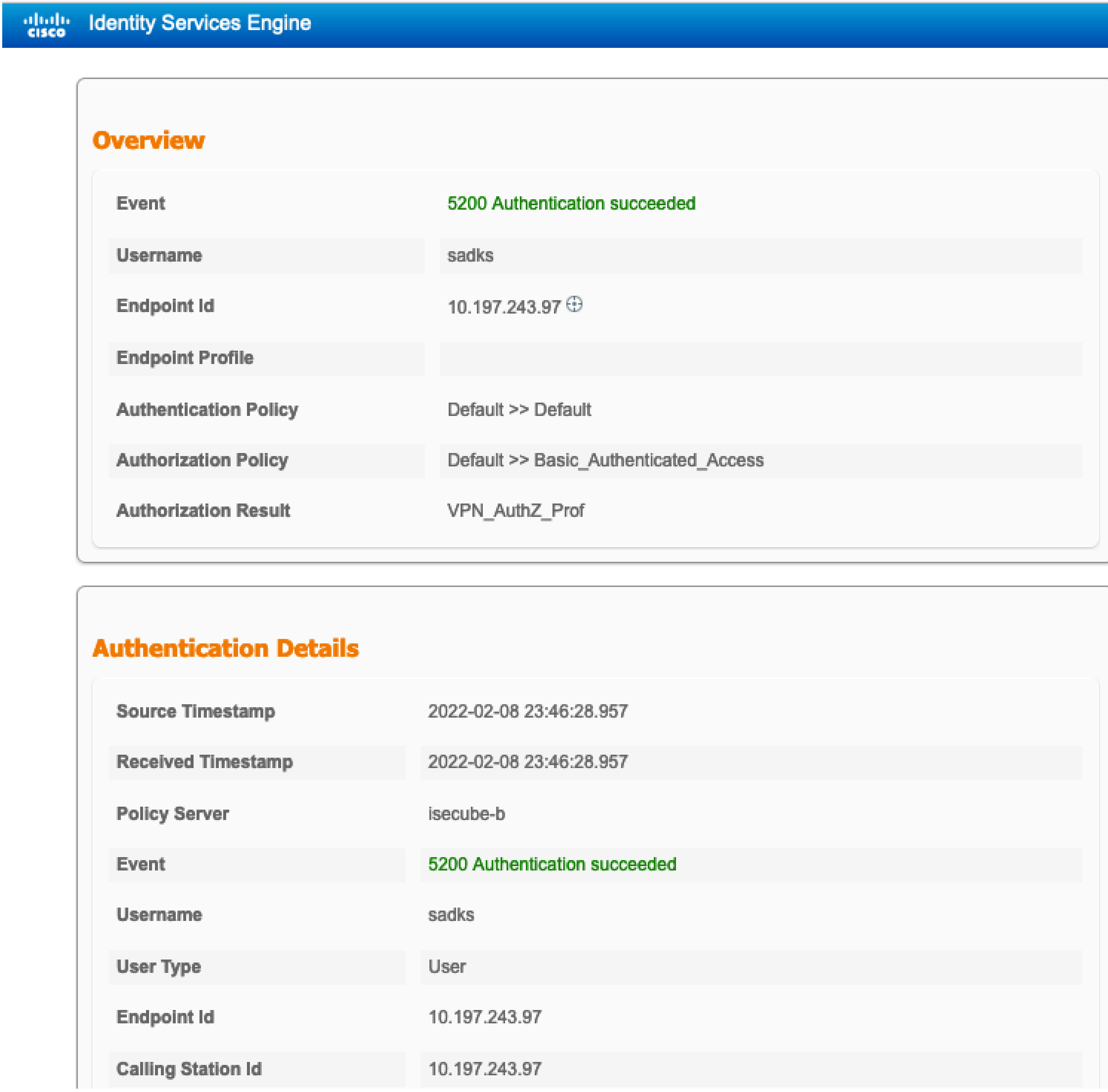
```
Session status: UP-ACTIVEâ€¯ â€¯ â€¯
Peer: 10.197.243.97 port 54198 fvrf: (none) ivrf: (none)
â€¯ â€¯ â€¯ Phase1_id: cisco.com
â€¯ â€¯ â€¯ Desc: (none)
â€¯ Session ID: 114 â€¯
â€¯ IKEv2 SA: local 10.106.54.143/4500 remote 10.197.243.98/54198 Activeâ€¯
â€¯ â€¯ â€¯ â€¯ â€¯ Capabilities:DN connid:1 lifetime:23:58:53
â€¯ IPSEC FLOW: permit ip 0.0.0.0/0.0.0.0 host
```

192.168.13.5

```
â€¯ â€¯ â€¯ â€¯ Active SAs: 2, origin: crypto map
â€¯ â€¯ â€¯ â€¯ Inbound:â€¯ #pkts dec'ed 3 drop 0 life (KB/Sec) 4607998/3532
â€¯ â€¯ â€¯ â€¯ Outbound: #pkts enc'ed 0 drop 0 life (KB/Sec) 4608000/3532
```

3.Verification on ISE live logs

Navigate to Operations > Live Logs in ISE. You can view the authentication report for the primary authentication.


Identity Services Engine

Overview

Event	5200 Authentication succeeded
Username	sadks
Endpoint Id	10.197.243.97 ⊕
Endpoint Profile	
Authentication Policy	Default >> Default
Authorization Policy	Default >> Basic_Authenticated_Access
Authorization Result	VPN_AuthZ_Prof

Authentication Details

Source Timestamp	2022-02-08 23:46:28.957
Received Timestamp	2022-02-08 23:46:28.957
Policy Server	isecube-b
Event	5200 Authentication succeeded
Username	sadks
User Type	User
Endpoint Id	10.197.243.97
Calling Station Id	10.197.243.97

ISE - Live Logs

4. Verification on DUO authentication proxy

Navigate to ths file on DUO Authentication Proxy; C:\Program Files\Duo Security Authentication Proxy\log

<#root>

```
2022-02-08T23:24:50.080854+0530 [duoauthproxy.lib.log#info]

 Sending request from 10.106.54.143

 to radius_server_auto

                                                                                             //10.106.5
```

```
2022-02-08T23:24:50.080854+0530 [duoauthproxy.lib.log#info] Received new request id 163 from ('10.106.54
2022-02-08T23:24:50.080854+0530 [duoauthproxy.lib.log#info] (('10.106.54.143', 1645), sadks, 163):

login attempt for username 'sadks'


2022-02-08T23:24:50.080854+0530 [duoauthproxy.lib.log#info]

Sending request for user 'sadks' to ('10.197.243.116', 1812)


with id 191                                                                          //Primary auth sent t


2022-02-08T23:24:50.174606+0530 [duoauthproxy.lib.log#info]

Got response for id 191 from ('10.197.243.116', 1812); code 2


2022-02-08T23:24:50.174606+0530 [duoauthproxy.lib.log#info] http POST to

https://api

-

xxxx[.]duosecurity[.]com:443/rest/v1/preauth


2022-02-08T23:24:50.174606+0530 [duoauthproxy.lib.http._DuoHTTPClientFactory#info] Starting factory <_Du
2022-02-08T23:24:51.753590+0530 [duoauthproxy.lib.log#info] (('10.106.54.143', 1645), sadks, 163): Got p
2022-02-08T23:24:51.753590+0530 [duoauthproxy.lib.log#info]

http POST to

https://api

-

xxxx[.]duosecurity[.]com:443/rest/v1/auth


2022-02-08T23:24:51.753590+0530 [duoauthproxy.lib.http._DuoHTTPClientFactory#info] Starting factory <_Du
2022-02-08T23:24:51.753590+0530 [duoauthproxy.lib.http._DuoHTTPClientFactory#info] Stopping factory <_Du
2022-02-08T23:24:59.357413+0530 [duoauthproxy.lib.log#info] (('10.106.54.143', 1645), sadks, 163):

Duo authentication returned 'allow': 'Success. Logging you in...'


2022-02-08T23:24:59.357413+0530 [duoauthproxy.lib.log#info] (('10.106.54.143', 1645), sadks, 163):

Returning response code 2: AccessAccept


2022-02-08T23:24:59.357413+0530 [duoauthproxy.lib.log#info] (('10.106.54.143', 1645), sadks, 163): Sendi
2022-02-08T23:24:59.357413+0530 [duoauthproxy.lib.http._DuoHTTPClientFactory#info] Stopping factory <_Du
```

Troubleshoot

1. Debugs on C8000V.

For IKEv2:

- debug crypto ikev2
- debug crypto ikev2 client flexvpn
- debug crypto ikev2 internal
- debug crypto ikev2 packet
- debug crypto ikev2 error

For IPSec:

- debug crypto ipsec
- debug crypto ipsec error

2. For the DUO Authentication Proxy, check the log file proxy-related logs. (C:\Program Files\Duo Security Authentication Proxy\log)

The snippet for an error log where ISE is rejecting the primary authentication is shown:

```
<#root>

2022-02-07T13:01:39.589679+0530 [duoauthproxy.lib.log#info]

Sending proxied request

 for id 26 to ('10.197.243.116', 1812) with id 18
2022-02-07T13:01:39.589679+0530 [duoauthproxy.lib.log#info]

Got response

 for id 18 from ('10.197.243.116', 1812); code 3
2022-02-07T13:01:39.589679+0530 [duoauthproxy.lib.log#info] (('10.106.54.143', 1645), sadks, 26):

Primary credentials rejected - No reply message in packet


2022-02-07T13:01:39.589679+0530 [duoauthproxy.lib.log#info] (('10.106.54.143', 1645), sadks, 26): Return

AccessReject
```