Implementation Note:

Jamf Active Directory Certificate Services Connector

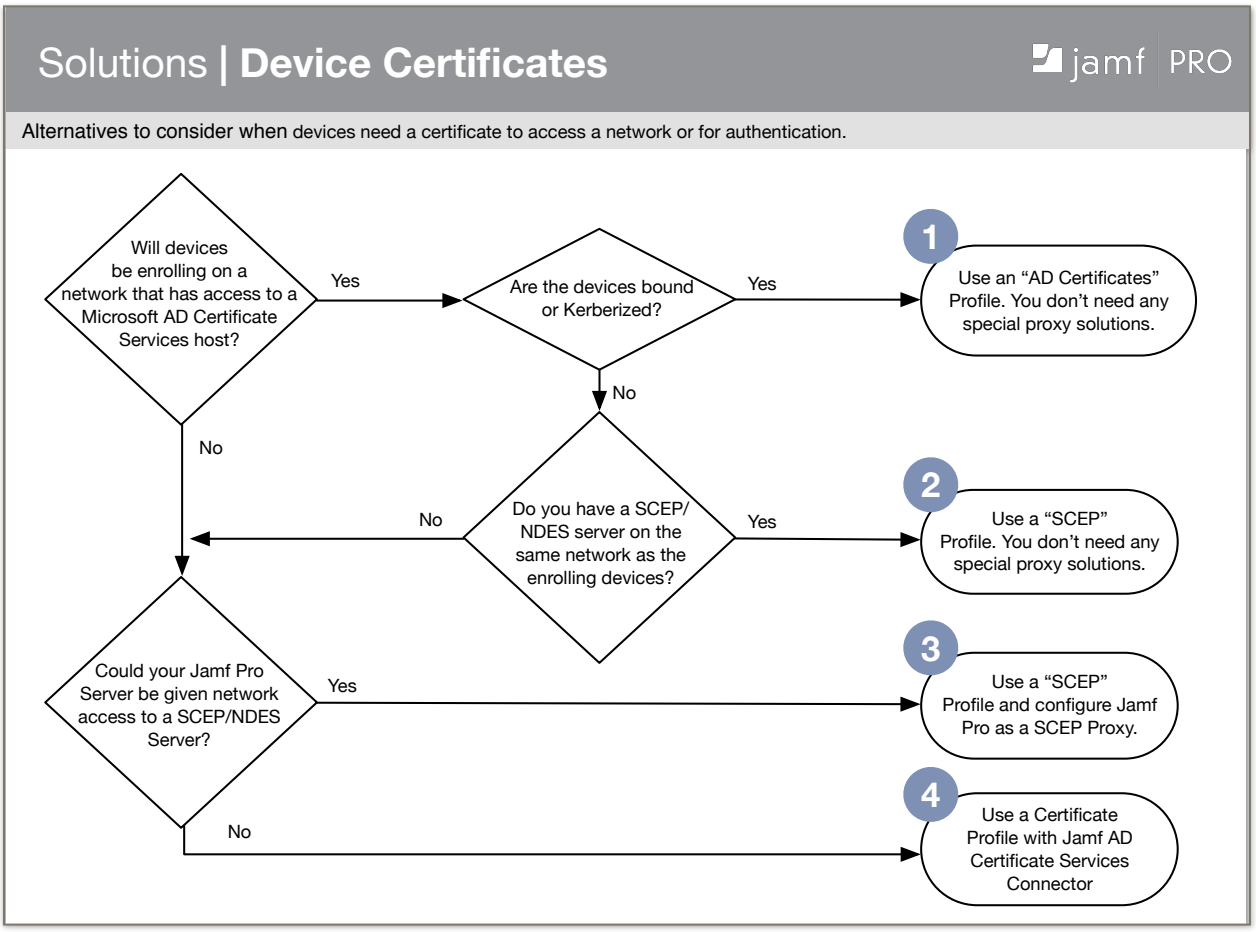
Jamf Implementation Engineering
16 June 2020/ol

jamf

CONTENTS

Options for Deploying Device Certificates

When an organization uses Microsoft PKI, Jamf Pro supports four profile-based methods to deploy certificates to devices. The one you use will depend on your circumstances.



Options 1 and 2 are traditional methods that require devices to enroll on an internal network. Options 3 and 4 work where enrolling devices are not initially on an internal network.

Option 3 allows the devices to use the Jamf Pro web application as a conduit for their transaction with a SCEP/Microsoft NDES service, and since the trust basis for all components is strong, this may be both acceptable and desirable, because in option 4, the Jamf Pro web application creates the private key, gets a signature from ADCS, and then delivers the completed identity to the device. In all other options, the private key is created by the managed device and never needs to leave it.

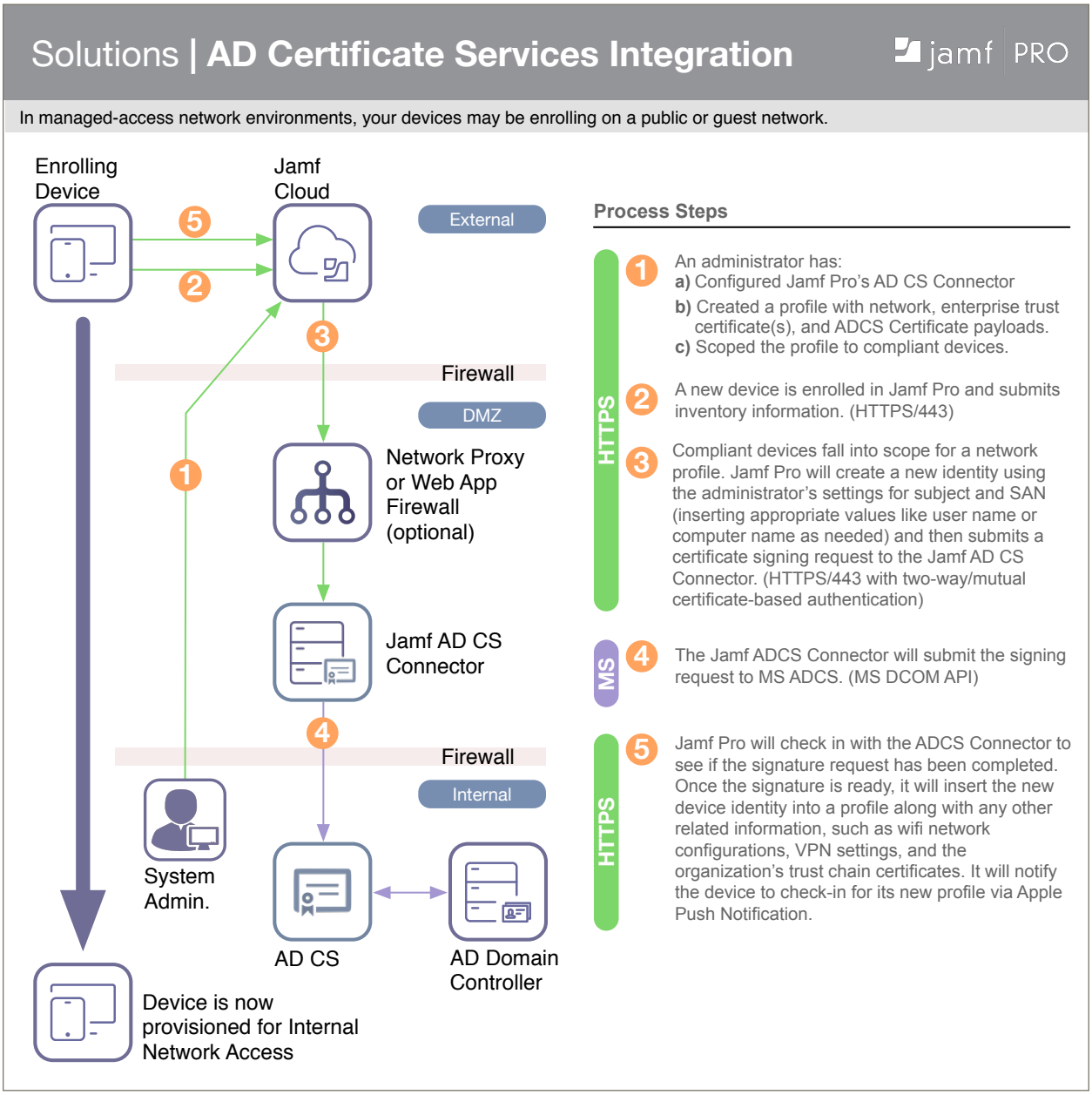
Some organizations choose ADCS Connector over SCEP Proxy because they prefer the former's certificate-based authentication, are opposed to using NDES/SCEP, or because they require the flexibility of using a variety of certificate templates.

The remainder of this document deals with the Jamf Active Directory Services Connector and assumes that you have already determined that this option is the best fit for your organization.

ADCSC – Background

The Jamf Pro Active Directory Certificate Services Connector ("ADCS Connector" or "ADCSC") is an HTTP REST API running on a Microsoft IIS web server. It acts as an intermediary between Jamf Pro and Microsoft Active Directory Certificate Services ("ADCS"), submitting certificate requests to ADCS on behalf of Jamf Pro and returning completed signatures. Network communications, ports, protocols, and authentication are described in the following sections.

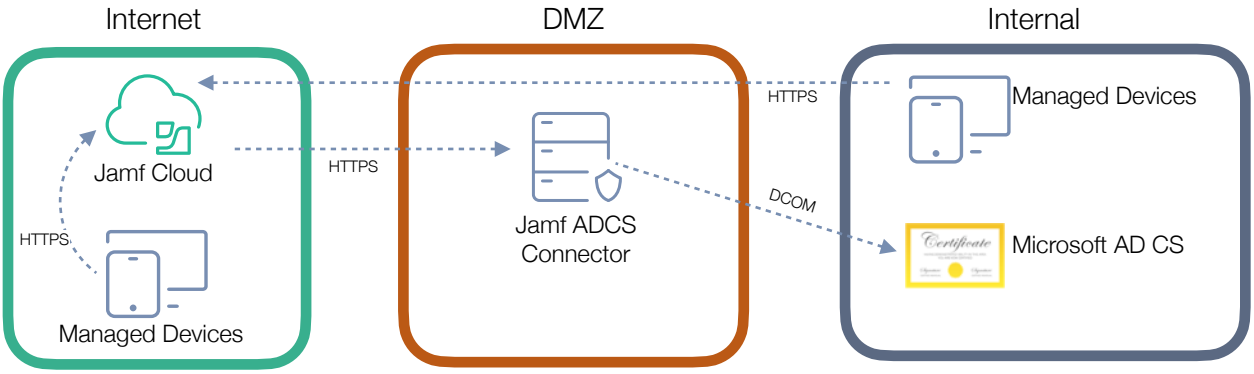
This diagram summarizes the managed device certificate deployment process using ADCS Connector.



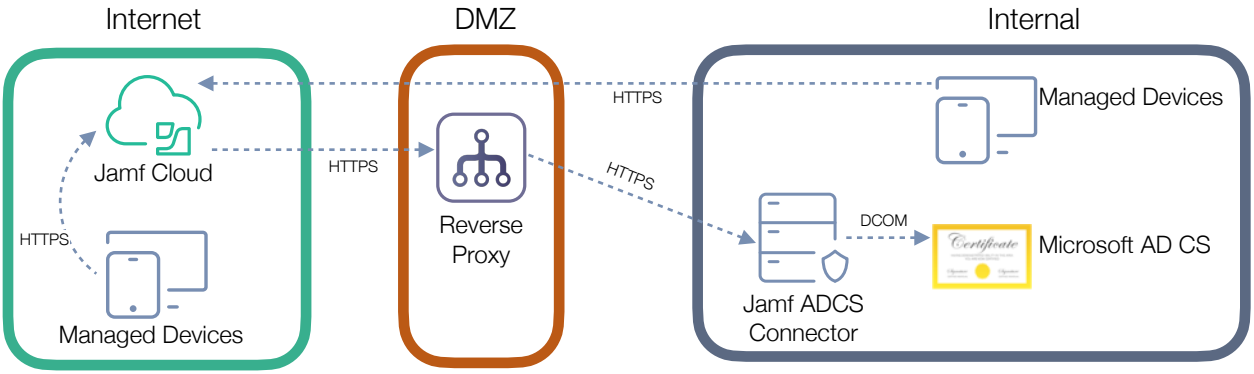
Network Connections

The following diagrams illustrate some common implementations of the Jamf ADCS Connector.

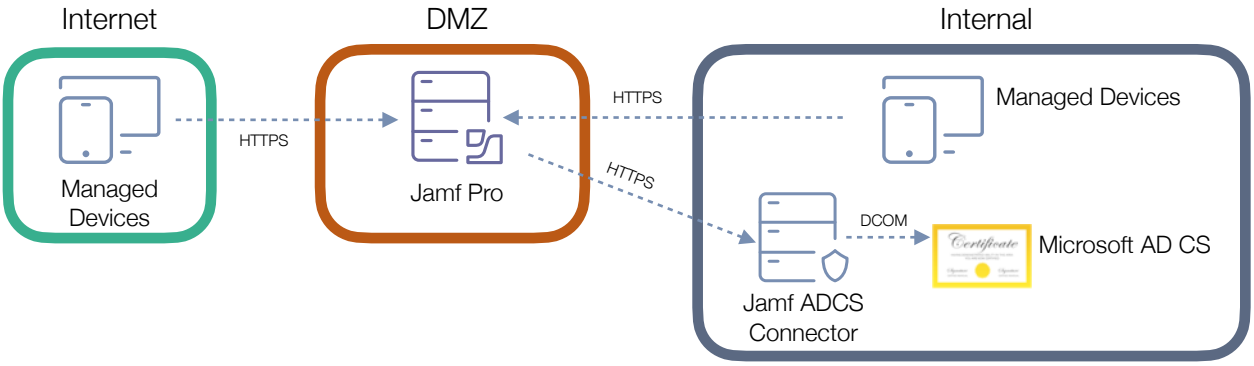
Jamf Cloud with Jamf ADCS Connector in the DMZ



Jamf Cloud with a DMZ Reverse Proxy Layer



Self-hosted Jamf Pro Server in the DMZ



Network Zones and Firewall Configuration

The ADCSC communications are encrypted and authenticated, but additional security is obtained by creating firewall rules in your network infrastructure and/or on the server/OS firewall.

The source IP addresses from which Jamf Cloud connections will originate are documented by https://www.jamf.com/jamf-nation/articles/409/permitting-inbound-outbound-traffic-with-jamf-cloud.

The host names, internal and external (VIP) IP addresses, or port numbers used in your internal networks can be configured as needed. Port 443 is commonly used for HTTPS connections. DCOM (Microsoft Distributed Component Object Model) connections between the ADCS Connector server and the ADCS server run on Microsoft's default ports (135 and 49152-65535), though those can be configured as well. Ref: Default Ports Documentation. Please see the "Configuring ADCS to use an Alternate Port" section of this document for further considerations.

Connection	TCP Port (Typical)	Protocol	Description
Managed Devices to Jamf Pro	443	HTTPS	Apple OS-devices connect to an enrolled mobile device management ("MDM") server to receive management payloads.
Jamf Pro to Jamf AD CS Connector	443	HTTPS	Jamf Pro sends certificate signing requests and retrieves completed signatures by opening a connection to the Jamf AD CS Connector, typically on TCP port 443, but any available port can be used if preferred.
Jamf ADCS Connector to Microsoft ADCS	135: MS DCE endpoint resolution used by DCOM. 49152-65535: Dynamic DCOM callback ports	Microsoft DCOM	The Jamf AD CS Connector uses Microsoft Distributed Component Object Model (DCOM) to communicate with AD CS.

Security Mindset

Introduction

In many organizations, certificates are deployed to devices for use in verifying that devices or users which connect to internal networks are authorized to do so, and to allow network administrators to track who is connecting, when they connect, and which services they connect to. In other organizations, the certificate is used to authenticate to applications or for message signing. The security around the identity provisioning process must be considered in the context of the rights that identity confers and measured against the trust-basis of the provisioning process.

Regardless of the identity purpose, certain best-practices should be employed. These are discussed here.

ADCSC Communication Authentication and Trust Basis

Relationship	Authentication	Trust Basis
Devices to Jamf Pro	Message signing based on a device-specific MDM enrollment identity	This depends on the enrollment method, but for Automated Enrollment, 1) Device has been purchased by the organization and registered by Apple in Apple Business Manager or Apple School Manager, 2) An admin has accepted the device into a Jamf Pre-stage Enrollment Group, 3) The device user has authenticated with their organizational credentials on enrollment
Jamf Pro to ADCS Connector	Server and Client TLS certificate exchange	A Jamf Pro administrator will have uploaded the server's public key and the Jamf Pro ADCS Client Identity file into the Jamf Pro console. Without these, no connection to ADCSC is possible.
ADCSC to ADCS	Microsoft Auth (Kerberos)	The ADCS administrator has granted permission to obtain certificates to the ADCS Connector host.

ADCSC and IT Service Security

No IT service can have perfect security. The goal of security practitioners should be to ensure that services are planned, implemented, and operated in a manner that minimizes risk. The security around the ADCS Connector is will be similar to the good security practices an organization uses with any of their network-based services.

- Administrators must have a strong understanding of the trust-basis, network connections, protocols, encryption, and authentication at each step of a communications flow.
- Vulnerabilities in the operating systems underlying an IT service are among the most frequently exploited attack vectors. Your installation should rely on the vendor's recommended practices and the vendor's updates should be applied diligently.
- Jamf patches related to security are uncommon, but action should be taken immediately in response to security notifications when the vulnerability effects a component or workflow that you are using. These will be sent to all customers via email and also posted prominently on

Jamf Nation. Jamf Cloud Standard customers are patched automatically. On-premise installations should be patched without undue delay.

- Strategies such as reverse proxies and firewalls can be used to insulate network components from attack. Proxies should be employed in a fashion that is consistent with your organization's standards and practices. Firewalls may be enforced to allow only the minimum required connections between network zones and at the OS level.
- Security plan approval workflows, audits, or informal methods such as peer configuration review and testing can be used to verify that systems are implemented correctly.
- Anything downloaded or installed on a server should be sourced directly from a trusted vendor. For example, we would not install a network traffic monitoring utility downloaded from an untrusted repository onto a production server.
- Never use a web browser on a server to do anything unnecessary on a server. If you need to look up some information when troubleshooting, do it from your user machine.
- Strong measures should be taken to protect credentials such as private keys and service-account user names and passwords in transit and at rest. For example, we would never send user account information/passwords or a .pfx keystore and it's password together in an email or copy them to a local user machine. The chain of custody of private keys should be carefully protected.
- Remote Desktop and ssh access to a server (and any management servers) should be limited only to trusted and required persons.
- Practices such as key/password rotation may be used to limit the amount of time that exposed credentials may be used to penetrate a system. Two-factor authentication ensures that exposure of a single factor (i.e. username/password) is not sufficient to gain access.
- Avoid the use of local administrator accounts on Windows servers. Domain accounts with password complexity, lockout rules, and expiration are preferred.
- Use certificate-based authentication for ssh, not username and password.

These are meant to illustrate general principles of server operation. More specific actions are generally available from network, server, monitoring, and OS vendors. These should be employed as they are with other IT services hosted by your organization.

Microsoft DCOM Binding Requirement

The standard installer will configure a thread pool to run the ADCS Connector in IIS. By default, it runs under the ADCSC's host computer's Windows auth identity, and this identity will need to be given permissions on the CA. For this reason, the server running the Connector host must be bound either to the same domain as ADCS, or to a forest domain that has a trust relationship with the ADCS domain. The Connector can also be configured to run as another user, such as a service account. This will be discussed later in the document.

Private Key Chain of Custody / Data at Rest and In Transit

Introduction

The encryption, authentication, and trust basis for each step of the ADCS identity provisioning process have already been discussed.

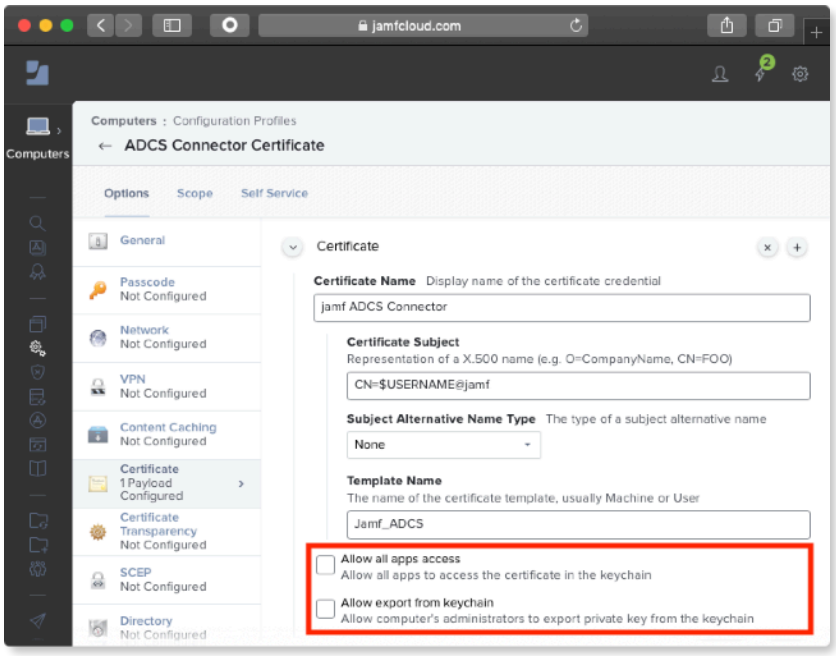
We have also previously noted that when using the Microsoft and SCEP (or SCEP Proxy) MDM payloads, the private key is generated on the managed device and never leaves. The device uses the private key to generate the CSR. With the ADCS Connector (Certificates) payload, the private key and CSR are generated by the Jamf Pro web application server. The private key is stored (AES-256 encrypted) in the Jamf Pro database to support certificate profile delivery and certificate lifecycle management. The application does not provide any facility for export or extraction of the private keys other than delivery (via MDM profile) to the intended managed device.

All HTTP/REST communications occur over TLS. Jamf Pro installers do not enable support for SSL v3.0.

Customers often ask how an identity delivered via the certificates profile is secured on the device with respect to data at rest and exportability of the private key. A key point to recognize here is that in the final step where we actual deliver the identity to the managed device, we are using an Apple-standard certificate payload. How these payloads are implemented is determined by exclusively by Apple and built into their OSs.

Once the profile with a certificate payload is received by a device, the OS will pass the identity into a local keychain file. You should refer to Apple documentation for further information. For example, https://support.apple.com/guide/security/keychain-data-protection-overview-secb0694df1a/web.

As for the exportability question, note that both the Certificate and SCEP payloads in Jamf Pro have access and exportability flags. These settings will be included in the profile we deliver to the device and respected by Apple's OSs.



Installation of ADCS Connector – Requirements Summary

The following preparations should be made prior to installation:

- A Windows OS with .NET Framework 4.5 or greater (E.g. Windows Server 2016/2019) joined to a domain that has a trust basis with the ADCS domain.
- Port 443 open inbound from Jamf Pro to the ADCS Connector host.
- DCOM (Microsoft Distributed Component Object Model) permitted between the ADCS Connector host and the ADCS server. Ports 135 and 49152-65535 are the MS defaults.
- The DNS used by Jamf Pro can resolve the FQDN of your ADCS Connector. E.g., if you are on Jamf Cloud, The FQDN of the Connector's external VIP is available in public DNS.

Installing the Jamf ADCS Connector

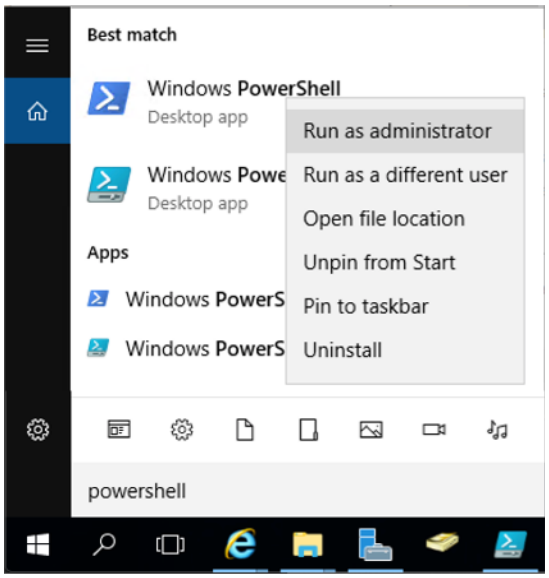
1. Download a copy of the installer

If you are a Jamf customer, the installation software is available under the "My Assets" section once you have logged into Jamf Nation.

Copy the installer to the computer that will host the ADCS Connector and decompress the .zip archive.

2. Run the installer

The installer includes a Powershell script that can be called from the Windows command line or Powershell command line to unzip the ADCS Connector files and setup/configure Microsoft IIS.



Run the the Windows PowerShell command line as administrator, "cd" into the folder that contains the deploy.ps1 script, and run the installer. For the -fqdn parameter, specify the host name Jamf Pro will resolve to connect to the Connector. Note that this is the external/VIP hostname, not necessarily the same as the actual host that runs the Connector. For -jamfdn, use your Jamf Pro host name. See the next page for an example.

The documentation is available from http://docs.jamf.com/ad-cs-connector/1.0.0/index.html.

The operation will be similar to the following:

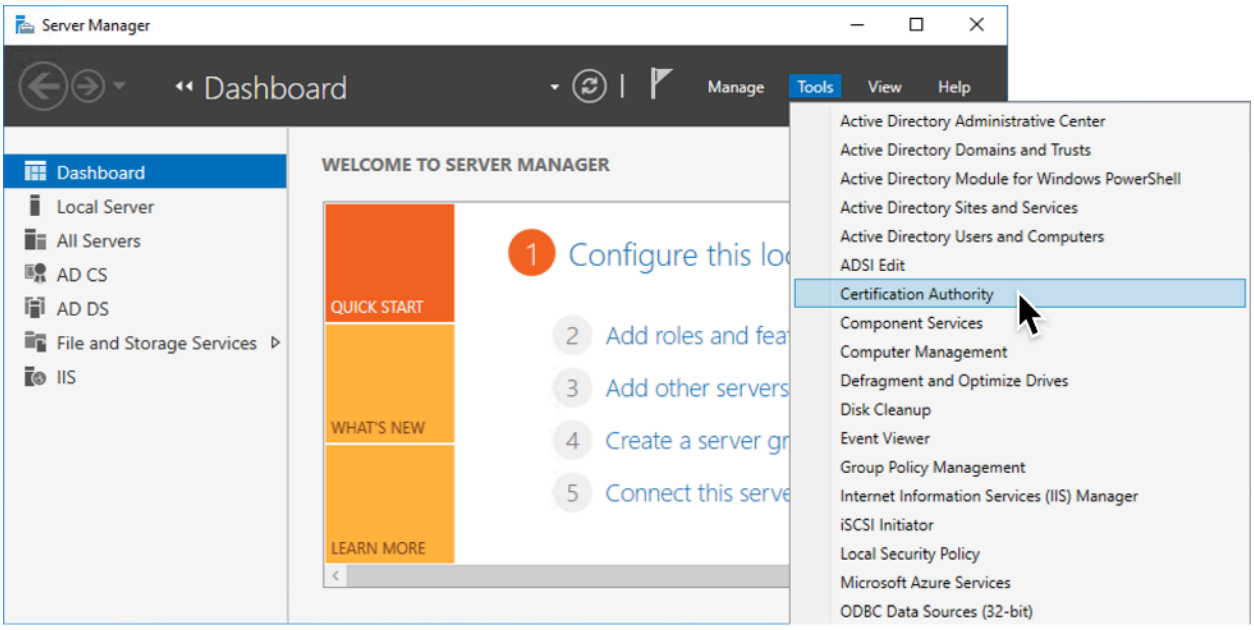
```
PS > cd "C:\Users\admin\Desktop\ADCS Connector"
PS C:\Users\admin\Desktop\ADCS Connector> .\deploy.ps1 -fqdn adcsc.my.org
-jamfProDn my.jamfcloud.com

Enabling IIS and ASP.NET features...
IIS and ASP.NET enabled.
Removing AdcsProxyPool Application Pool...
Removing AdcsProxy Site...
Install path C:\inetpub\wwwroot\adcsproxy already exists.
Cleaning C:\inetpub\wwwroot\adcsproxy...
Unzipping site to C:\inetpub\wwwroot\adcsproxy...
Creating AdcsProxyPool Application Pool...
Creating site AdcsProxy...
Creating local user account AdcsProxyAccessUser. This user will be referenced
for IIS Client Certificate Mapping Authentication.

Created new local user AdcsProxyAccessUser with password ^\::X"+Y#bb8Wh?rC8lh

!!!NOTE - Please save this information if setting up IIS Client Certificate
Mapping Authentication manually.

Adding Windows Firewall rule to allow inbound TCP traffic on port 443
Configuring HTTPS...
Generating self-signed certificate for ms.jamf.club...
Adding adcsc.my.org to local root CA store...
Generating adcsc.my.org-signed certificate for j...
Configuring IIS Client Certificate Mapping Authentication for
AdcsProxyAccessUser...
Exporting client certificate keystore...
Client keystore exported.

!!!NOTE - Client cert keystore password: c2sG5J5orHM3ZLP
```

Make note of the Client cert keystore password. You'll be prompted to enter this password when importing the client identity file ("client-cert.pfx") to Jamf Pro. If you close the Powershell window before noting the password, you'll need to re-run the installer to get a new identity generated.

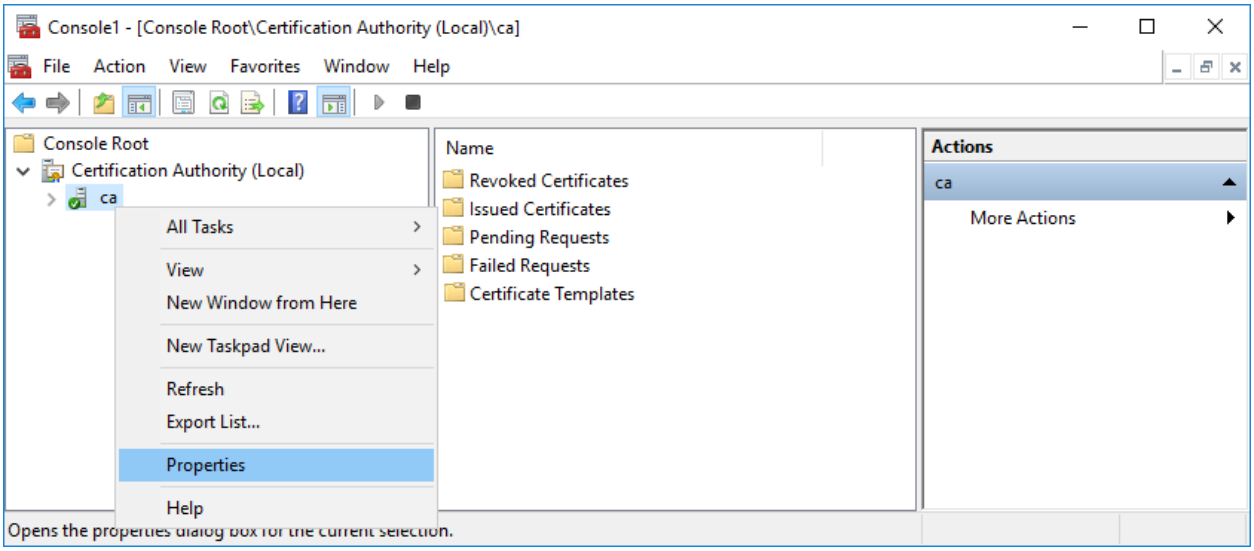
3. Give ADCS Connector permission to talk to the CA

The Connector is ready to accept certificate requests and pass them on to ADCS, but if you do it now, you'll get a "CR_DISP_DENIED" error because we haven't yet given the Connector any permissions in ADCS.

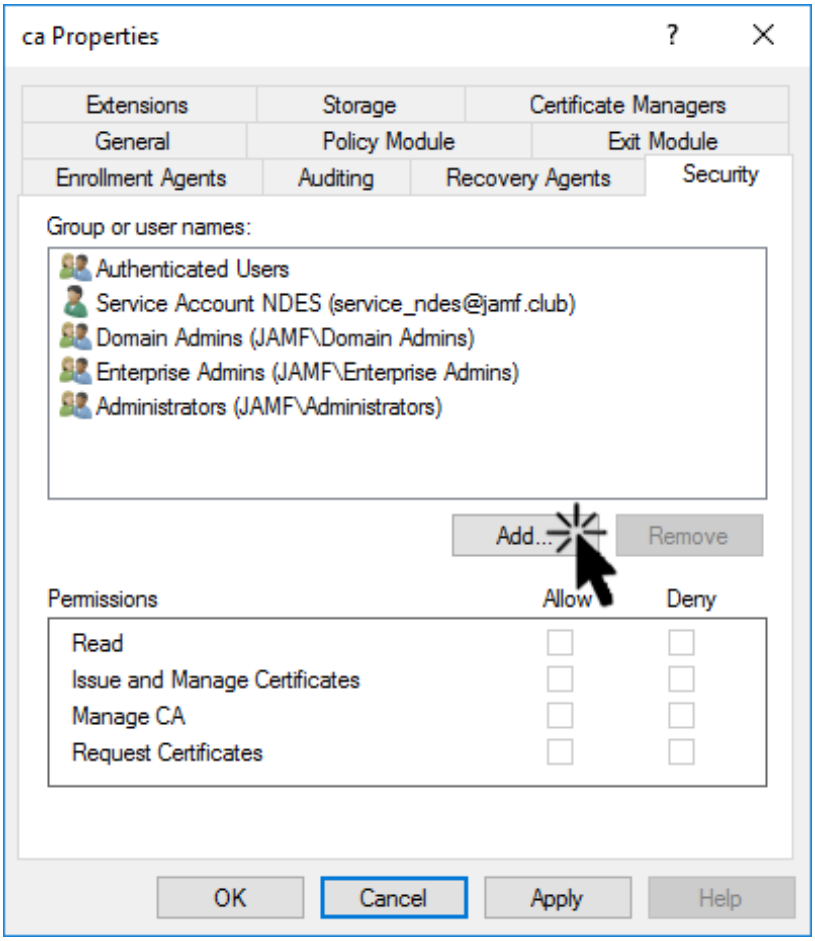
Run certsrv via cmd or as an MMC snap in. Or just select "Certification Authority" from Server Manger's Tools menu.



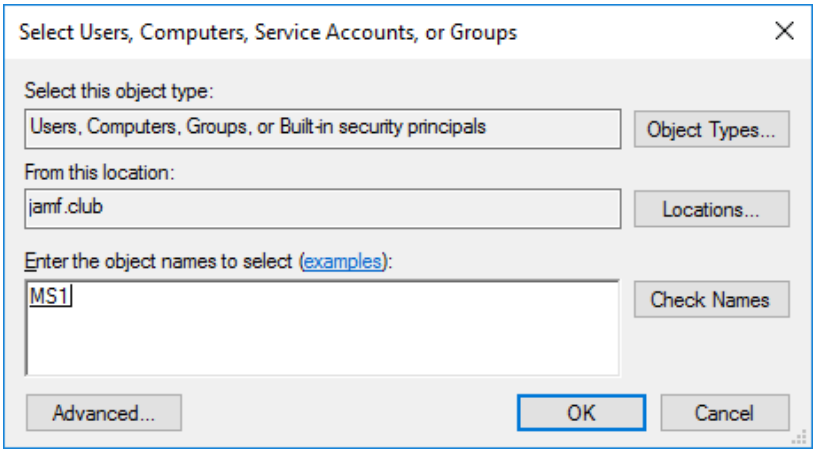
Right click on your CA's name and select "Properties...".



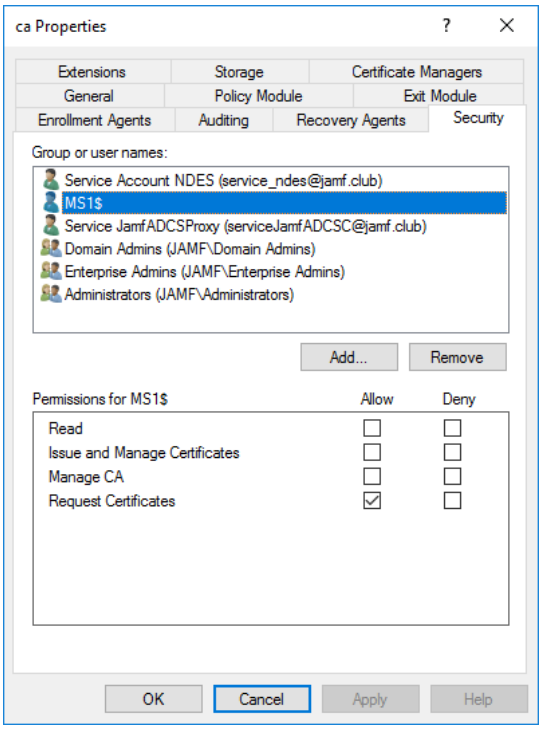
Switch to the "Security" tab and click the "Add..." button.



Make sure "Computers" is in the list of selectable object types, If it's not, use the "Object Types..." button to add it. Then add the server that's running ADCS Connector and click "OK".



You will not see the Connector Host entry in the Group and User names list. Grant the "Request Certificates" permission. It also needs "Read" permissions, but in a default ADCS setup, that permission is inherited via "Authenticated Users" so you don't need to check it here.



Creating a Certificate Template in ADCS and Granting Template Permissions

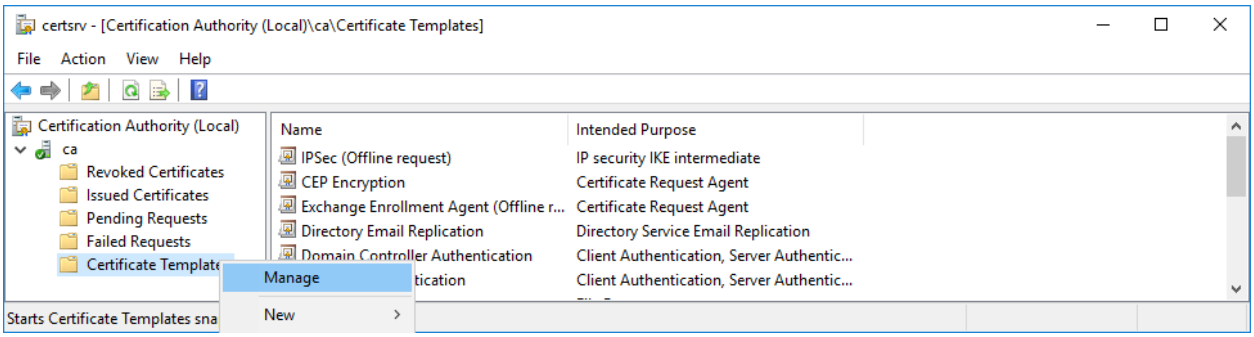
If you're running a stand-alone CA, you're done configuring permissions. If you use an Enterprise CA, you will also need to configure a certificate template.

Warning: Templates are usually set up to derive the certificate subject from the authenticating user making the request. But since we're setting up a proxy, we're going to create one that allows the requester to specify an arbitrary subject. Follow the upcoming instructions carefully so that only the Jamf ADCS Connector can obtain certificate signatures using this template.

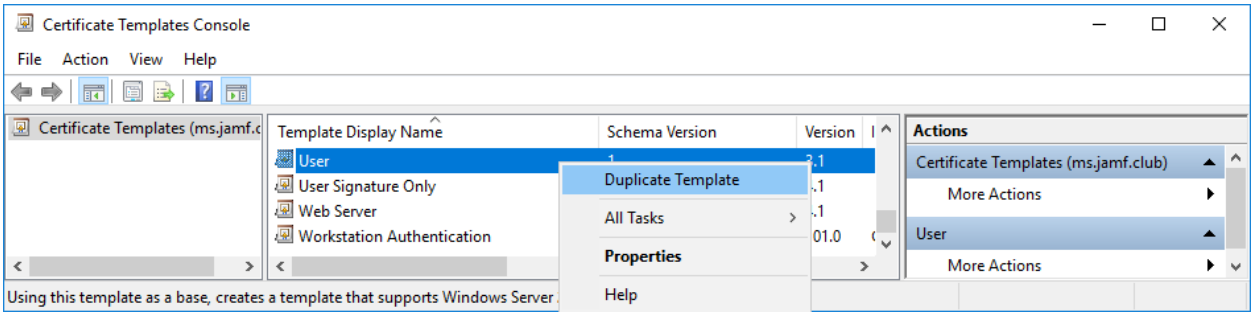
Your existing CA probably already has a template that's being used to deploy certificates to bound computers and servers. But if you used that with the ADCS Connector, every certificate would have the name of the Connector host as its subject, not the device or username for which we're actually trying to provision the certificate. We need to duplicate that existing template and set the new version up so we can specify the subject when we make certificate requests.

Using a separate template dedicated to use by the Jamf ADCS Proxy will also help the CA admin to pick out the Apple templates when they look at the Issued/Failed lists in their ADCS console.

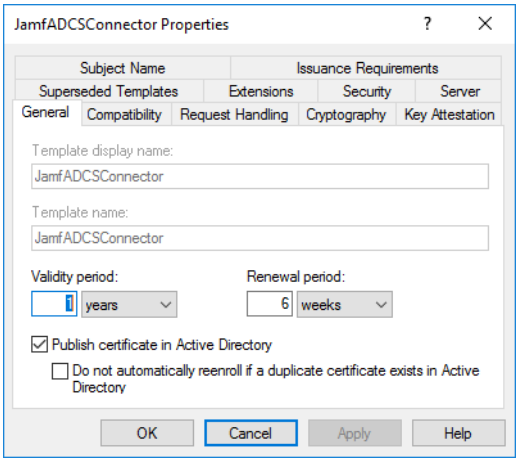
Certificate templates are managed using the Certificate Templates Console. In certsrv, right-click on "Certificate Templates" and select "Manage" from the contextual menu to run the template console. You can also access Certificate Templates Console as mmc snap-in or by running certtmpl.msc directly.



You could create a new template from scratch, but it's usually easier to duplicate an existing known-good template -- typically the same one you are already using successfully to provision certificates for domain-bound devices. Right-click the source template to duplicate it.



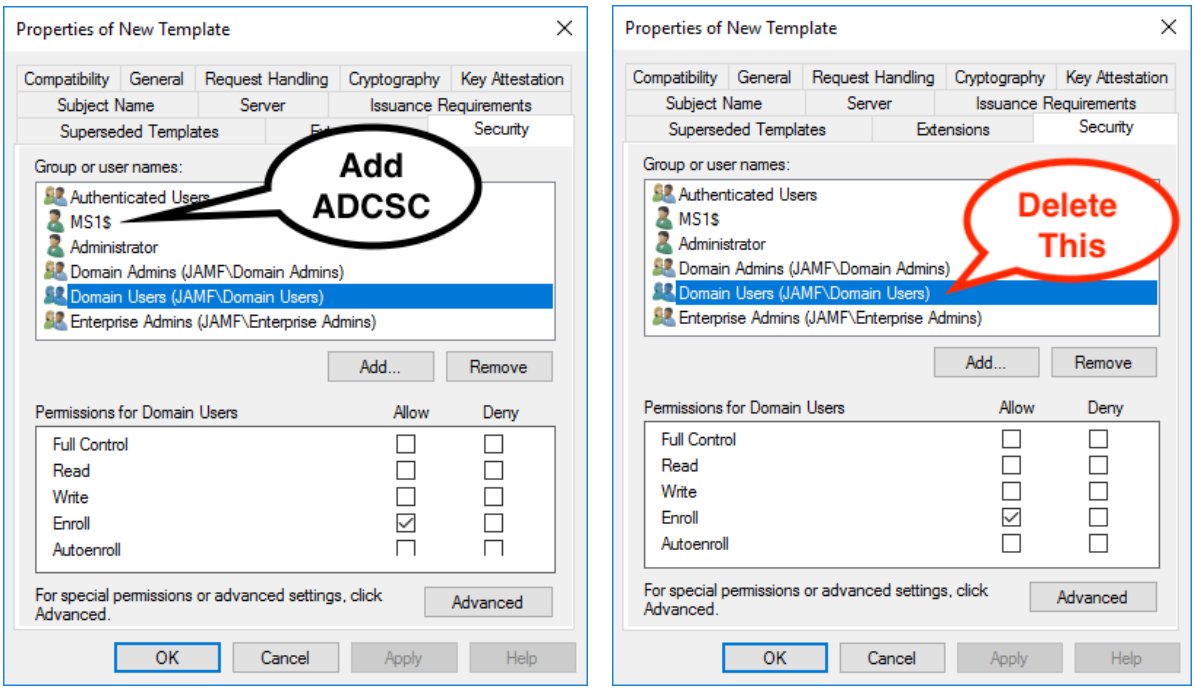
A certificate properties editor dialog will appear. In the "General" tab, give it a name consistent with whatever naming standard your CA admin prefers. Make a careful note of the name or paste it into an email/document. You'll to enter this exact name when you're configuring Jamf Pro to work with the Connector. Note that it's the **Template Name** we need to specify, not the display name. They could be different.



In the "Security" tab, add the ADCS Connector host, just as you did at the CA-level and grant the "Enroll" permission.

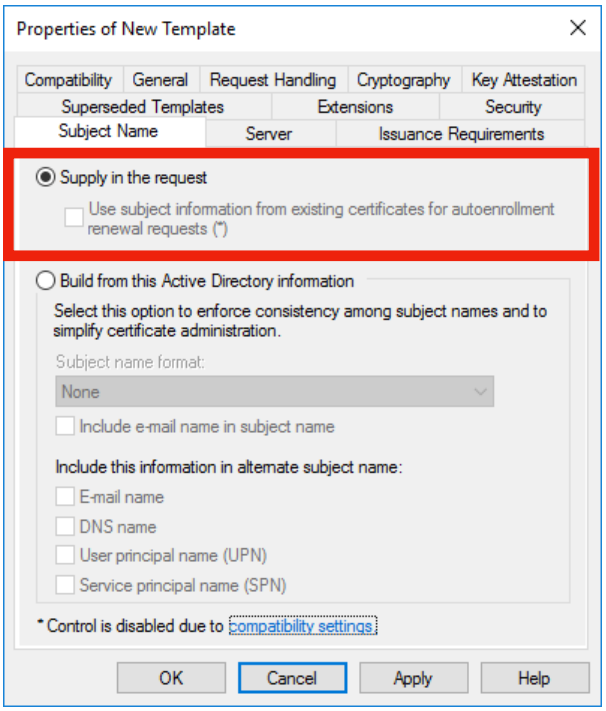
Next, select "Authenticated Users" and verify that it has Read permission and does not have the enroll permission. Some organizations will also remove "Authenticated Users" in favor of explicitly allowing each individual CA host. If that's the case, make sure the ADCS Connector host and all the subordinate CA boxes have read permission on the template.

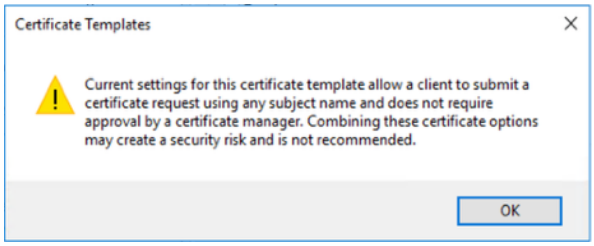
If "Domain Users" or "Domain Computers" are in the list, delete them. It wouldn't hurt if they were there and had only read access, but you don't want to risk making a mistake and giving them enroll or auto-enroll. If you did, any user could use this template to create any certificate subject they wanted, even a wildcard for your domain!



https://itpro.outsidesys.com/2018/03/21/adcs-manage-pki-certificate-templates/ has some good discussion of this topic if you want to understand it better.

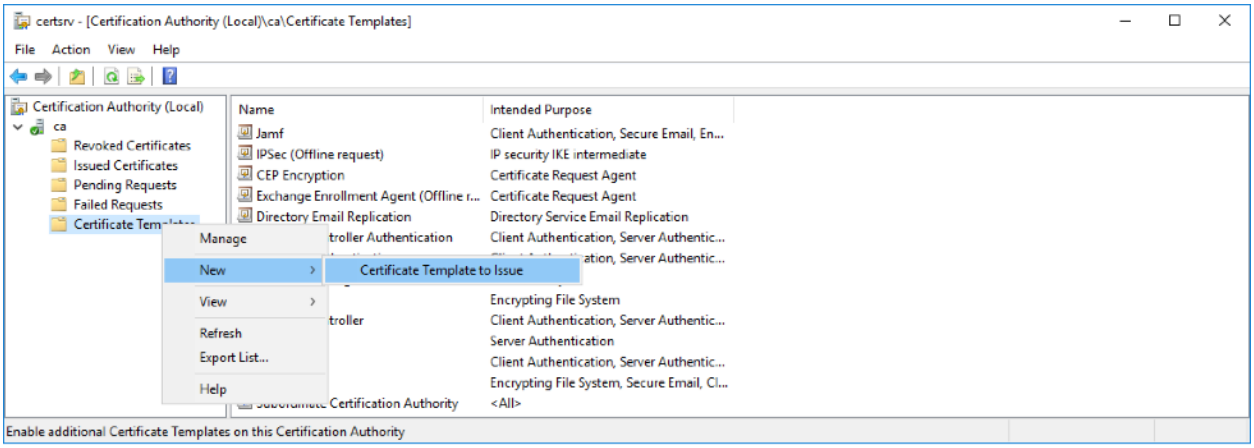
In the "Subject Name" tab, allow the request to be supplied in the request. You will see a warning when you make this change. ADCS shows this for the same reason we warned you to prevent everyone other than the ADCS Connector to have enroll permissions on the template.



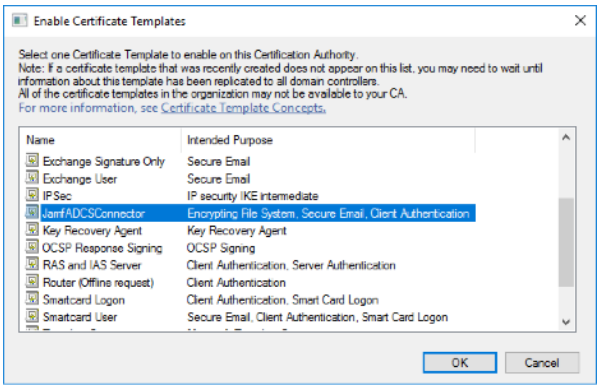


Click "OK" to exit the setup.

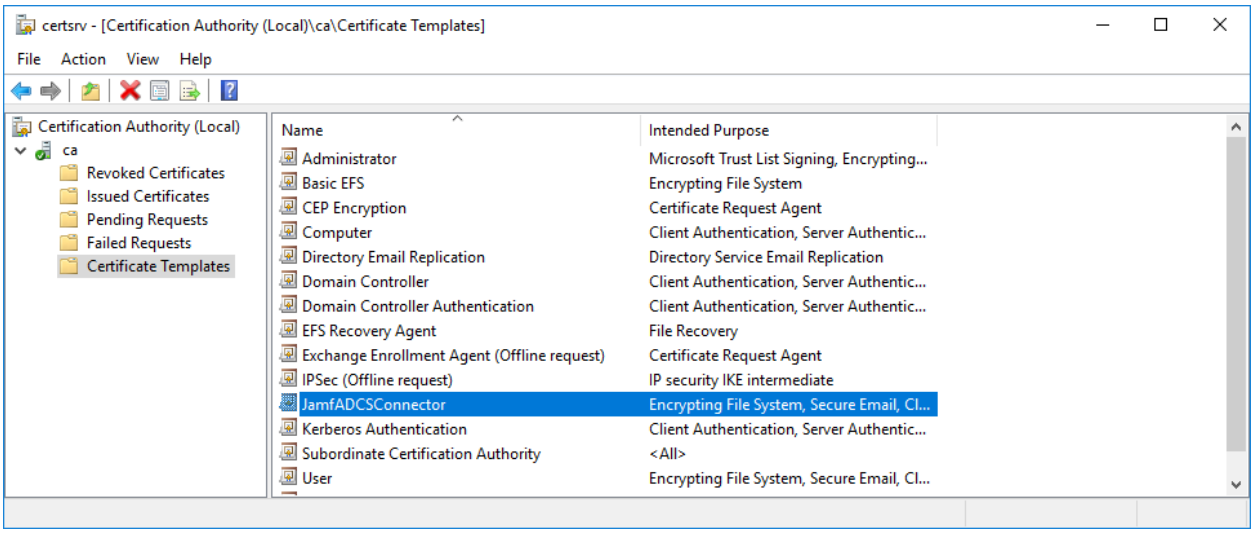
Now that we have created the certificate template, we need to tell the CA that it's available. Go back to the certsrv Certificate Authority console and right-click on "Certificate Templates" and select "New>Certificate Templates to Issue".



Select the template you created for the Connector and click "OK".



The template is now added to the CA's list of issuing templates.



Artifacts

At the completion of the installation process, you will have the following ready for configuration in Jamf Pro:

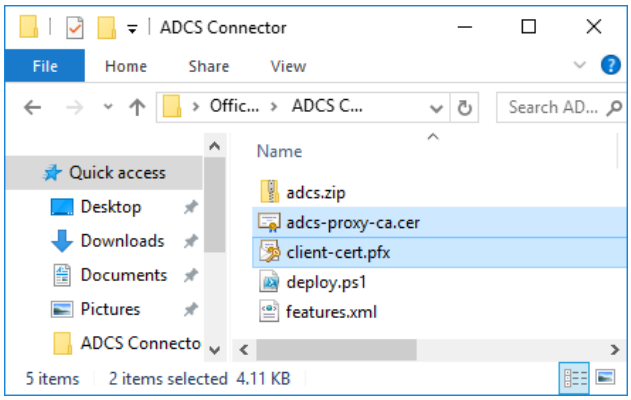
1) The adcs-proxy-ca.cer file, the public key of the Connectors TLS Server certificate
2) The client-cert.pfx file, the keypair Jamf Pro will use to authenticate to the Connector
3) The password needed to unlock the client-cert.pfx file.
4) The template name. (Again... *not the display name*, unless they happen to be the same.)

Next Steps

The following pages show how to see the changes that were made in the IIS configuration after running the installer, followed by a section that explains how to configure Jamf Pro to talk to the newly-installed Connector server.

Resulting Configurations

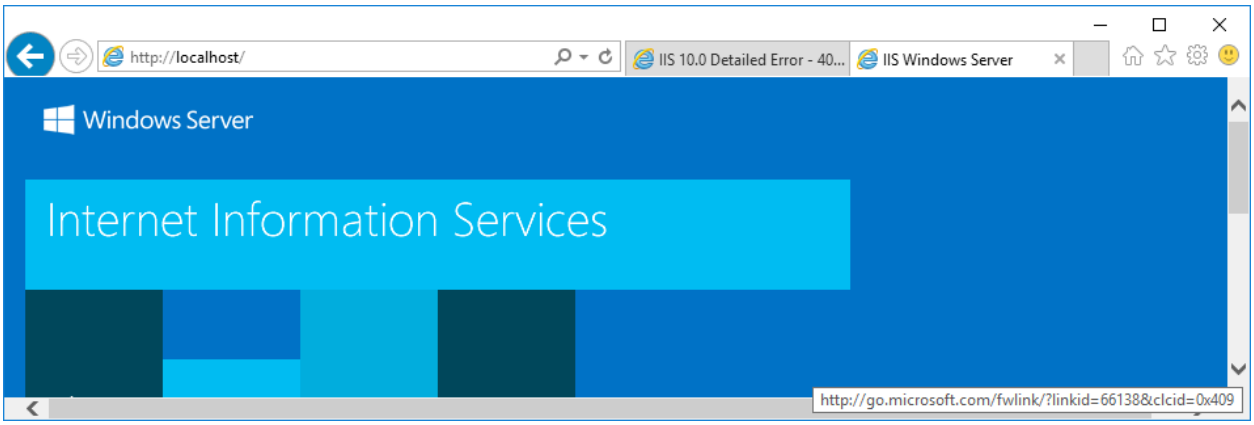
You now have everything you need to configure the ADCS Connector in Jamf Pro. In the working directory from which you ran the script, you now have two new files.



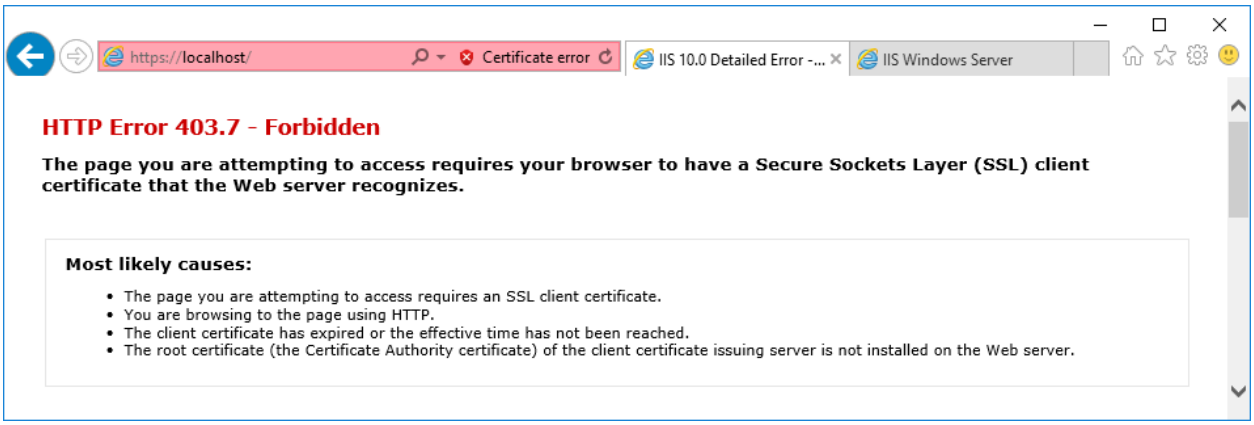
adcs-proxy-ca.cer is the public key for the identity that IIS will use when negotiating TLS when Jamf Pro tries to connect. If the server uses an identity that doesn't match up with this public key, Jamf Pro will not trust the server and the TLS handshake will fail.

Even more importantly, the ADCS Connector needs to know that the connecting client is authorized. The client-cert.pfx file is the keypair that Jamf Pro will need to present in order to successfully authenticate to IIS and reach the Connector application. This file is protected by a random password, which is shown at the end of the deploy.ps1 script's output (shown with orange highlight in the example run we showed earlier).

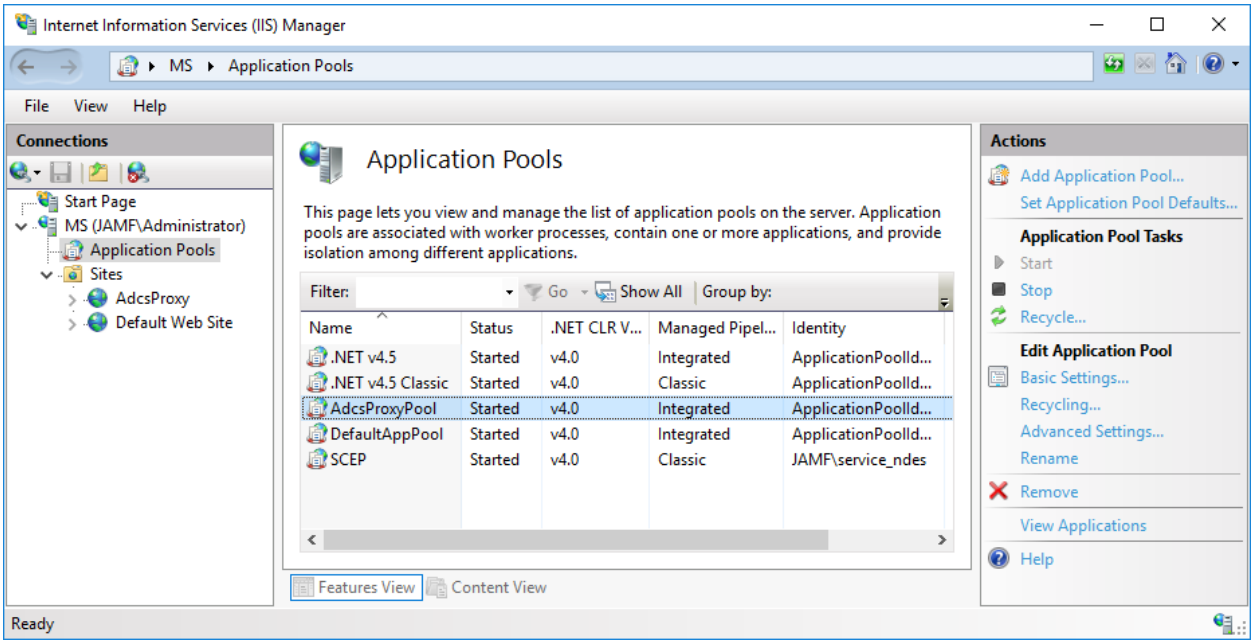
If we launch a web browser on the Connector host, we can see that IIS has been installed.



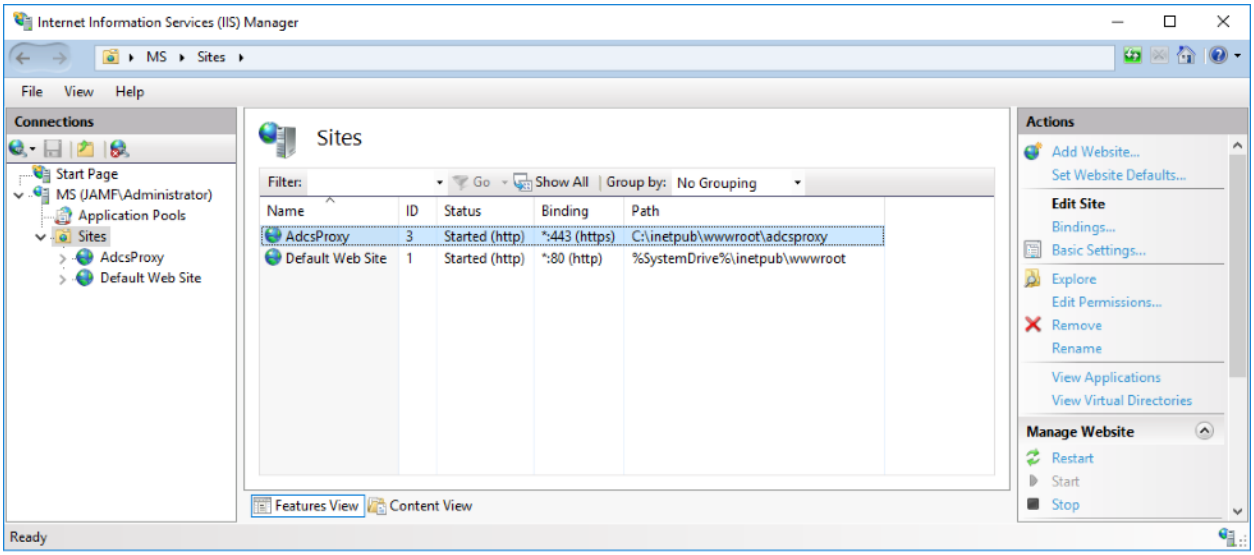
If we attempt to browse to the Connector and accept the self-signed server certificate warning, we will get an authentication error, showing that anonymous auth is disabled.



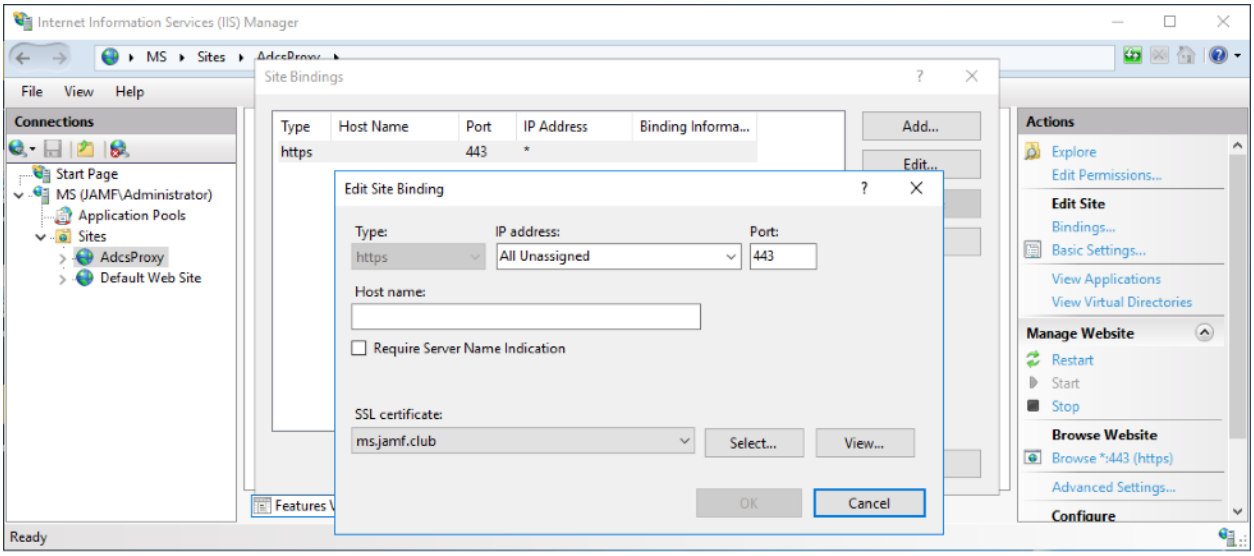
In IIS Manger, we observe that a new application pool has been created for the ADCS Connector. The ADCS Connector site will run within this pool. We see that the Connector is running as "ApplicationPoolIdentity", an identity derived from the local computer's bind to the domain. This is why we gave the computer certificate enrollment permissions on the CA and the template we created.



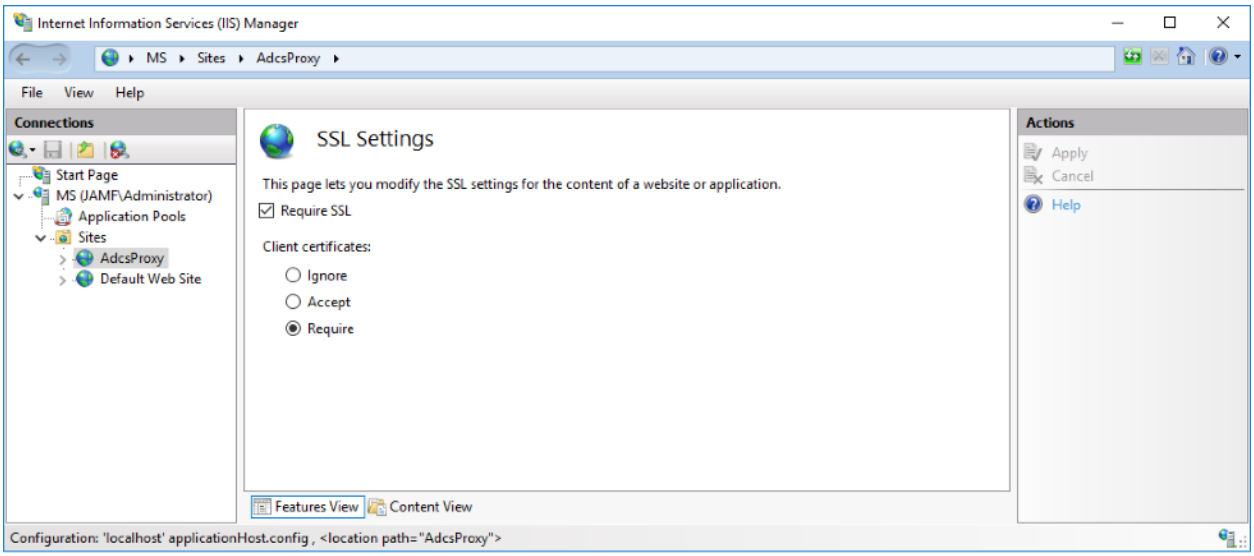
Under Sites, we'll see the corresponding site. It's listening for https on port 443.



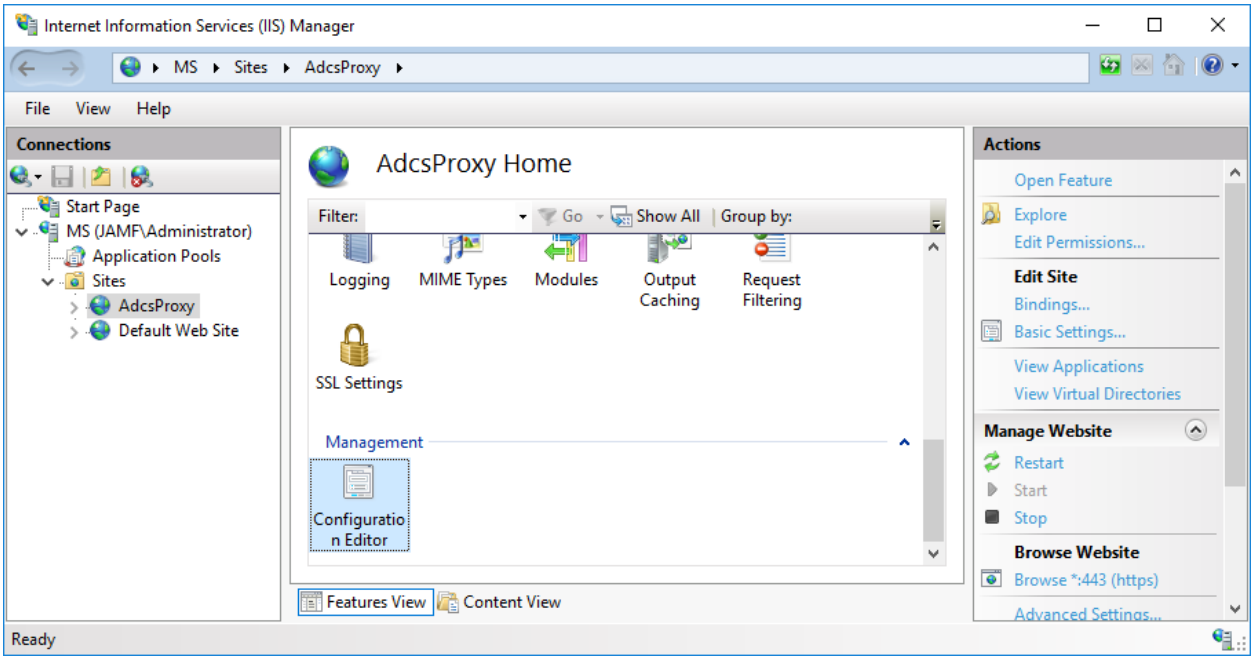
In bindings, we see that the TLS certificate subject matches the FQDN we will tell Jamf to resolve when it connects.



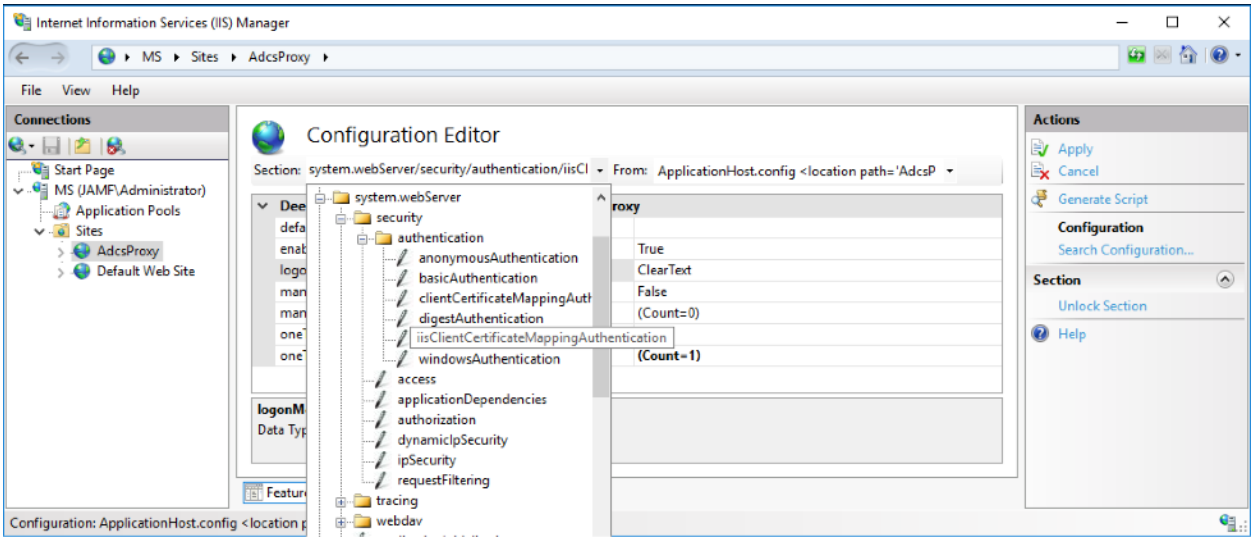
Under SSL Settings, we see that IIS will require SSL connections and that connecting computers present a client certificate for authentication.



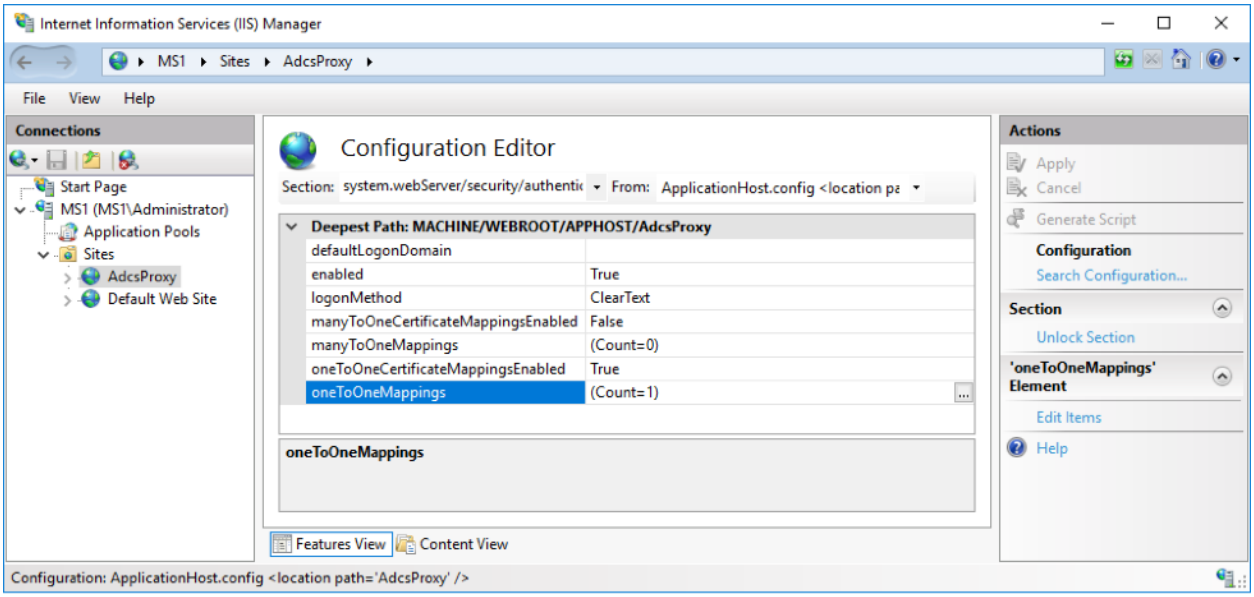
To review client certificate authentication settings, go to Configuration Editor.



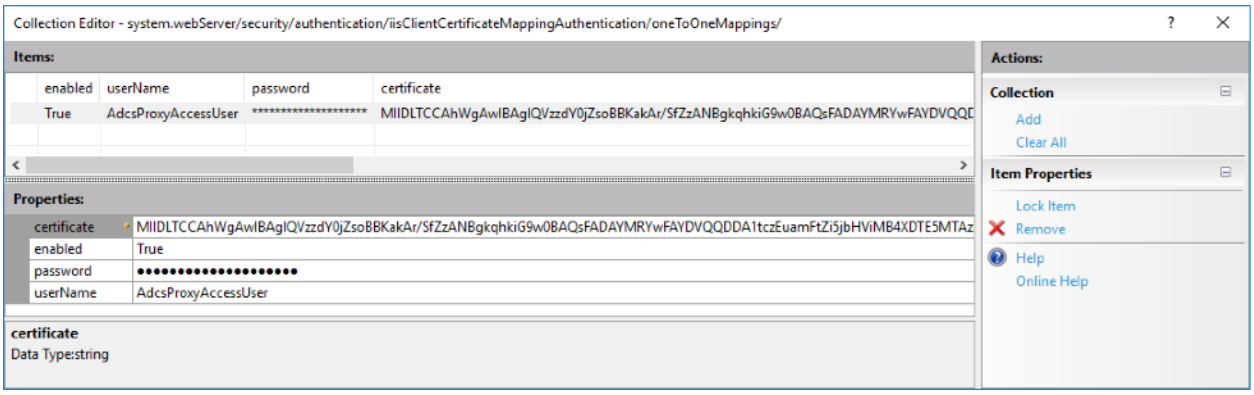
Navigate to "system.webServer > security > authentication > iisClientCertificateMappingAauthentication" in the "Section" drop-down menu.



Highlight oneToOneMappings and click the "..." Button to the right of the configuration entry.



The editor will display the settings for client configuration. The certificate value is the base-64 public key for the client identity. It is used to ensure a valid identity is being used to negotiate TLS. The username and password indicate the user that will be authenticated to IIS when a valid certificate is presented.



File Location Notes:

IIS Configuration Settings: `C:\Windows\System32\inetsrv\config\applicationHost.config`

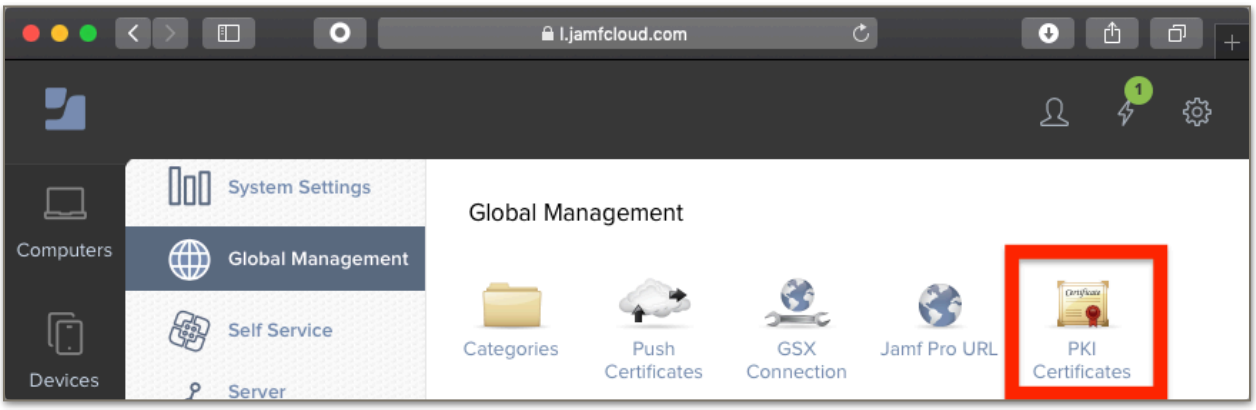
IIS Connection Logs: `C:\inetpub\logs\LogFiles`

Note: You'll see multiple folders here, one for each site ID. You can get ADCSC's IIS site ID from the site list in IIS Manager.

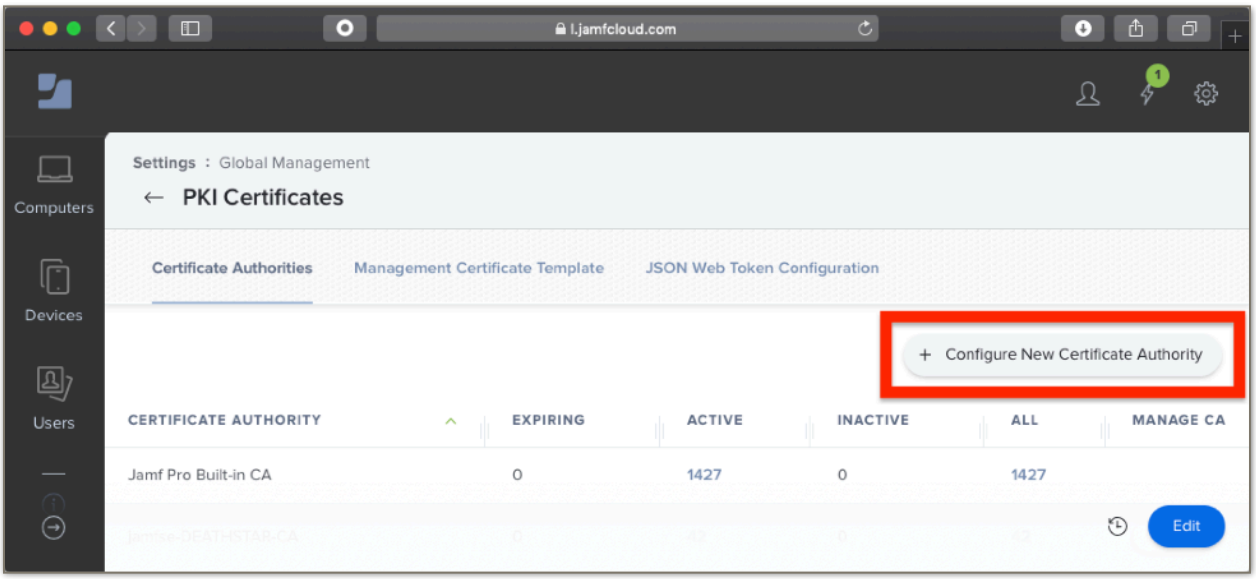
Jamf Pro Configuration

After installing the ADCS Connector Software, we will configure Jamf Pro to use it when obtaining certificates. Complete instructions for Jamf Pro Configuration are available in the Jamf Pro product documentation but we will summarize them here.

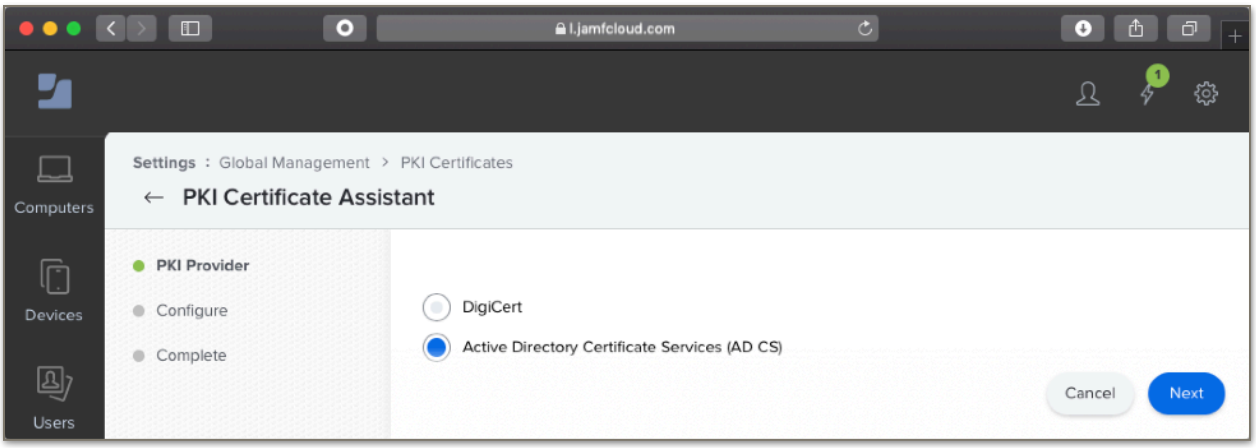
1. Login to Jamf Pro
2. Click the gearbox in the upper right corner to access the settings page
3. Go to Global Settings
4. Click PKI Certificates



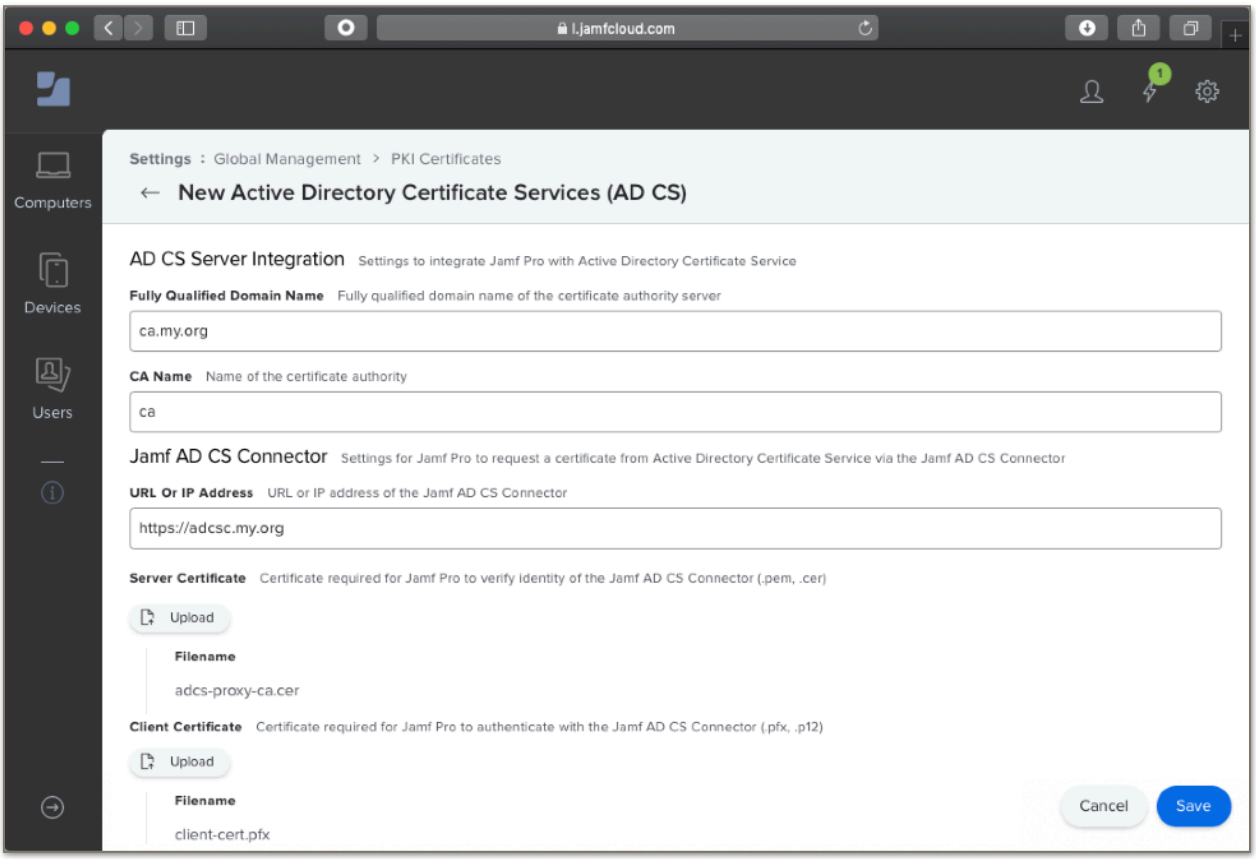
Click "Configure New Certification Authority".



Select the "Active Directory Certificate Services (AD CS)" option.



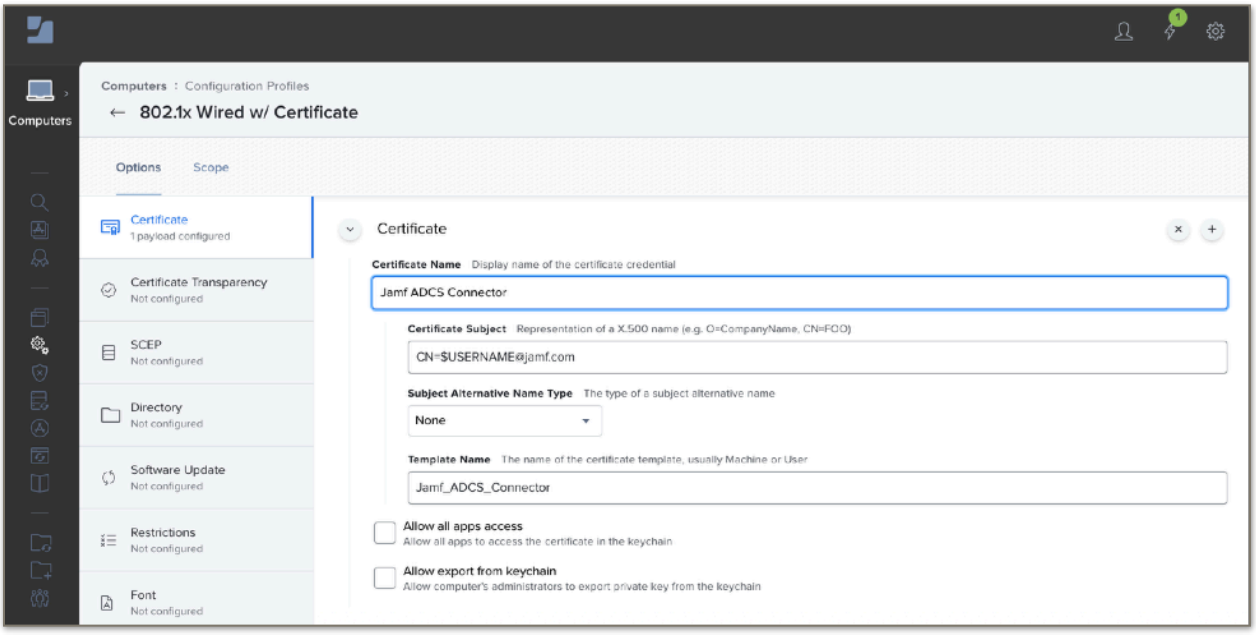
Enter the hostname of the AD CS server (what the Jamf AD CS Connector will talk to to request a certificate), the name of the CA instance, and the URL of the ADCS Connector (what Jamf Pro will talk to to request a certificate.) Upload the server certificate (how Jamf Pro will verify the identity of the Jamf AD CD Connector) and the client certificate (what Jamf Pro will present to the Connector to verify that it is authorized to request certificates).



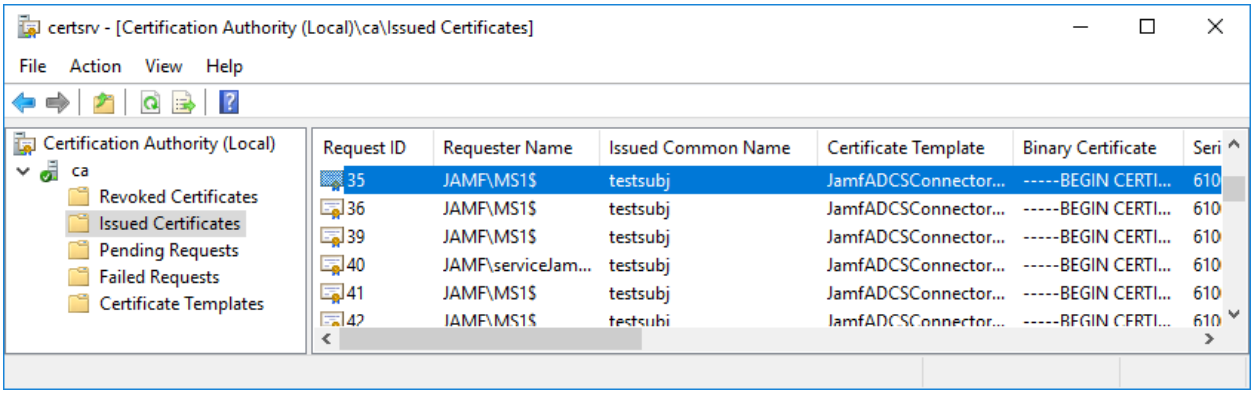
Click the Save button when finished. You can now create certificate profiles to deploy to your devices and Jamf Pro can obtain them via the AD CS Connector proxy service.

Example Certificate Profile and Issued Certificate

Once you've configured the AD CS Connector in Jamf Pro PKI settings, you'll have the option to provision certificates using the certificates payload under Computer and Mobile Device Profiles.



As devices obtain their certificates, they'll start showing up in your ADCS console. Note that the "Requester" is the Jamf ADCS Connector host and the subject will conform to the format you specified in your certificates profile payload.



Introduction to ADCS Connector Customizations

Common questions about the implementation of ADCS Connector include:

- Can we adjust things like the port used in IIS or the expiration date on the identities the installer script generates?
- Can it run in a load-balanced configuration to support high availability?
- Can it run behind a reverse proxy or web application firewall to insulate it from other network zones?
- Can we use our own server and/or client TLS identities?

We will discuss these customization options in the sections that follow.

Installation Script Customization

The installation script is written in PowerShell. Many Windows admins will already be familiar with this scripting language. The parameters section at the top of the script identifies available configuration options such as port, host names, etc. These are mainly used when we install the Connector on an existing IIS server already running other applications or sites.

```
param (
    [switch]$help = $false,
    [string]$archivePath = ".\adcs.zip",
    [string]$installPath = "C:\inetpub\wwwroot\adcsproxy",
    [string]$hostPath = "",
       [int]$bindPort = 443,
    [switch]$installIIS = $true,
    [switch]$cleanInstall = $true,
    [string]$appPool = "AdcsProxyPool",
    [string]$siteName = "AdcsProxy",
    [switch]$configureHttps = $true,
    [string]$fqdn = '',
    [string]$jamfProDn = ''
 )
```

Some other configurations are easy to adjust in the script. For example, if we have an IT security rule that all service-to-service client certificates will have a validity period of one year, we would locate the client certificate line in the script and change the "10" to a "1". If you do this, set up a calendar invite to your team well ahead of the expiration so you can schedule a change to update the identity. Otherwise the system will break with the expiration is reached.

```
$clientCert = New-SelfSignedCertificate `
  -CertStoreLocation cert:\localmachine\my -DnsName "$jamfProDn" `
  -KeyExportPolicy Exportable `
  -KeyUsage DigitalSignature, DataEncipherment,KeyEncipherment `
  -Signer $cert `
  -NotAfter (Get-Date).AddYears(10)
```

Use a Domain Service Account when Authenticating to ADCS

Introduction

The default installation requires that the ADCS Connector host be given rights to ADCS and, in an enterprise CA, also to one or more templates. Some organizations may prefer to use a domain user service account instead of the Connector host's computer account, and IIS can be configured to support this.

If you are considering making this customization, please think through the implications carefully. We want the highest possible security on the authentication to any template that permits an arbitrary subject to be specified in the CSR. In this case, we will usually prefer the Connector's default computer account authentication scheme. User service account are portable in that they can be used anywhere, and the user name and password are going to be known by some humans and transferred between them during the setup process. The domain user service account's username and password can be used to obtain a certificate with an arbitrary subject from any computer that can connect to ADCS. Using a computer account to authenticate to ADCS is not portable and its credentials are less likely to be exposed. The computer account's AD password is randomized at the time when a host is bound to AD and is never recorded or transferred in plaintext.

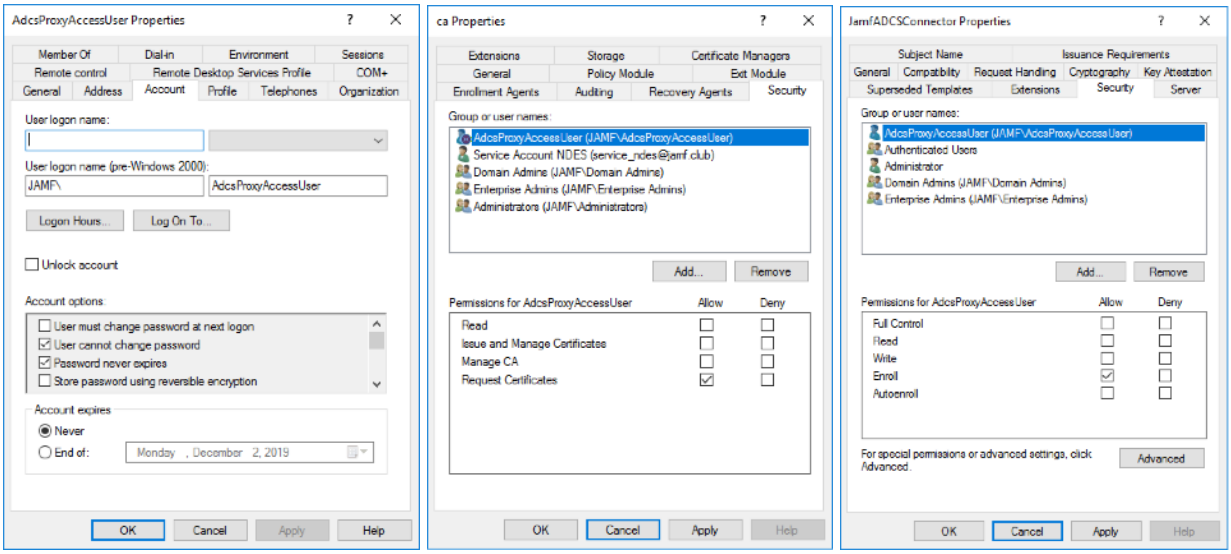
https://docs.microsoft.com/en-us/iis/manage/configuring-security/ensure-security-isolation-for-web-sites is a useful reference. The standard installer follows these guidelines in that it runs the Connector's IIS site within the standard app pool. However, if a domain user service account is required, the following instructions may be used.

Procedure

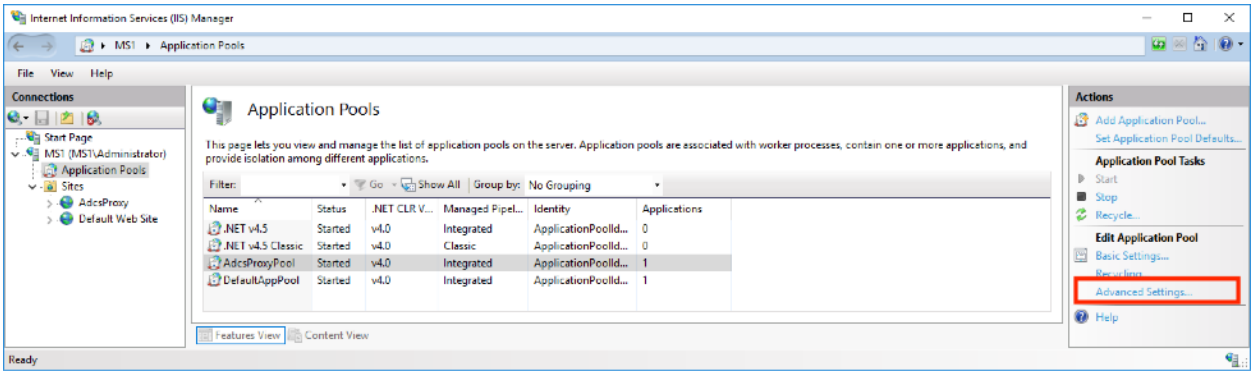
Service accounts are typically configured with "User cannot change password" and "Password never expires". In this example, the user name is "AdcsProxyAccessUser".

Once you have the login for your service account, Open the CA configuration console (refer back to Step 3 of the "Installing the Jamf ADCS Connector" section in this document...) and give the user "Request Certificates" permission in the CA Security properties, and then go to the Template Configuration console to give it enrollment permission on the template.

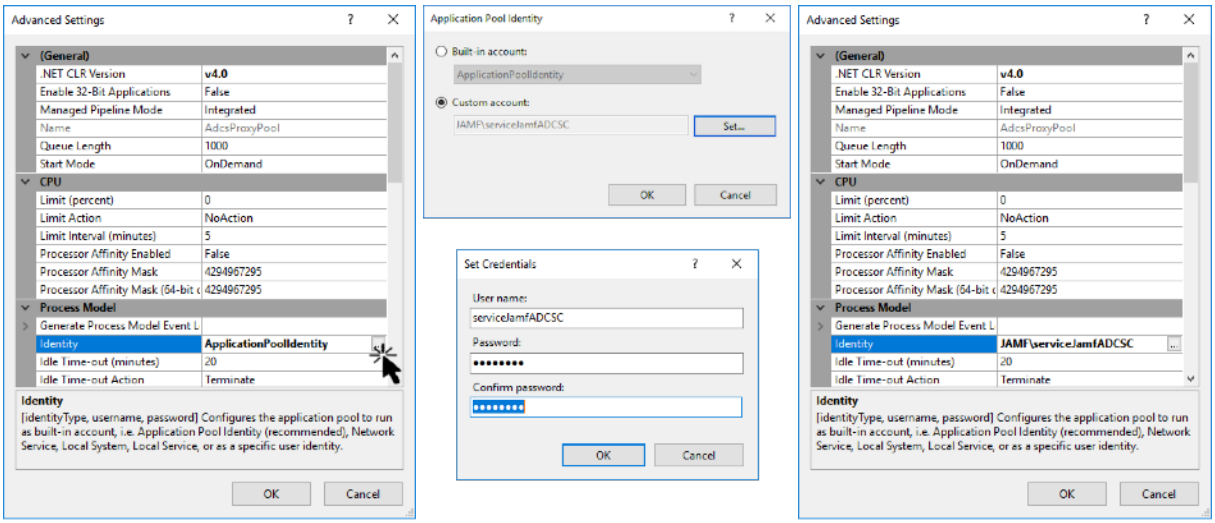
If you had previously granted these permissions to the ADCSC host, you can remove those after adding the new service account.



Then we can run the Connector as our service account and it will replace the Connector host as the identity that authenticates to ADCS. Highlight the ADCSProxyPool and click "Advanced Settings".



Highlight the "Identity" setting and click the "..." button to the right of the current setting... applicationPoolIdentity. Use the "Set..." button in the dialog to switch to a custom account and enter your service account's <domain\>username and password. Click the OK button and you will see your change listed in Advanced Settings. Use the OK button to close the dialog.



The ADCS template (or templates) used by the connector will need to be reconfigured so that the domain service user has the required permissions and permissions for the ADCS Connector host are removed.

Configuring IIS to use an alternate Server Certificate

The server identity is used by the server when negotiating TLS connections with clients. The Connector installer instructs the Windows OS running on the Connector host to generates a self-signed identity for this purpose. Your organization may prefer to use certificates generated by your own internal PKI or from a third party public CA on its web servers instead of the self-signed ones configured by Jamf's ADCSC installer.

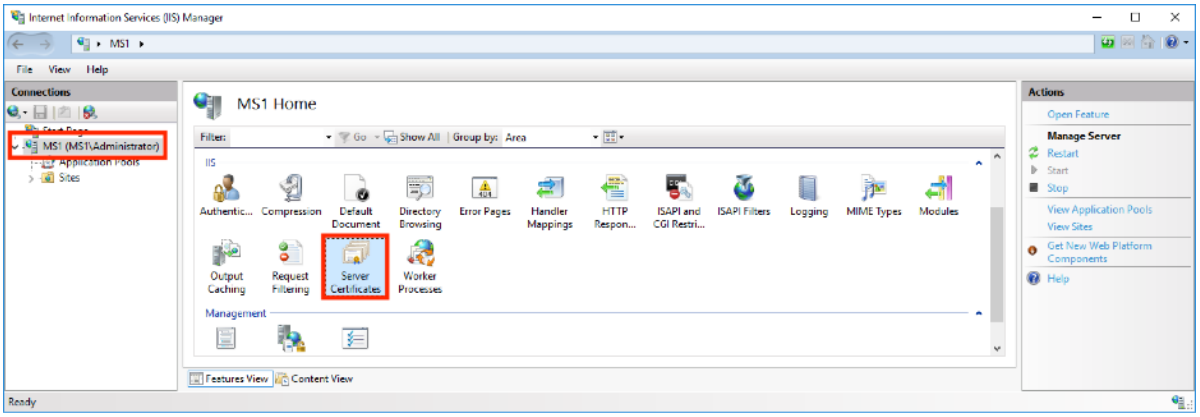
The following basic steps are used to install a server identity for IIS:

1) Run the ADCSC deploy script.
2) Obtain a new server identity from your preferred source.
3) Install your identity on the IIS server.
4) Configure the IIS site to use that identity instead of the one created by the ADCSC installation script. To do so, select the AdcsProxy Site in IIS Manger and click "Bindings...".

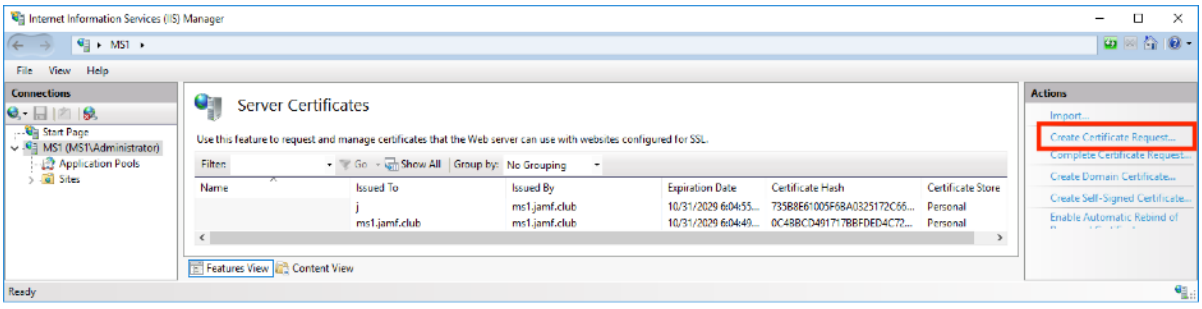
Obtaining a Certificate Signing Request

Your CA administrator or public certificate vendor will often ask that you provide a Certificate Signing Request ("CSR"). If you create this on the IIS server, the private key for the identity will remain on the server, so this is often the preferred workflow. There are many utilities for creating CSRs, including one built into IIS that is often used.

1) Highlight the server name in IIS Manager and click "Sever Certificates".



2) Open the "Create Certificate Request" Wizard under "Actions".



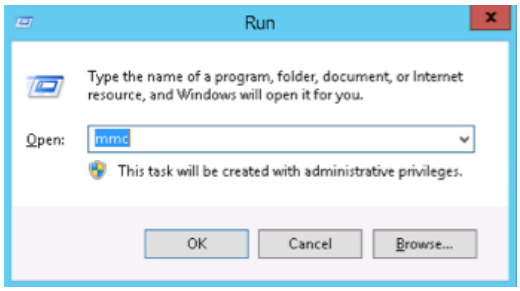
3) The Wizard will walk you through the rest of the process for configuring and saving the CSR. The Common Name (CN) will be the host name that Jamf Pro connects. In the case of Jamf Cloud configurations, this is the external DNS ("VIP") that resolves to your external IP address. Use the default Microsoft RSA SChannel Cryptographic Provider and a bit length of at least 2048.

Configuring IIS to Use the Alternate Server Identity

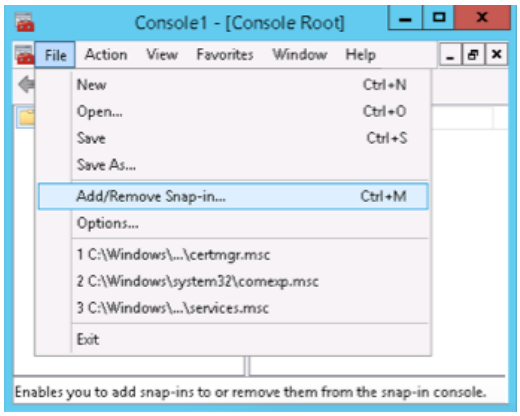
Once you already have the identity .pfx file that you want to use as the ADCSC site's SSL server certificate, it's an easy two-step process to install it. We'll add it to the Windows certificate store using the Certificates mmc snap-in, then tell IIS to use it to secure our site.

First, upload the identity file to the Windows keystore:

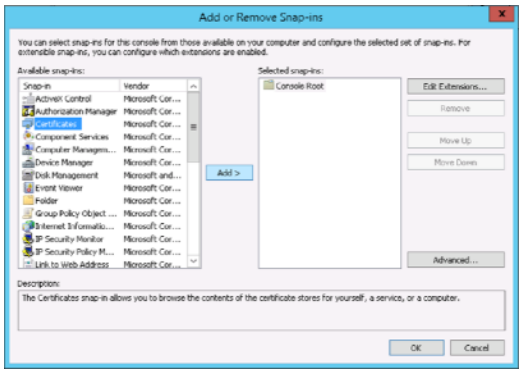
1. On the Start menu click Run and then type mmc



2. Select File > Add/Remove Snap-in

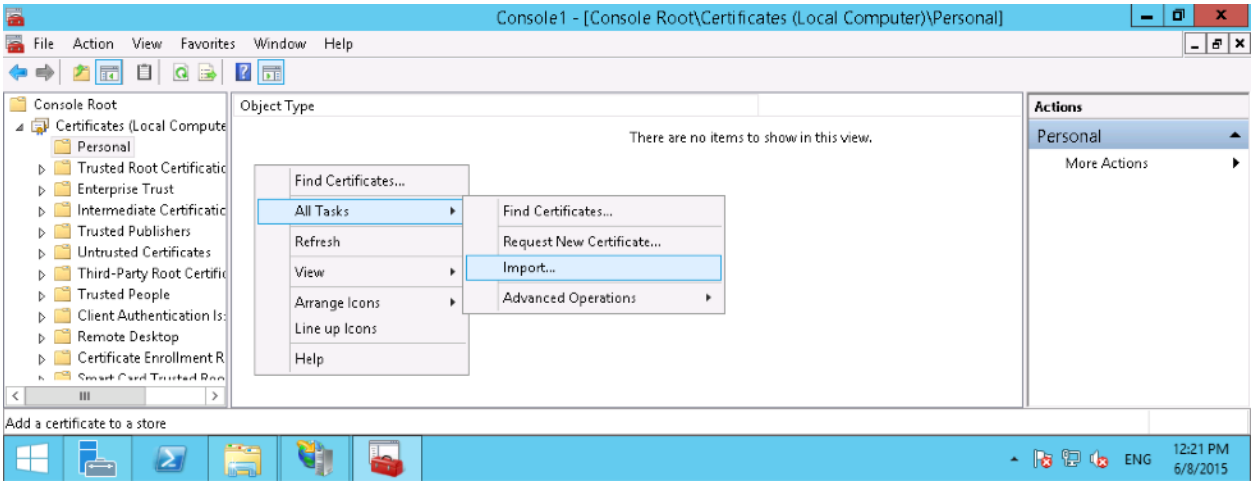


3. Click Certificates > Add

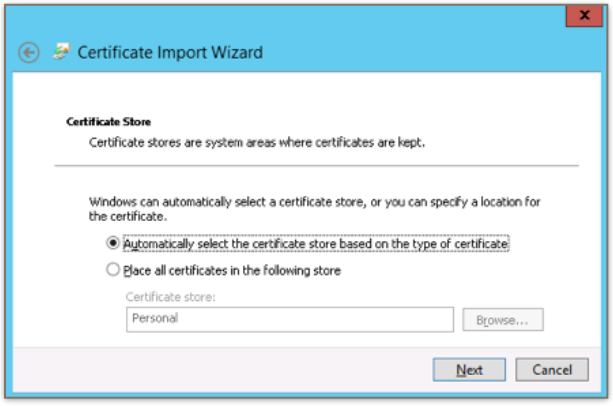


4. Select Computer Account and then click Next.

5. Select Local Computer and then click Finish. Then close out of the "add snap-in" window.
6. Click the + to expand the certificates (local computer) console tree and look for the personal directory/folder. Right-click on the Personal certificates folder and select All Tasks > Import from the contextual menu.

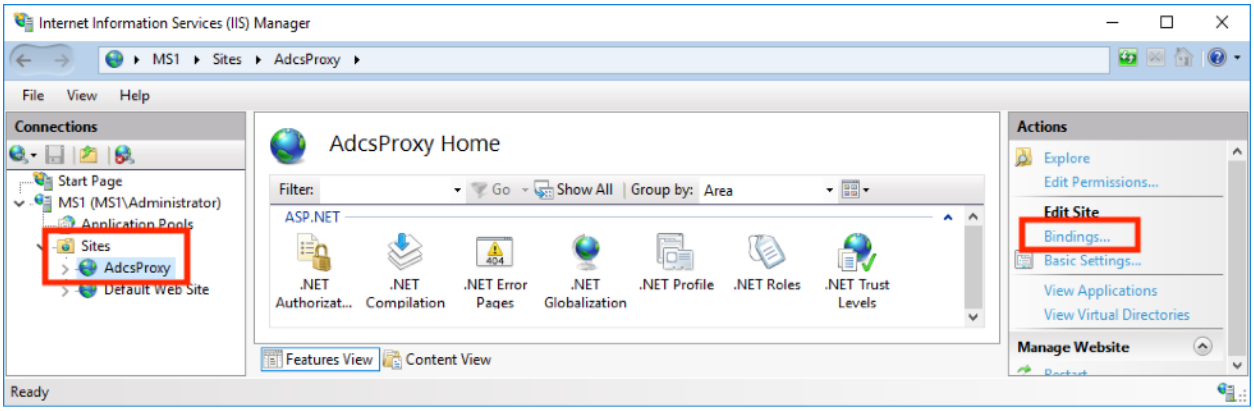


7. Follow the certificate import wizard to import your primary certificate from the .pfx file. When prompted, choose to "automatically place the certificates in the certificate stores based on the type of the certificate". The advantage of that choice is that the wizard will correctly distribute the .pfx's components, putting your server cert into Personal, and any root or intermediate certs into their correct locations as well.

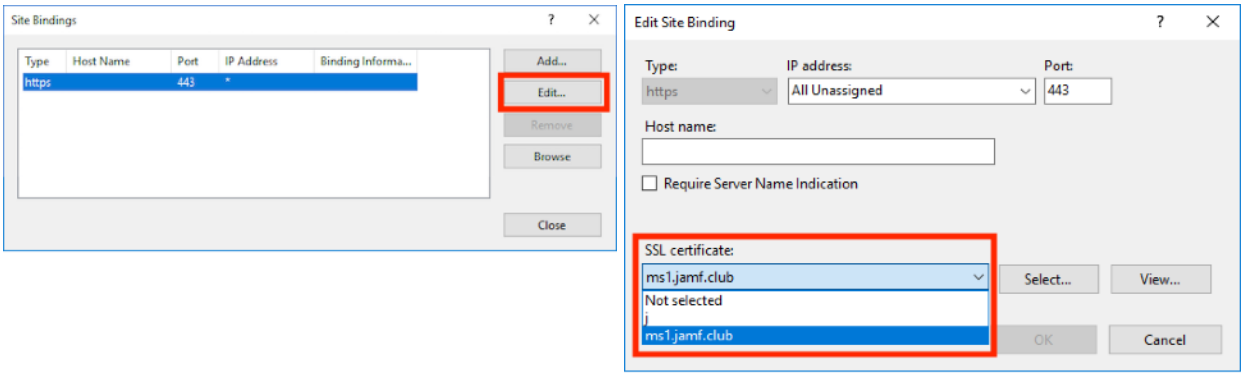


If your identity needs root or intermediate certificates for its source CA trust chain that were not included in the .pfx file, make sure they're already installed on your windows server. If not, you'll need to add them to the Windows keystore using the same procedure.

Now we just need to tell IIS to use our newly-installed identity. Highlight the ADCS Proxy site in IIS Manager, and click "Bindings..."



Edit the https binding and select the desired certificate from the SSL certificate drop-down menu.

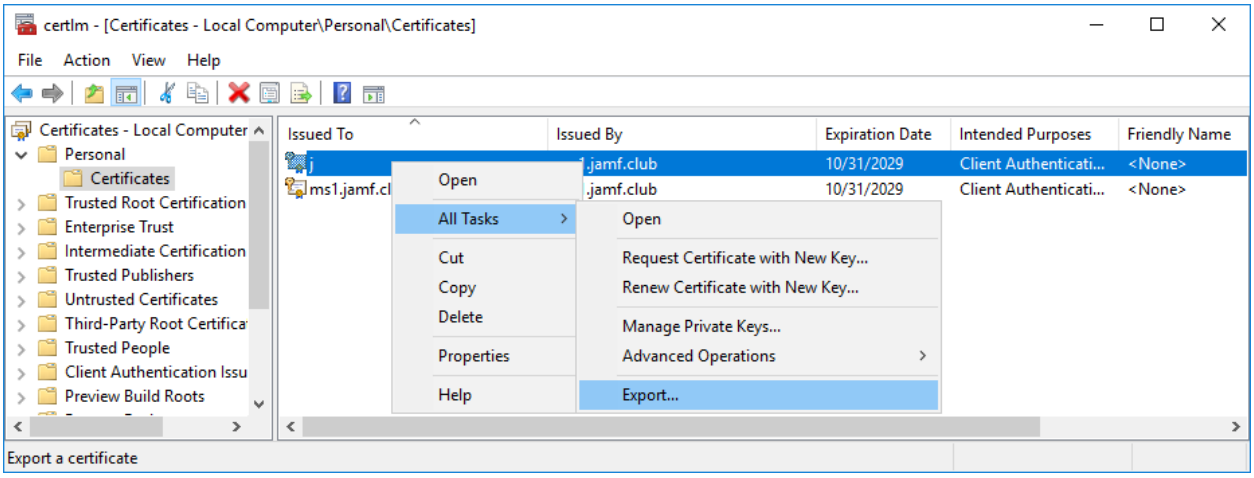


Replacing a server certificate in IIS prior to expiration

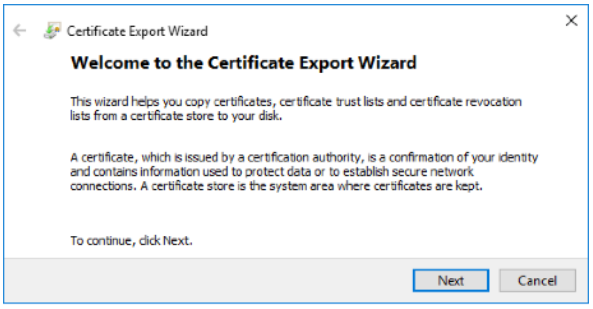
You should replace your IIS server certificate prior to expiration. If you don't, Jamf Pro will no longer be able to negotiate TLS connections once the expiration date has passed. The steps to follow are the same as the initial installation. You can install a new certificate any time you want and it doesn't matter if it's an update of the the existing certificate or you create a brand new one... the only requirement is that the public key that is uploaded in the ADCS Connector PKI entry in Jamf Pro matches the server identity.

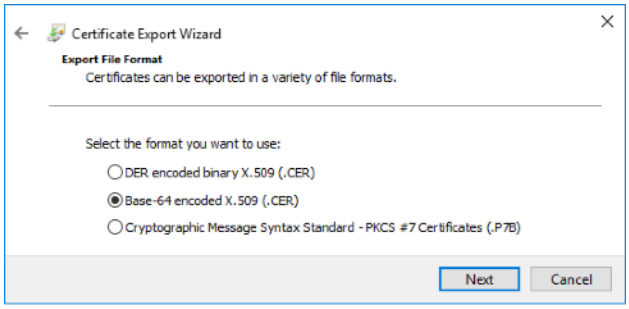
Configuring IIS to use an alternate Client Certificate

If you have another identity file (.pfx or .p12) that you want to use to authenticate Jamf Pro to ISS, you will need to use its public key in IIS's Client Certificate Mapping configuration. You can use Windows' certificates utility to export the public key. Open Computer Certificates ("certlm"), locate the client certificate you want to use, right-click on the identity and select "All Tasks > Export...".

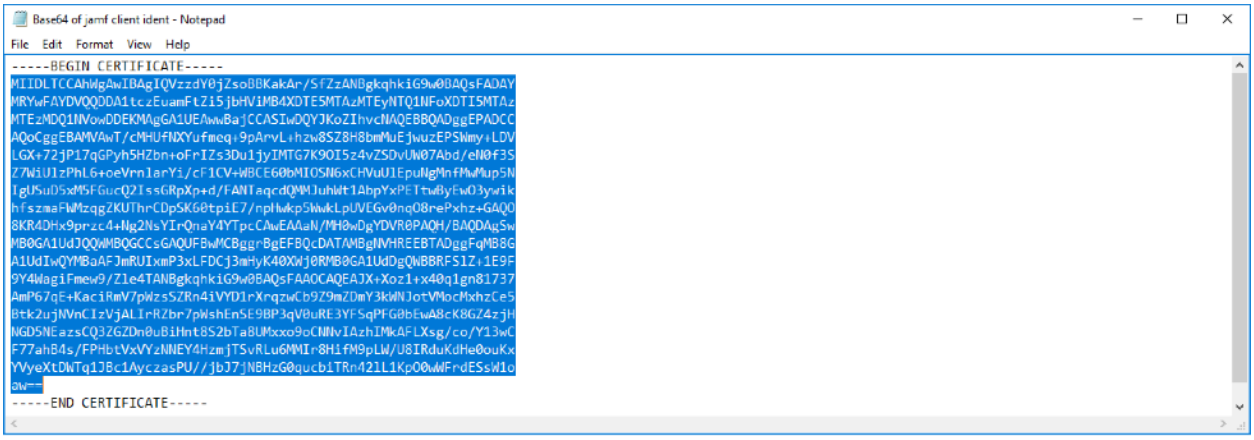


The wizard will step you through the export process. Do not export the private key. Select the Base-64 export format.





Open the exported .cer file and copy the section between the BEGIN and END lines.

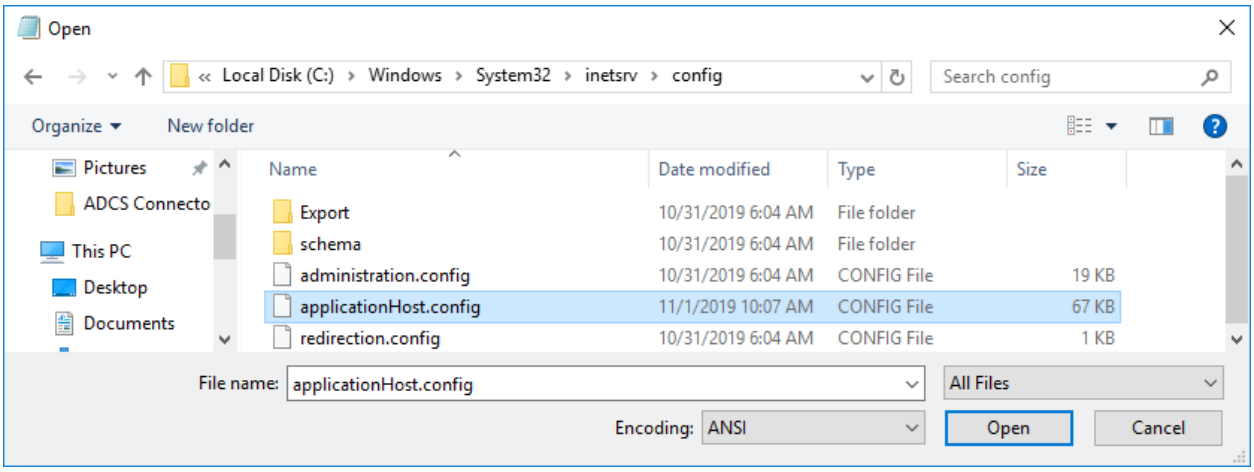


The instructions and screen shots for navigating to IIS's client certificate authentication configuration were demonstrated in "To review client certificate authentication settings..." in the above section where installation script configurations were discussed. You can use the configuration editor screen to paste the base-64 of the new key to replace the one created by the installer.

Alternately, you can edit the IIS configuration file manually.

Navigate to "`C:\Windows\System32\inetsrv\config\applicationHost.config`" and make a backup copy before making any changes.

Run NotePad (or another text editor) as Administrator, change the file filter to "All Files" and navigating to the IIS applicationHost configuration file.



Replace the existing base-64 key with the contents you coped from the .der document and remove any carriage returns to the key is one contiguous string.

Save the configuration file and restart IIS.

Requirements for Reverse Proxy, Load-Balanced, and Web Application Firewall Network Configuration

The Connector will be implemented in many different IT environments, each with different network layouts and practices for service deployment. Some of these will mandate high-availability, reverse proxy, or web application firewall configurations. The understanding needed to implement any of these is similar. They all work well with the Connector. Network administrators only need to understand that ADCSC is just like any other HTTPS web site running on IIS, no different than any other web services in an organization, and that it implements one-to-one client certificate authentication.

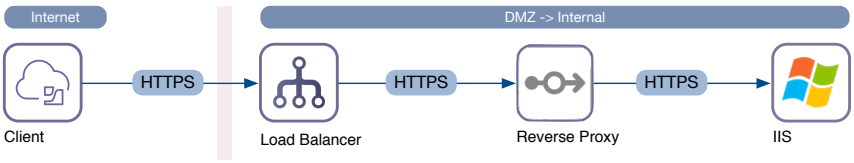
The implications are:

- The server certificate used by the proxy, load balancer, or web application firewall when negotiating TLS must have a name or SAN that matches the host name configured in Jamf Pro and must also match the public key configured in Jamf Pro.
- When a proxy or load balancer is configured for TCP pass-through, the client certificate presented by Jamf Pro will be passed transparently to IIS and IIS will do the verification.
- When a proxy, load balancer, or web application firewall is configured for TLS interception, the proxy should use the public key of Jamf Pro's client certificate to verify the authenticity of the Jamf Pro connection. Organizations can use whatever means they prefer to authenticate the connection between the proxy and IIS (e.g. NTLM) so long as both ends of the connection are configured in tandem. If certificate based authentication is used, the proxy and IIS will be set to require client certificate authentication and the proxy will use the identity whose public key has been set to verify the client certificate in IIS. This may or may not be the same client certificate used by Jamf Pro to connect to the proxy.
- When a load balancer is used, the same rules for server and client certificate authentication apply. There's no limit to the number of ADCS Connector/IIS instances that can be in a load-balanced server pool. However, you should understand that the certificate signing process in ADCS has two-steps. First, a signing request is submitted, and then a subsequent connection is made to retrieve the finished signature. ADCS will only allow retrievals by the same identity that made the request. The implication here is that if load-balanced Connectors are running with the default AppPool identity, you should use a primary/failover configuration for high availability. (The load on the connector will never be high enough to require true load balancing.) If you want to use methods like round-robin or least-load, you'll need to set the app pool identity on all Connectors in the cluster to use the same domain service account. Then any Connector instance will be able to collect signatures generated by any other.

The critical understanding here is that ADCSC is front-ended by Microsoft IIS. The Connector site itself is not involved in negotiating network connections, TLS, or authentication. Customers may route the HTTP/TCP traffic to their Connector in any way that's supported by IIS and

consistent with their own standards and practices. The configuration steps will be based on the documentation from your proxy's manufacturer and Microsoft's IIS documentation.

The following is an example reverse proxy/load balanced planning diagram:



Owner?	Mac team	Network team	Proxy admin	Mac team
What?	REST over HTTPS (TCP Port 443 is typical but use whatever you like…)			
Auth?	TLS with client Identity cert	*None (TCP Passthrough)* →	Verifies client's Identity cert	Anonymous? Simple? Re-encrypt+Client Certificate?
Hostname	my.jamfcloud.com	edge.my.org	proxy.my.org	us_srv_093.my.internal
IP Address	**Source IPs for access rule:** 54.208.14.206, 54.208.84.215, 52.1.62.94, 52.1.215.211, 52.203.216.218, 34.233.253.88, 34.234.26.211, 52.72.152.43, 52.39.2.203, 52.39.4.253	xx.xx.xx.xx (This is needed when creating the A-record in external DNS)	yy.yy.yy.yy (This is needed to set the Firewall rule on Windows Server.)	zz.zz.zz.zz
Cert	**Client Identity Certificate** **Source:** Internal CA **Owner:** Mac Team **CN/SAN** This can be anything you want, but just to make things easier to identify, we usually use the hostname of the client (E.g. my.jamfcloud.com) or a domain service account.	n/a	**Server Identity Certificate** **Source**: Internal CA. **Owner:** Proxy Team **CN/SAN** proxy.my.org	**IIS Identity Certificate** **Source**: Internal CA **Owner:** Mac Team **CN/SAN:** Whatever the proxy is connecting too. E.g. us_srv_093.my.internal or a C-Name alias to it.
DNS	AWS Route 53 managed by Jamf	External DNS A-Record edge.my.org -> <external IP address?>	n/a	Internal DNS A record already exists for the IIS host if it has an IP reservation in DHCP. us_srv_093.my.internal -> zz.zz.zz.zz
Firewall rule	n/a	Allow TCP 443 from the list of AWS VPC outbound NAT source IPs to the VIP that leads to the proxy.	n/a — Load Balancer can already hit Proxy.	Allow TCP 443 only from Proxy's IP address. Consider isolating other services from outside access as well.

Configuring ADCS to use an Alternate Port

Scenario

Since the Windows OS computer running ADCS Connector needs to be bound to a domain, it typically is on the same network as both a domain controller and the ADCS CA. For this reason, we rarely need to do any special firewall changes to have them speaking to each other on the standard communications ports used by Windows.

However, there may be cases where the ADCS server is isolated, which might be the case when if you run a stand-alone CA that only services a small number of authorized services rather than being open to all devices.

Perhaps the best approach in this situation might be to put a reverse proxy in the DMZ to forward Jamf Pro's HTTPS traffic to the ADCS Connector installed on the same isolated/internal network as ADCS.

If the ADCS Connector will run in a different network zone than ADCS, firewall admins may not wish to open all of the dynamic DCOM ports between the two zones. In this case, Microsoft allows customization of the ports.

Procedure

A summary of the steps is included here to show the basic idea, but you should use Microsoft's documentation when doing this. Reference: https://social.technet.microsoft.com/wiki/contents/articles/1559.how-to-configure-a-static-dcom-port-for-ad-cs.aspx

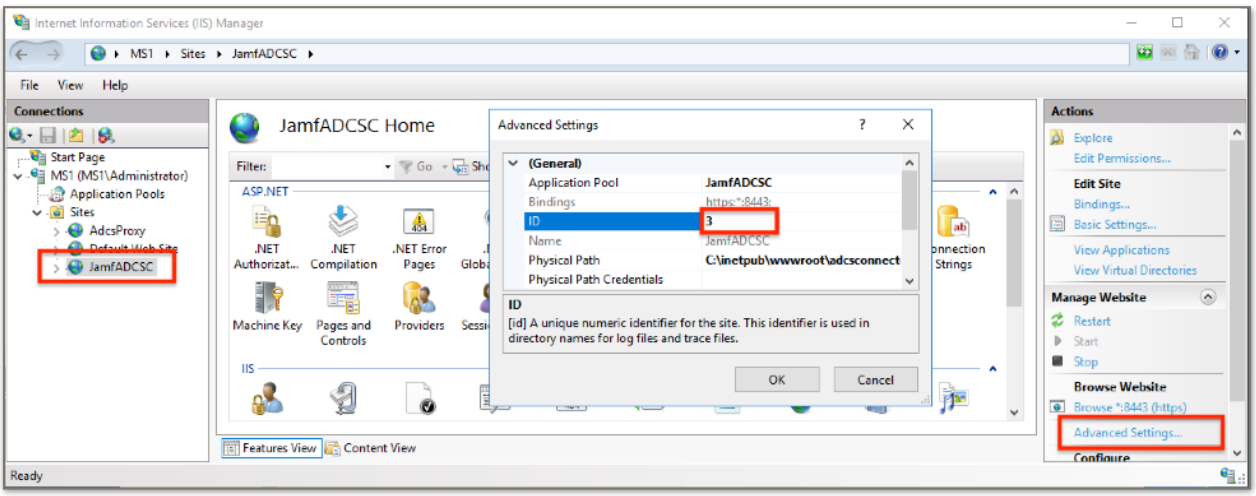
To configure the Active Directory Domain Services (AD CS) certification authority (CA) service (CertSvc) to listen on a static DCOM port

1. Log on with an account that has local administrator permission on the CA
2. Open the **Component Services** snap-In (dcomcnfg.exe).
3. In the left pane of the **Component Services** snap-In, expand **Component Services**, **Computers**, My **Computer**, and then **DCOM Config**.
4. In the right pane, select **CertSrv Request**.
5. On the **Action** menu, click **Properties**.
6. On the **Endpoints** tab, click **Add**.
7. Select **Use static endpoint**, enter an unused TCP port number, for example, 4000, and then click **OK** twice.
8. Close the **Component Services** snap-In.
9. Restart the certification authority service.
   net stop certsvc
   net start certsvc

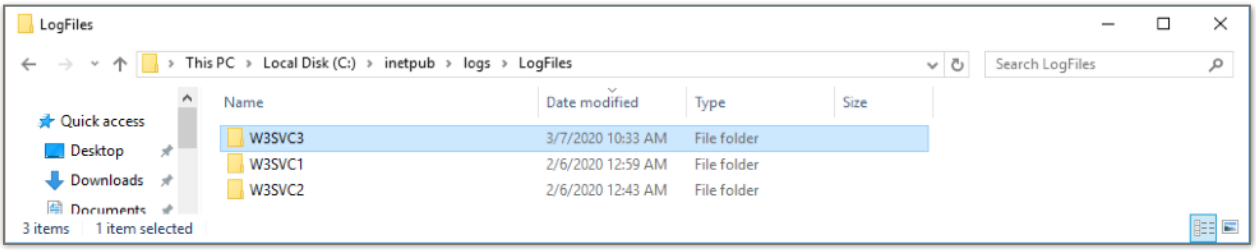
Troubleshooting

Viewing the IIS Access Logs

Go to c:\inetpub\logs\LogFiles. You may see multiple folders there... one for each site hosted in IIS. You might be able to click into them and figure out which one is for your ADCS Connector site based on the timestamps of the folders or their logged connections. Otherwise, get the site number to find the right folder. Click on your Connector site and click "Advanced Settings...". In the example below, we see the ID number for our Connector site is "3".



In the logs folder, this corresponds to "W3SVC3"...



Inside this folder, click on the most recent log file and you will see entries for each attempted connection.

Example Log Entries — 403.16

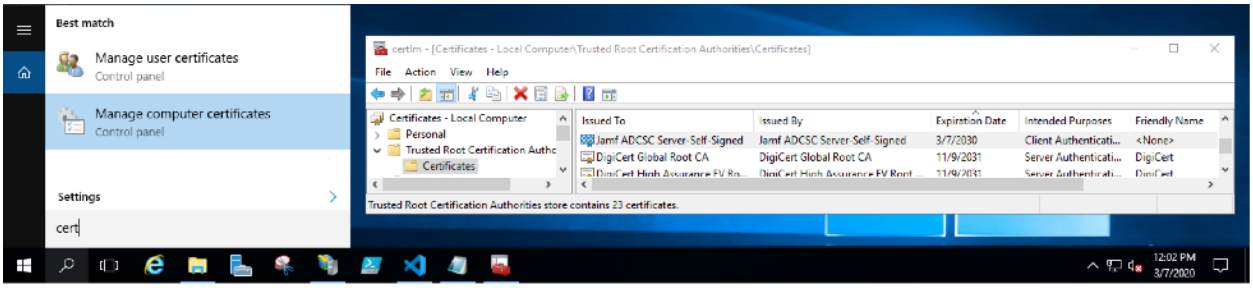
In the example below, we see that at 2020-03-07 15:33:11, a client with IP address 192.168.1.57 attempted to connect to the /api/v1/certificate/request endpoint on port 8443. An HTTP status of 403.16 was returned.

```
#Software: Microsoft Internet Information Services 10.0
#Version: 1.0
#Date: 2020-03-07 15:33:11
#Fields: date time s-ip cs-method cs-uri-stem cs-uri-query s-port cs-username c-ip
cs(User-Agent) cs(Referer) sc-status sc-substatus sc-win32-status time-taken
2020-03-07 15:33:11 192.168.1.57 POST /api/v1/certificate/request - 8443 -
192.168.1.47 curl/7.54.0 - 403 16 2148204809 1203
```

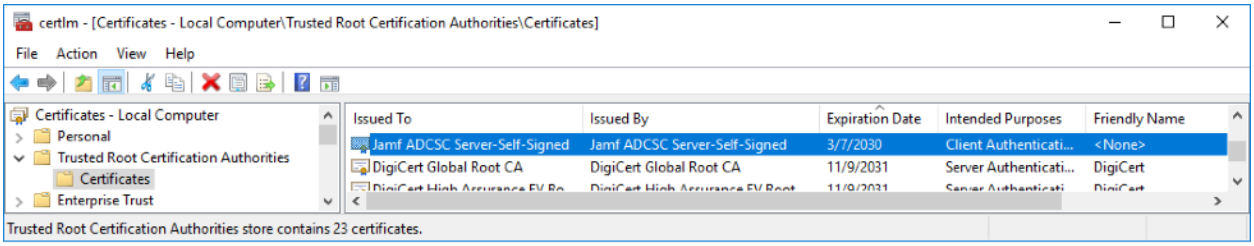
If we lookup that error, we'll find https://support.microsoft.com/en-us/help/942061/error-message-when-you-visit-a-web-site-that-is-hosted-on-iis-7-0-http.

So 403.16 indicates that the client presented an authentication certificate, and it probably matched up with the public key in the one-to-one client certificate mapping, but IIS couldn't establish a trust chain -- the CA cert that signed the client cert isn't in the *Trusted Root Certification Authorities* certificate store on the IIS server. If you let the ADCS Connector installer script generate the client certificate, it was signed by the server cert it used to create the site binding. If you provided a client cert from your own or a third-party CA, then you need to load the trust chain for that CA into *Trusted Root Certification Authorities*.

Bring up certlm. You can do a find on "cert" and select "Manage computer certificates". Make sure that the trust chain certs that signed your client authentication certificate are in here.

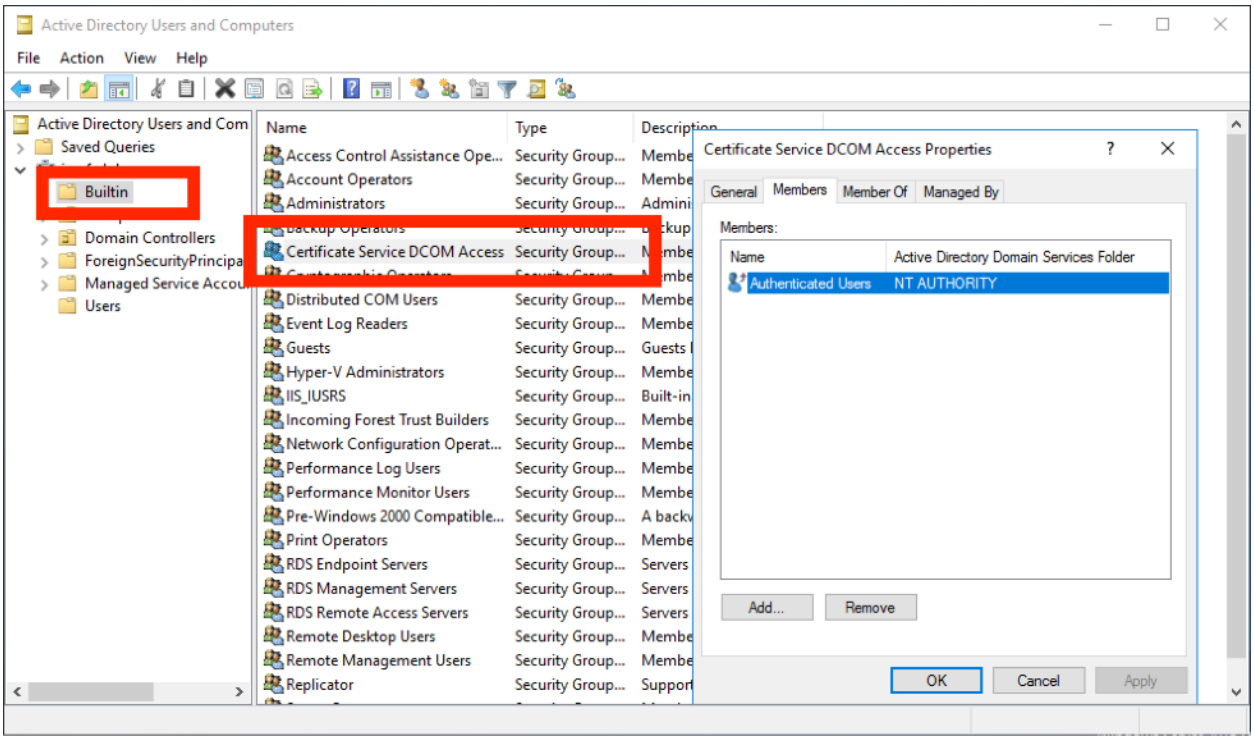


It's not uncommon for organizations to have a computer management restriction that blocks any new certs from being added to the trusted roots because if anything wrong gets in there you're a sitting duck for MITM attacks. We've seen several cases where the server where the Connector was being installed had this restriction but the SCCM admin wasn't aware of it.



The DOM Access Group

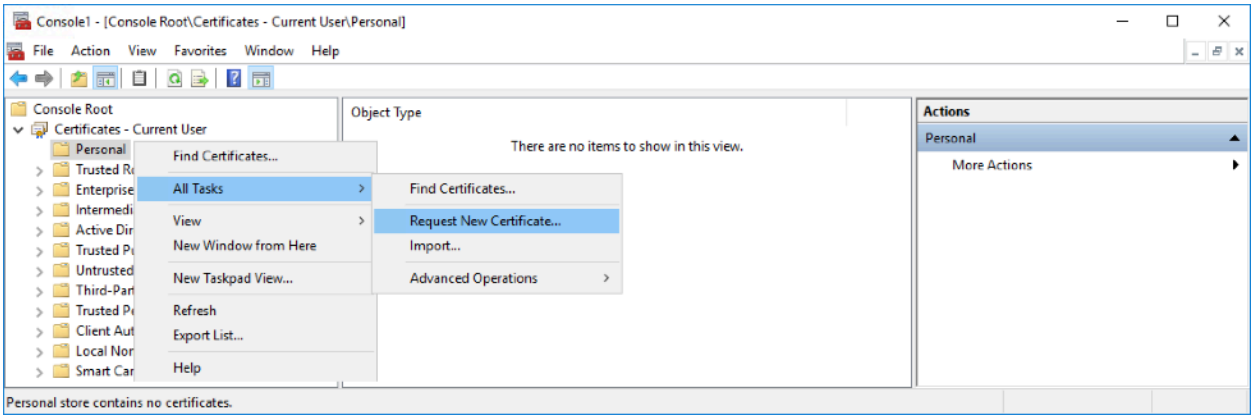
Windows' has a domain local group called Certificate Services DCOM Access. By default, Authenticated Users will be a member of this group and the connector will automatically be a member of the Authenticated Users group since it's bound to the domain. So it inherits all the permissions it needs. However, if your PKI admin has made this group more restrictive, you can explicitly add the Connector to the DCOM Access group.



Troubleshooting with the Certificates MMC and Certreq

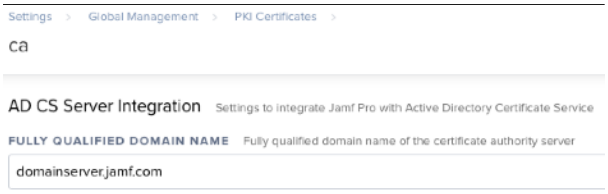
If you are having trouble getting certificates and suspect the CA or template configuration, you can remove Jamf entirely from the picture and test the backend configuration with native Microsoft tools.

To do so, just run the certificate snap-in on the Jamf ADSC Connector host and request a certificate from the template you want the Connector to use. If you can obtain a cert, you know that the host's computer account has the right permissions.



Microsoft's certreq utility uses the same DCOM interface as the Connector so that is another option that can be useful for testing.

Jamf Software Server Logs Entry Errors

Log Error	Solution
Caused by: com.jamfsoftware.pki.adcs.exception.AdcsConnectorCertificateNotIssuedException: INTERNAL_ERROR: System.Runtime.InteropServices.COMException – CCertRequest::Submit: The RPC server is unavailable. 0x800706ba (WIN32: 1722 RPC_S_SERVER_UNAVAILABLE)	The wrong hostname has been entered for the AD Domain Controller or the server is unreachable from the Connector host: 
Caused by: org.springframework.web.client.ResourceAccessException: I/O error on GET request for "https://192.168.1.198:8444/api/v1/version":Certificate for <192.168.1.198> doesn't match any of the subject alternative names: [adcsc.jamf.com, 192.168.1.198];	The server certificate uploaded to Jamf Pro does not match the subject or subject alternative names. Look for a typo in