Certificate Authority Infrastructure Hands-On Lab

Part 1: ADCS Installation & Configuration

Information Technology & Security

CLASS DESCRIPTION

The first of a two-part hands-on-lab series; this lab will take you step-by-step through the installation and configuration of an enterprise Public Key Infrastructure (PKI) using Microsoft Active Directory Certificate Services (ADCS).

OVERVIEW

We will be deploying the PKI environment described below in *Figure 1* and *Table 1*. The installation procedure will follow these major steps:

- Provision a web server to host PKI information (CDP and AIA).
- Deploy a standalone root CA
- Deploy an enterprise subordinate CA

NOTE: All domain and local account passwords are set to **pw**

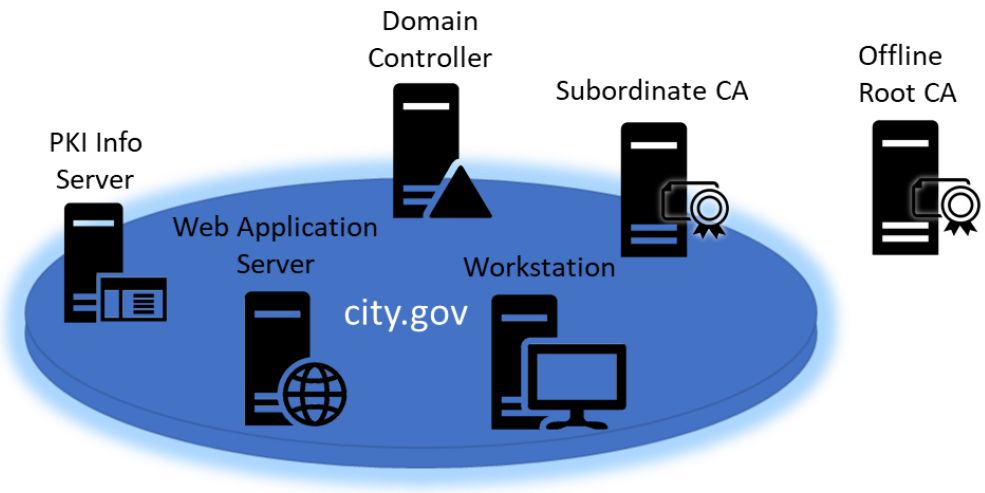


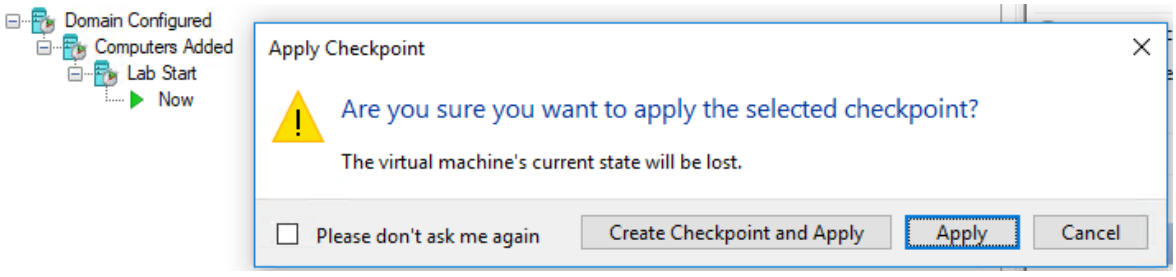
Figure 1 - Lab Infrastructure

Machine	Roles	FQDN [IP]
Domain Controller	DC, DNS, DHCP, WINS	dc.city.gov [10.10.10.10]
Root CA	Certificate Authority	rootca.city.gov [10.10.10.5]
Subordinate CA	Certificate Authority, Web Enrollment	subca.city.gov [DHCP]
PKI Info Server	IIS, File Share	pkiinfo.city.gov [DHCP]
Web Application Server	IIS	webapps.city.gov [DHCP]
Workstation	Windows Client OS	workstation.city.gov [DHCP]

Table 1 - Listing of Lab Machines

ADCS INSTALLATION AND CONFIGURATION HANDS-ON-LAB

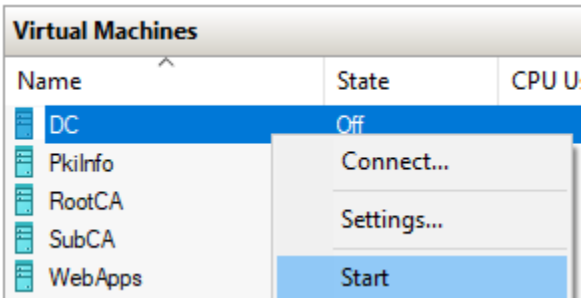
TIP: Before starting any VM in this lab for the first time, you should apply the **Lab Start** checkpoint



PKI Info Server

Provisioning the PKI Information Distribution Server

1. Start the Domain Controller (**DC**) if it isn't already running, wait for it to



2. Start the PKI Information server (**PkiInfo**)

3. Start a Hyper-V Virtual Machine Connection to **PKiInfo** and login as domain administrator

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NOTE: Domain administrator credentials are *user name*: **CITY\Administartor** *password*: **pw**

TIP: When logged in as the domain administrator you should see the following information in the top right of the desktop wallpaper:

Host Name:	**PKIINFO**
Machine Domain:	**CITY**
IP Address:	**10.10.10.12**

If the information shown is different you may have logged in as local administrator, log out and try again.

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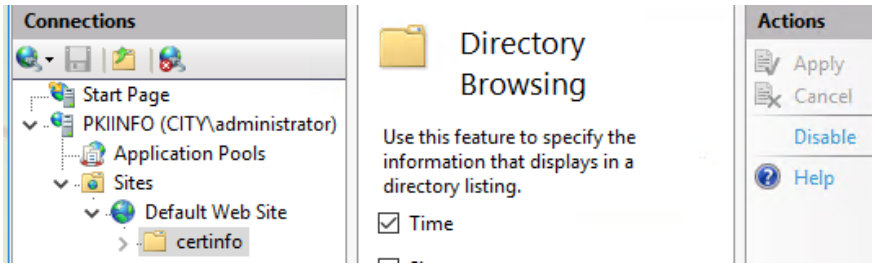
4. Start Internet Information Services Manager (**IIS Manager**) and verify that the **certinfo** directory is exists under the **Default Web Site** and directory browsing is enabled



5. Start Internet Explorer and verify that you can browse to **http://pkiinfo.city.gov/certinfo**

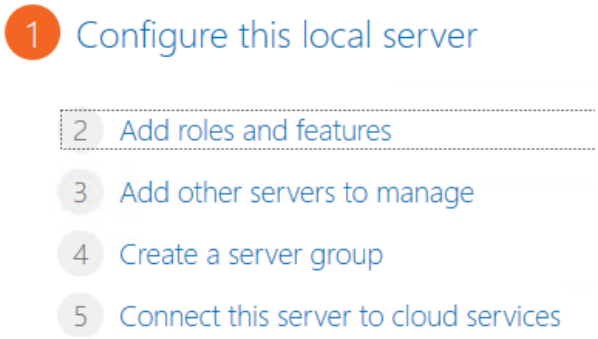
Offline Root CA

Deploying the Root Certificate Authority – Installation

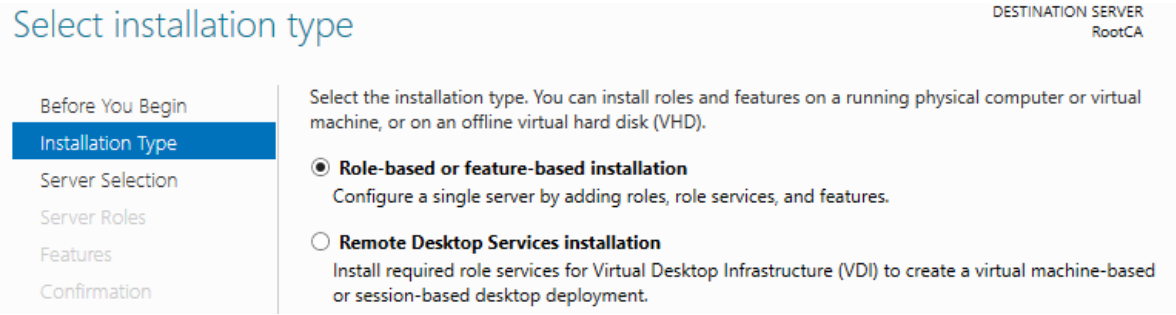
1. Start the Root CA server (**RootCA**) and login as local Administrator

> **NOTE**: A DNS entry for rootca.city.gov [10.10.10.5] has already been manually created for this server since it is **not** a domain member and hence will **not** self-register with the domain DNS.

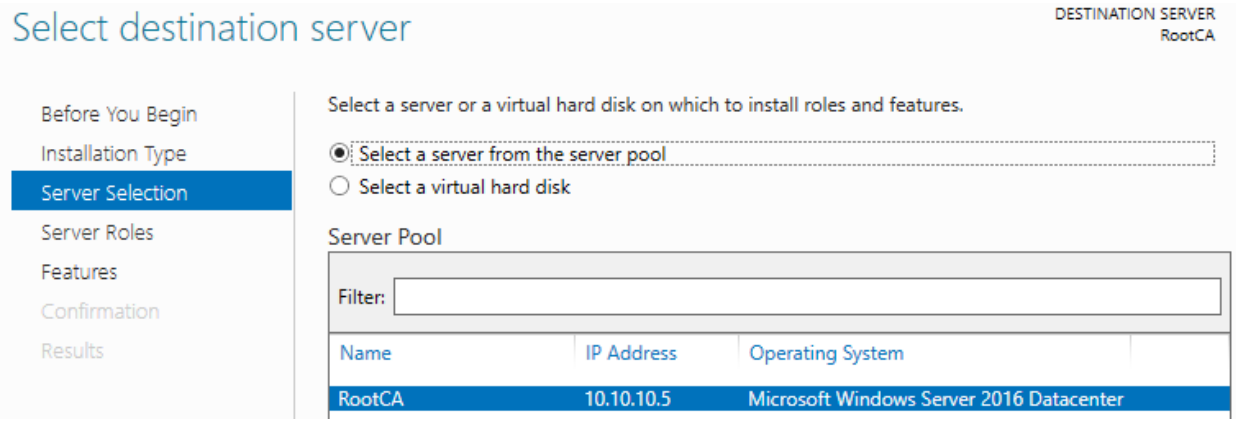
2. Start Server Manager and select **Add roles and features**, under the *Configure this local server* section



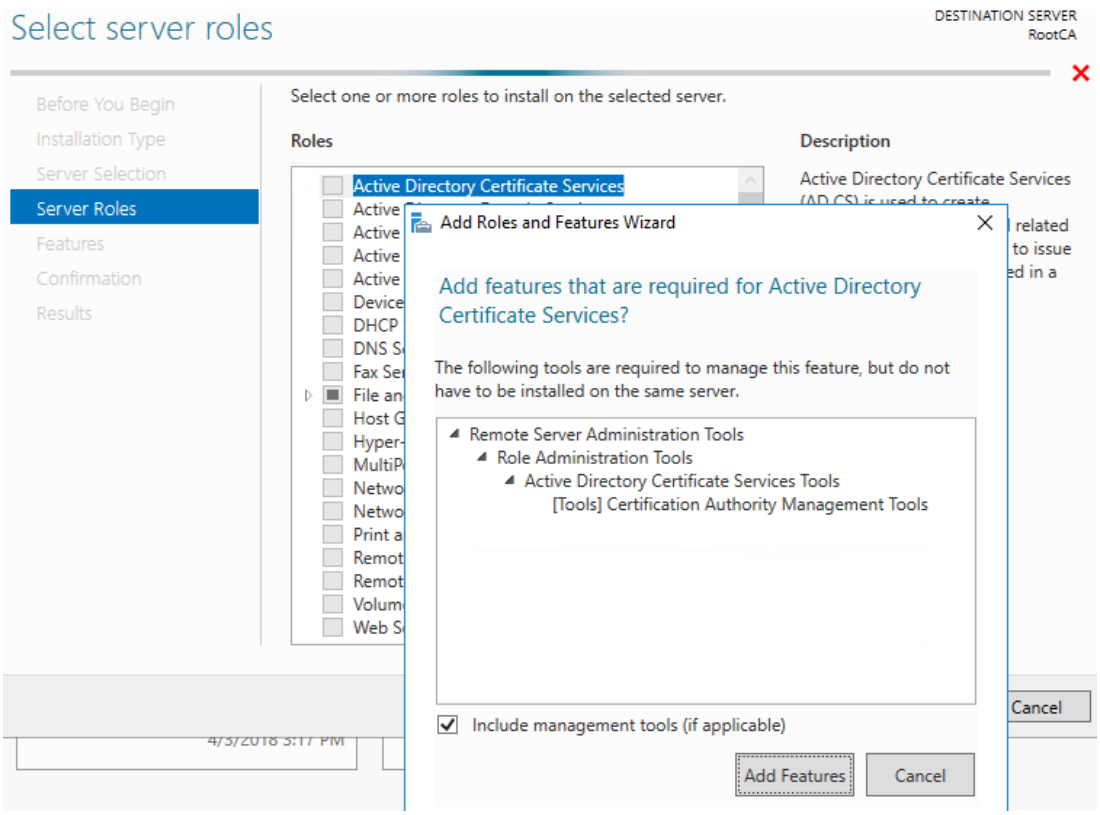
3. On the **Select installation type** screen, select Role-based or feature-based installation and click next



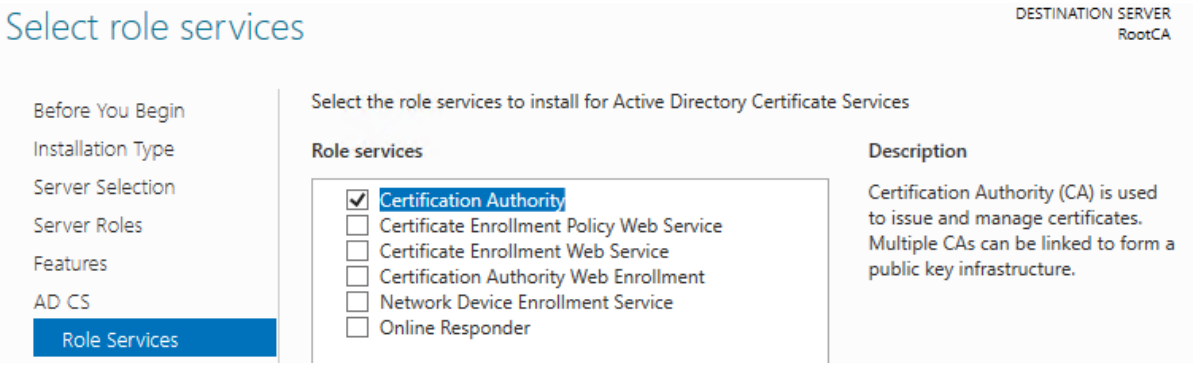
4. On the **Select destination server** screen ensure the **RootCA** server is selected and click next



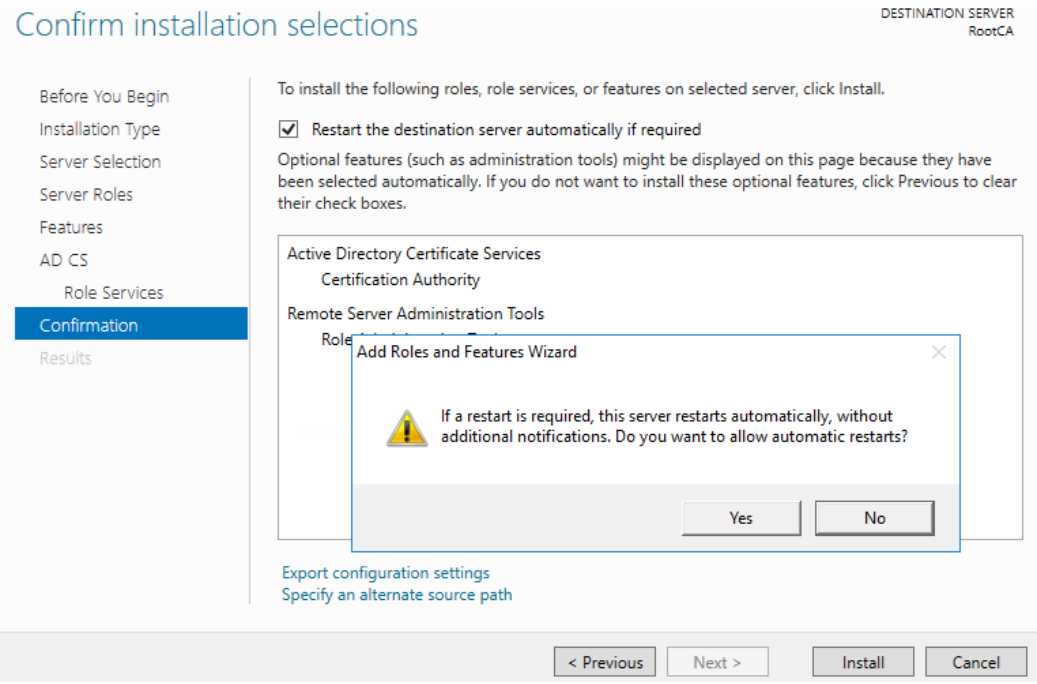
5. On the **Select server roles** screen, select **Activity Directory Certificate Services** then click Add Features in the dialog window. Click Next.



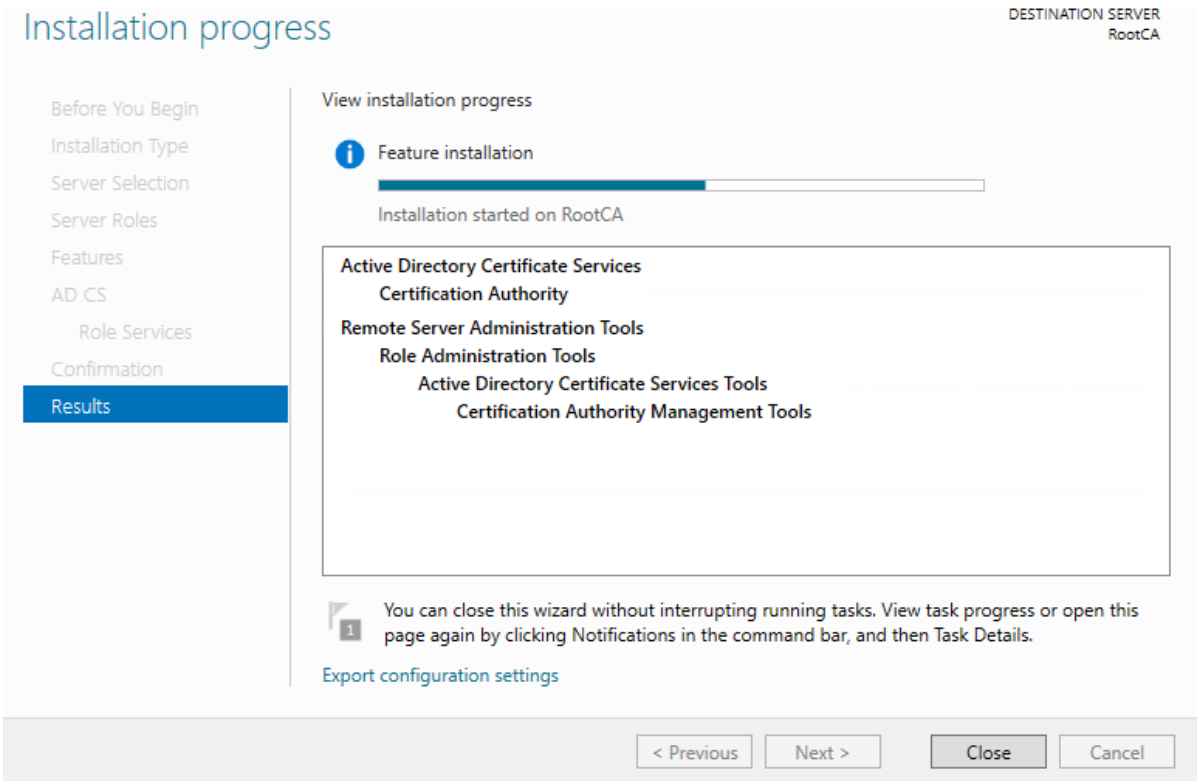
6. Skip to the **Roles Services** screen under AD CS and verify that only the **Certificate Authority** role service is selected. Click Next



7. On the **Confirm installation selections** screen, check the box to allow automatic restarts during installation and click Yes in the dialog box and finally click Install



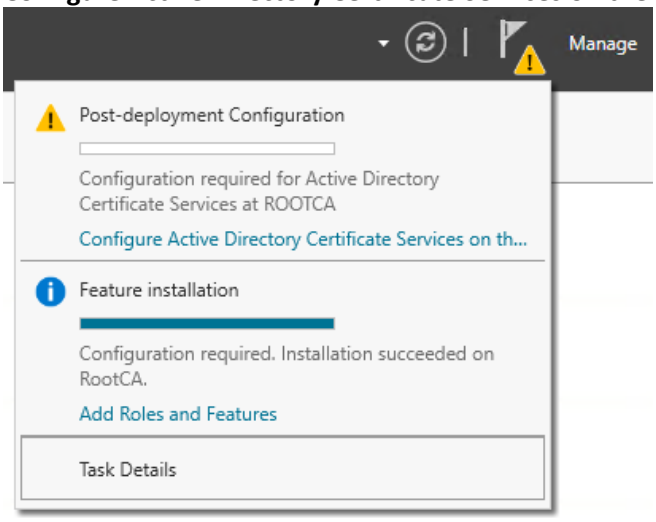
8. Wait for the installation to complete then click Close. The Certificate Authority role is now installed.



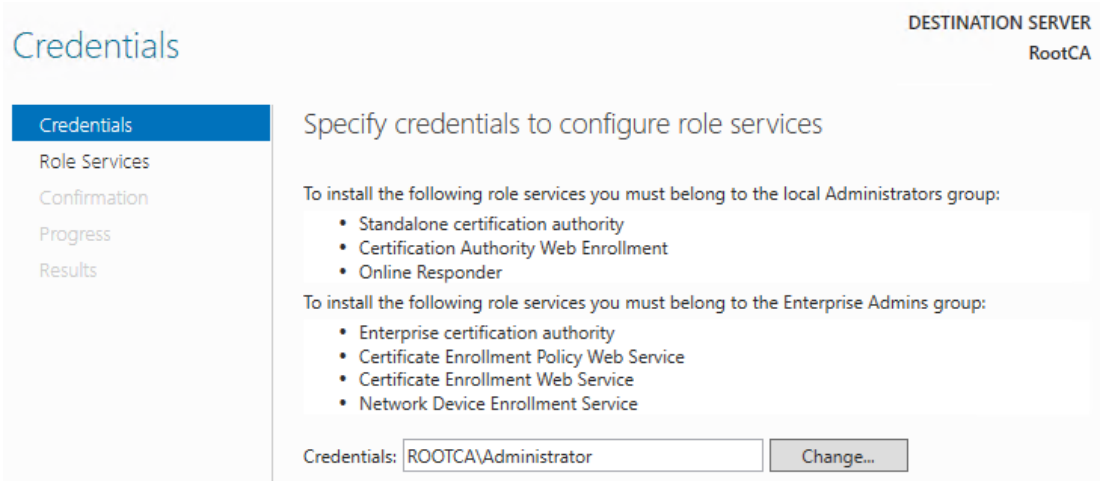
Offline Root CA

Deploying the Root Certificate Authority – Configuration

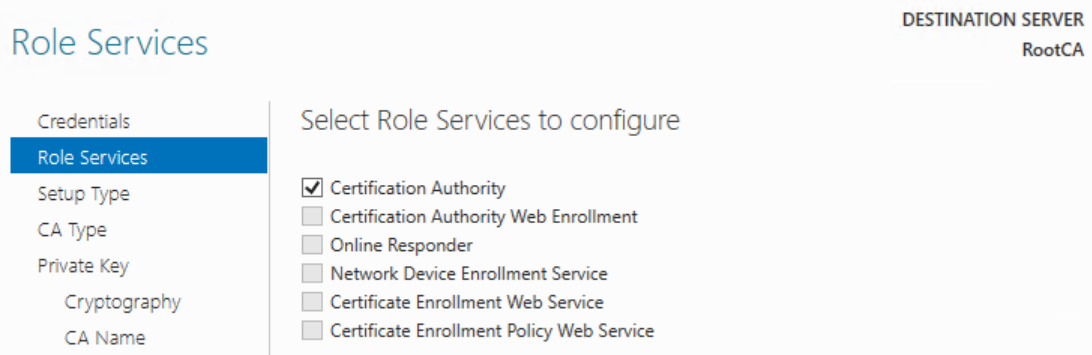
1. In the Server Manager notifications menu, find the **Post-deployment Configuration** notification and click the **Configure Active Directory Certificate Services on the destination server** link



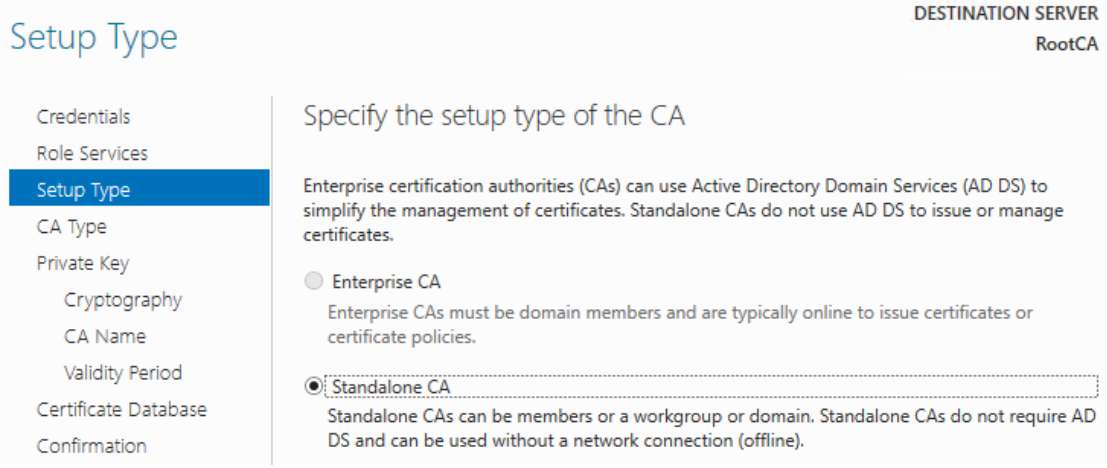
2. On the **Credentials** screen of the AD CS Configuration wizard, accept the default local Administrator credentials and click Next



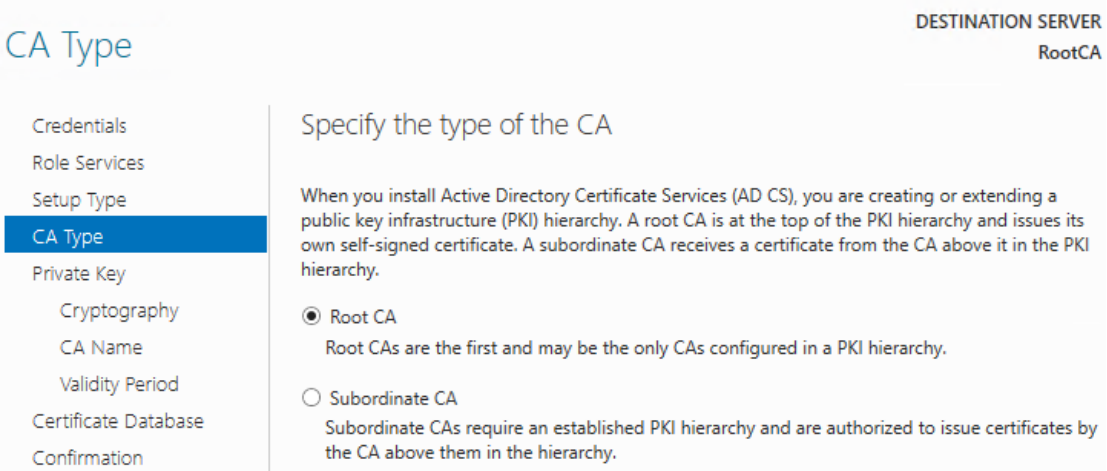
3. On the **Roles Services** screen, select **Certificate Authority** then click Next



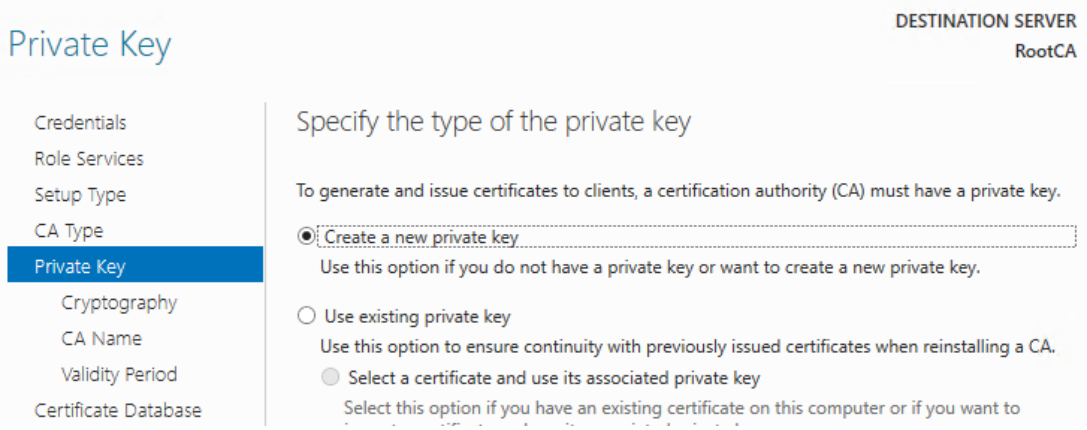
4. On the **Setup Type** screen ensure **Standalone CA** is selected then click Next.



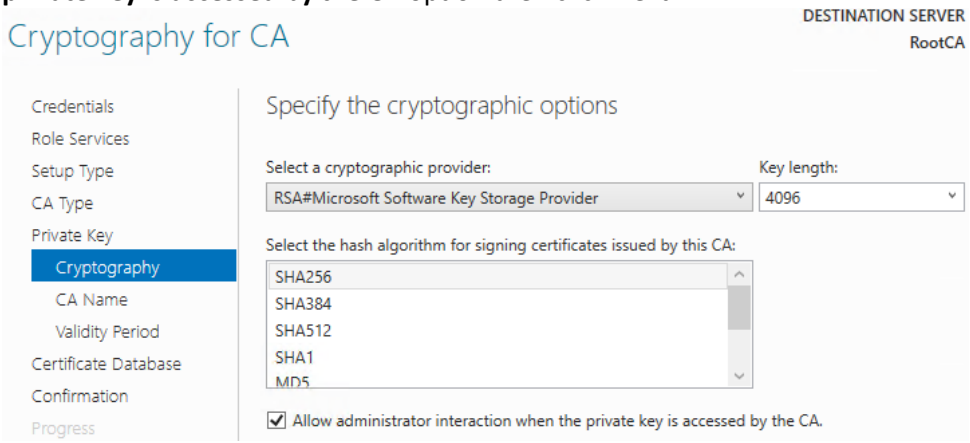
5. On the **CA Type** screen ensure **Root CA** is selected then click Next



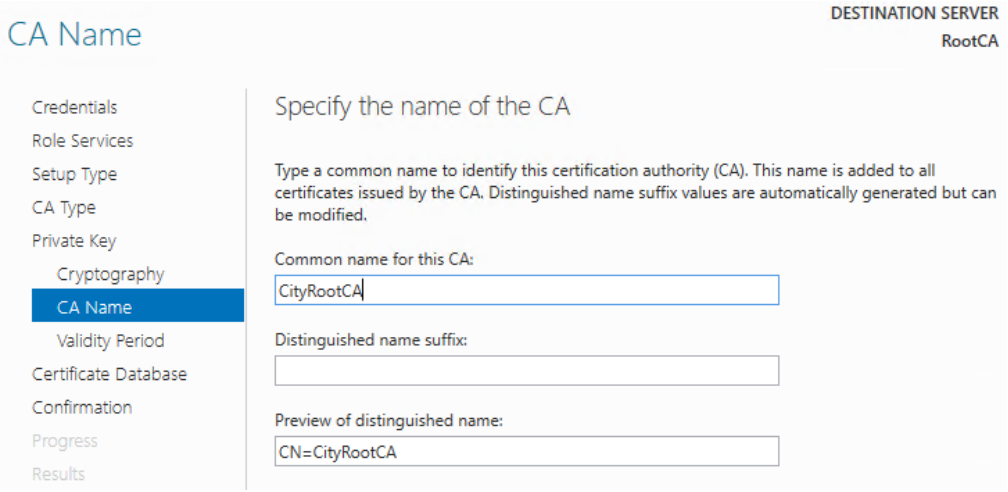
6. On the **Private Key** screen select **Create a new private key** then click Next



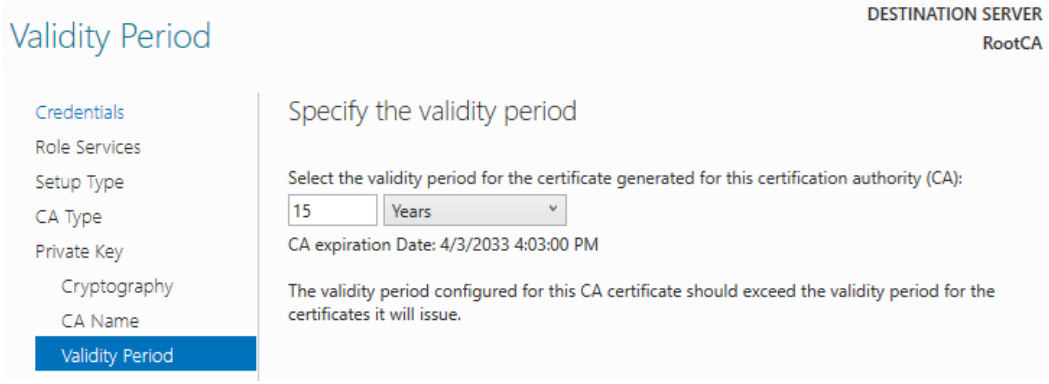
7. On the **Cryptography for CA** screen ensure **RSA#Microsoft Software Key Storage Provider** and **SHA256** are selected, however, change the Key Length to **4096** and check the **Allow administrator interaction when the private key is accessed by the CA** option then click Next



8. On the **CA Name** screen, enter a common name for you Root CA, we will use **CityRootCA** for this lab

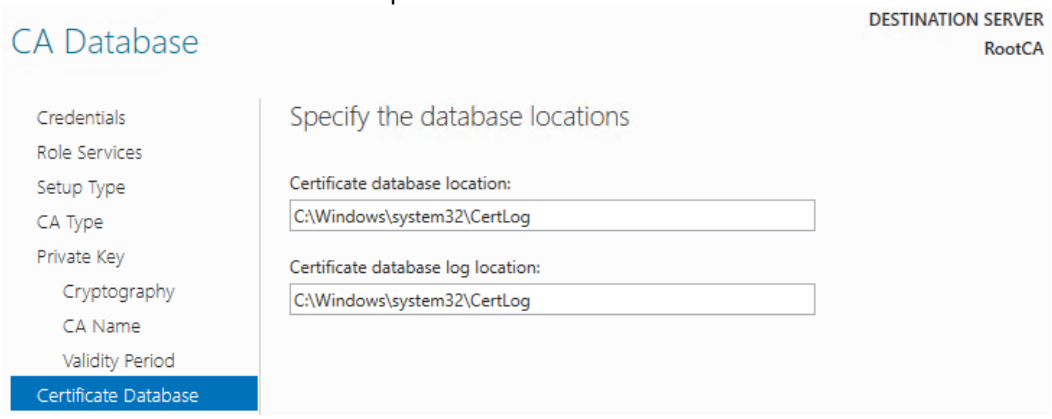


9. On the **Validity Period** screen enter the period for which the Root CA certificate will be valid, we will use **15** years for this lab

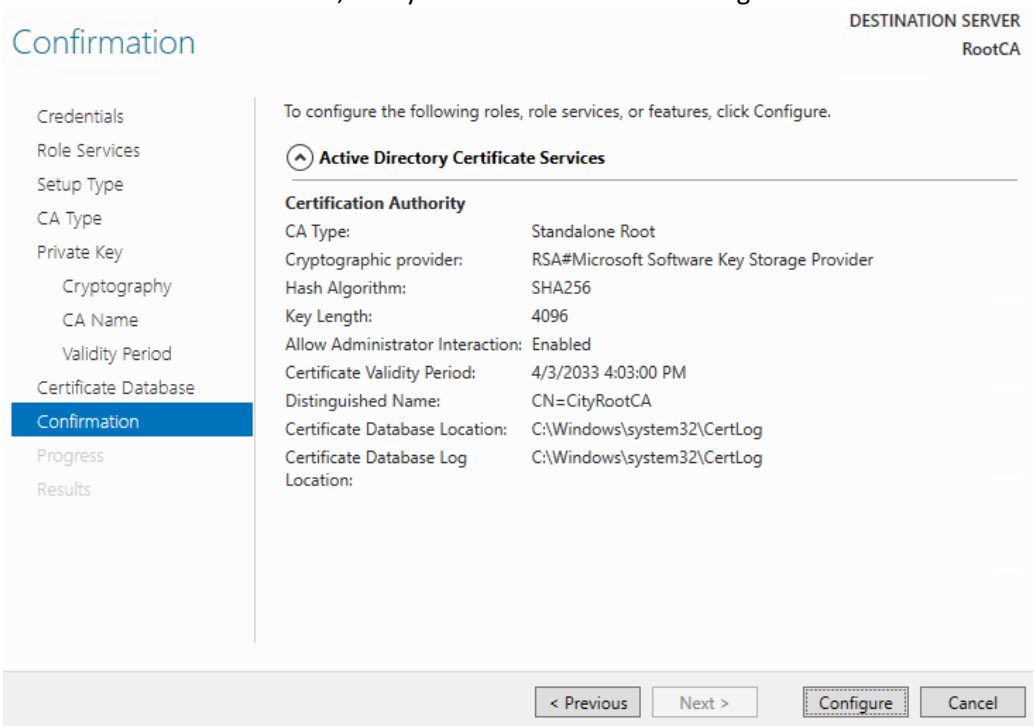


TIP: Given cryptography settings of **SHA256** and **4096** key length or stronger, 10 – 20 years is a reasonable range for validity periods.

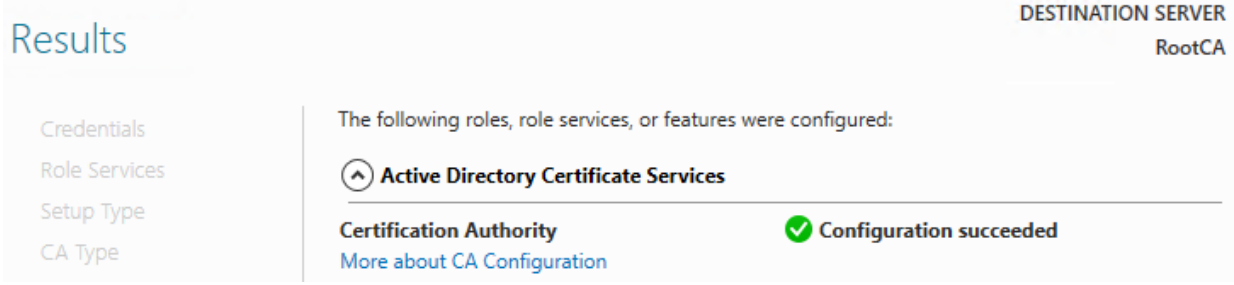
10. On the **CA Database** screen accept the default locations and click Next



11. On the **Confirmation** screen, verify all choices then click Configure

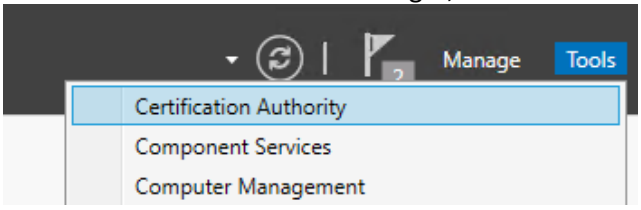


12. The **Certificate Authority** role service is now configured. Click Close.

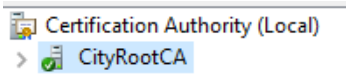


NOTE: We now need to configure the locations of the CDP and AIA to point to the PKI Information Server, so that the domain infrastructure has access to information published by the Root CA once it is offline

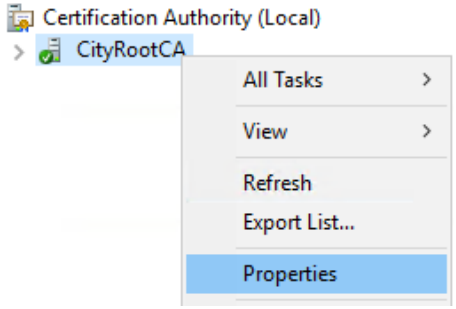
13. In the **Tools** menu of Server Manager, launch the **Certificate Authority** management console



14. Verify that the **CityRootCA** certificate authority service is running (green check mark)

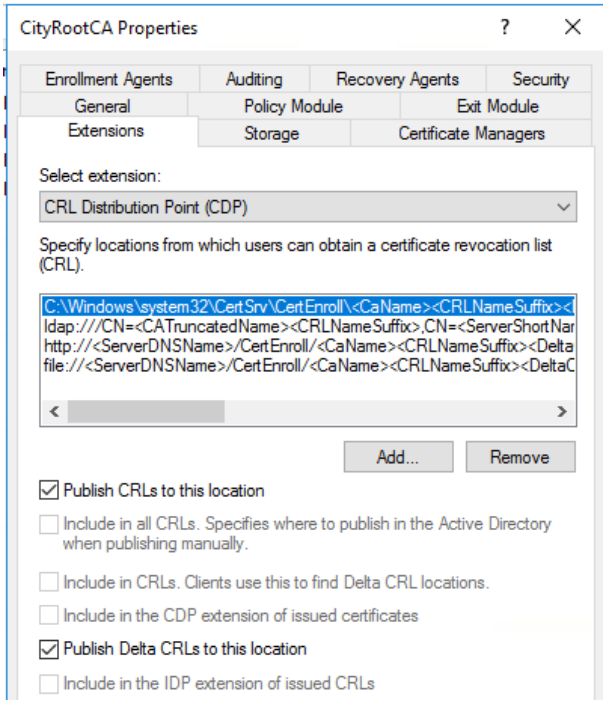


15. Right click the **CityRootCA** node and select Properties

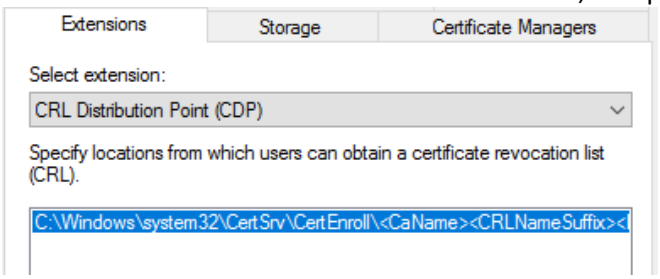


NOTE: It takes a few seconds for the Properties dialog box to show

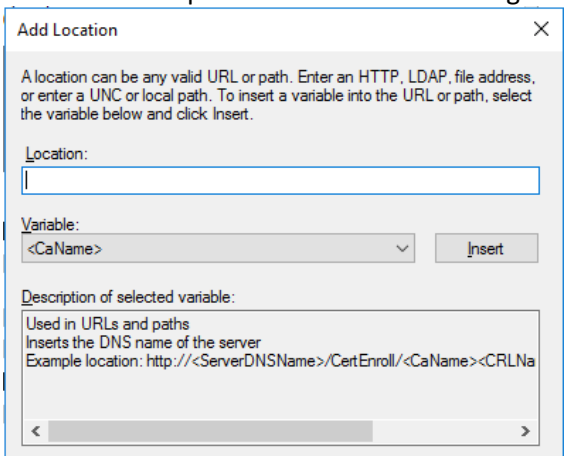
16. In the **CityRootCA Properties** dialog, select the **Extensions** tab



17. Remove all entries for the CRL Distribution Point, except for the file system entry on drive C:

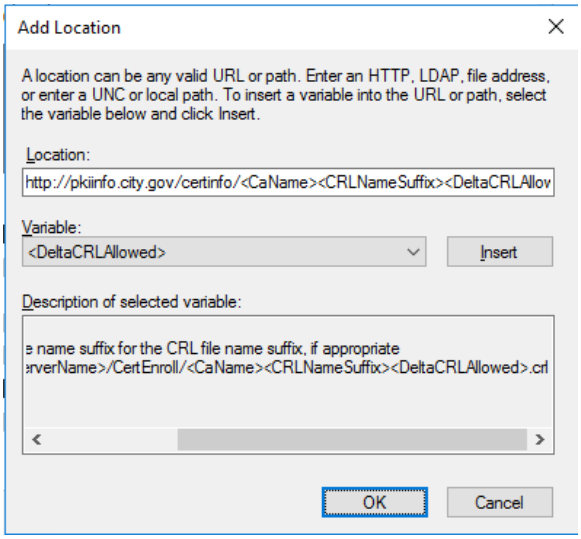


18. Click Add… to open the Add Location dialog



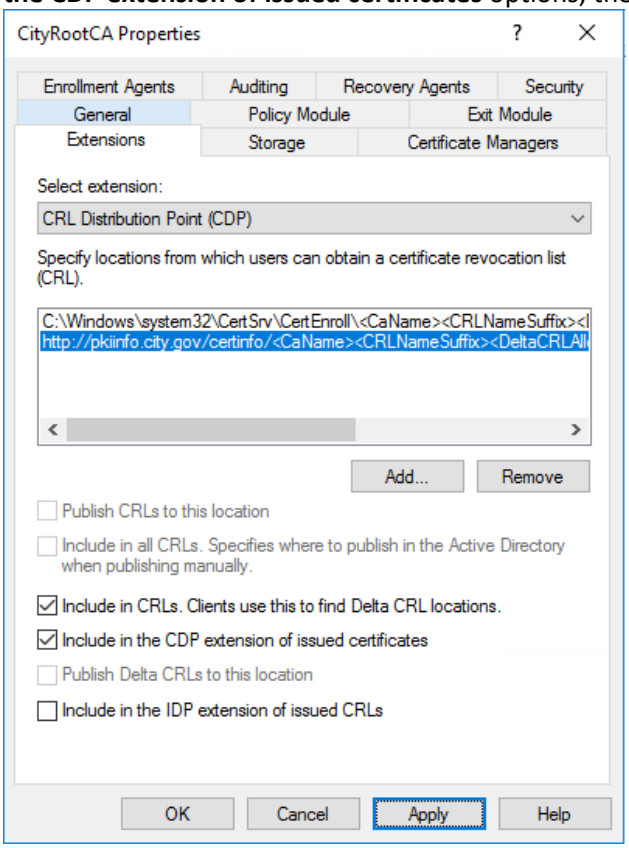
19. Enter for following URL to the PKI Information Server and click OK

http://pkiinfo.city.gov/certinfo/<CaName><CRLNameSuffix><DeltaCRLAllowed>.crl

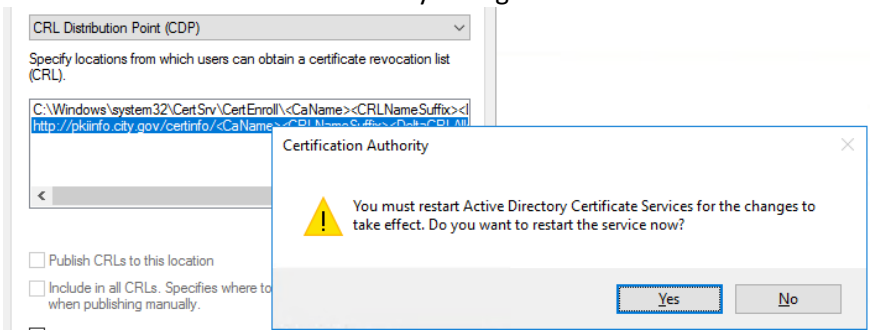


TIP: Use the **Variable** dropdown to insert the URL parts to avoid typos

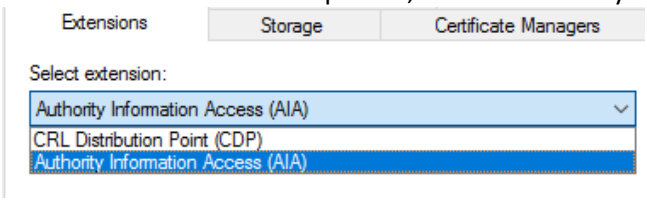
20. For this location check both the **Include in CRLs. Clients use this to find Delta CRL Locations** and the **Include in the CDP extension of issued certificates** options, then click Apply



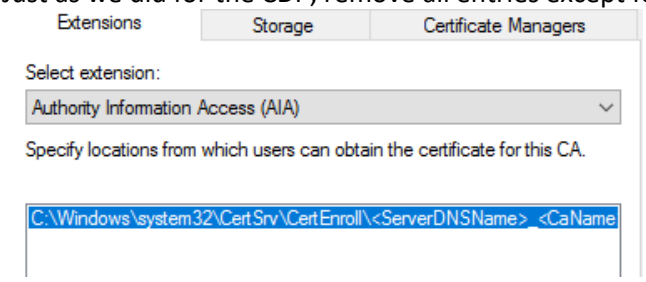
21. Click Yes in the Certificate Authority dialog box to restart the CA service



22. In the **Select extension** dropdown, choose Authority Information Access (AIA)

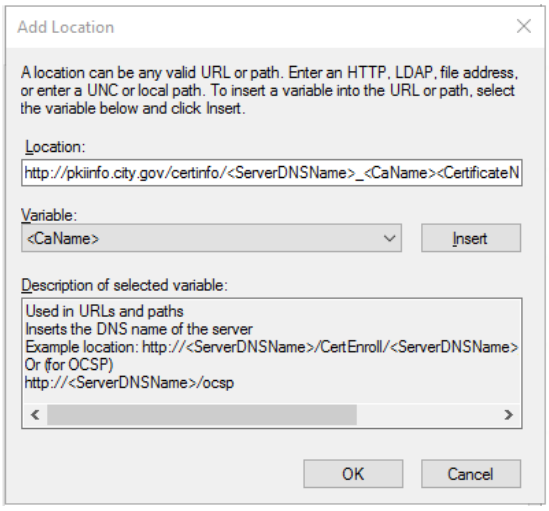


23. Just as we did for the CDP, remove all entries except for the file system entry on drive C:

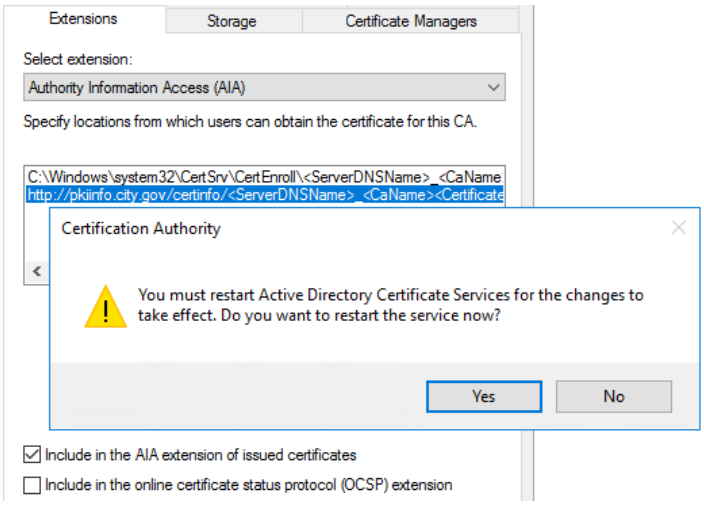


24. Click Add… and enter for following URL to the PKI Information Server then click OK

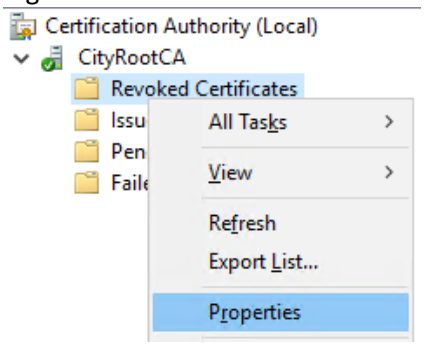
    http://pkiinfo.city.gov/certinfo/<ServerDNSName>_<CaName><CertificateName>.crt



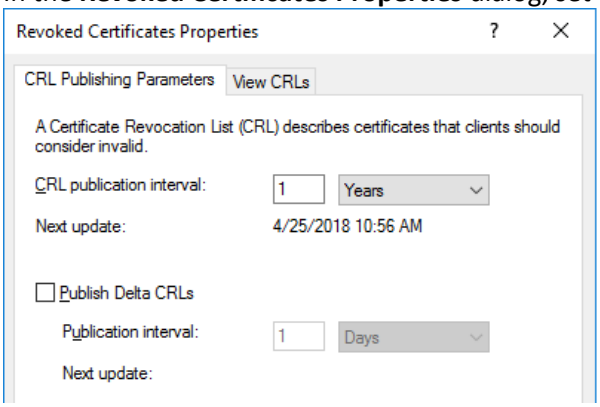
25. For this location check the **Include AIA extension of issued certificates** options, click OK then click Yes to restart the CA service



26. Right-click the **Revoked Certificates** node and select **Properties**



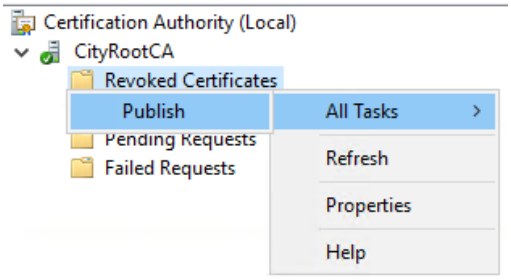
27. In the **Revoked Certificates Properties** dialog, set the **CRL publication interval** to **1 year**, then click OK



TIP: Expired CRLs will prevent online CA services from starting. Be careful to choose a publication interval that is sensible for your organization

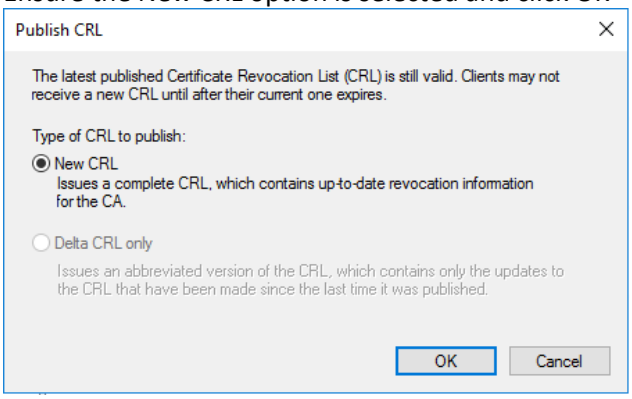
NOTE: We now need to publish the certificate revocation list (CRL) along with the AIA certificate that signs the CRL

28. In the **Certificate Authority** management console, right click **Revoked Certificates** folder under **CityRootCA**, go to All Tasks and click **Publish**



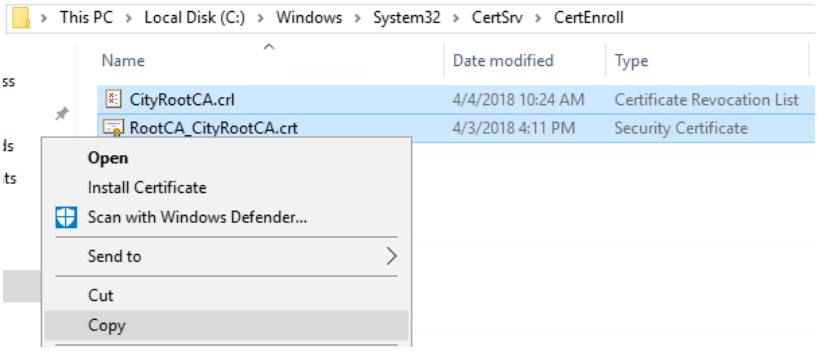
NOTE: It can take a few seconds for the Publish CRL dialog box to show

29. Ensure the New CRL option is selected and click OK



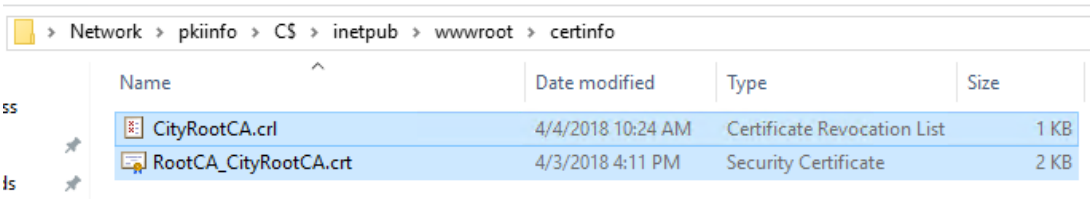
30. In Windows Explorer browse to the following path and copy the *crl* and *crt* files. These are the certificate revocation list and AIA cert

C:\Windows\System32\CertSrv\CertEnroll



31. Browse to the administrative share for drive C: on the PKI Information Server (**PkiInfo**) and copy the *crl* and *crt* files to the **certinfo** folder of the web server

    \\pkiinfo\C$\inetpub\wwwroot\certinfo

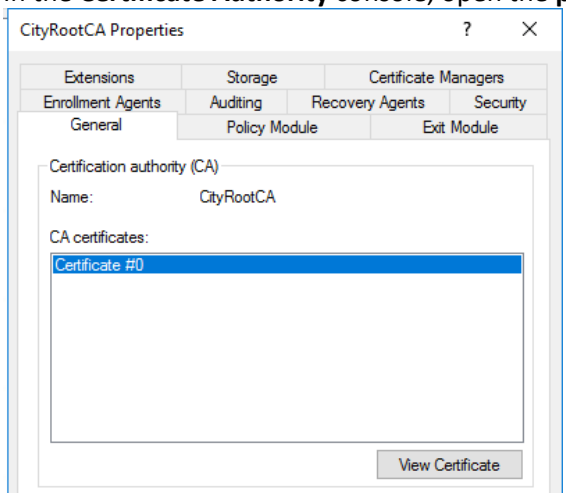


32. Use Internet Explorer to verify that the *crl* and *crt* files are available via the PKI Information Server URL

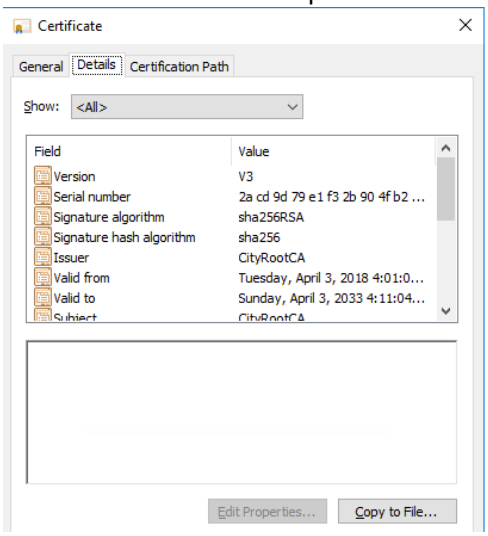
    http://pkiinfo.city.gov/certinfo

NOTE: Next we will make the Root CA certificate available via the PKI Information Server

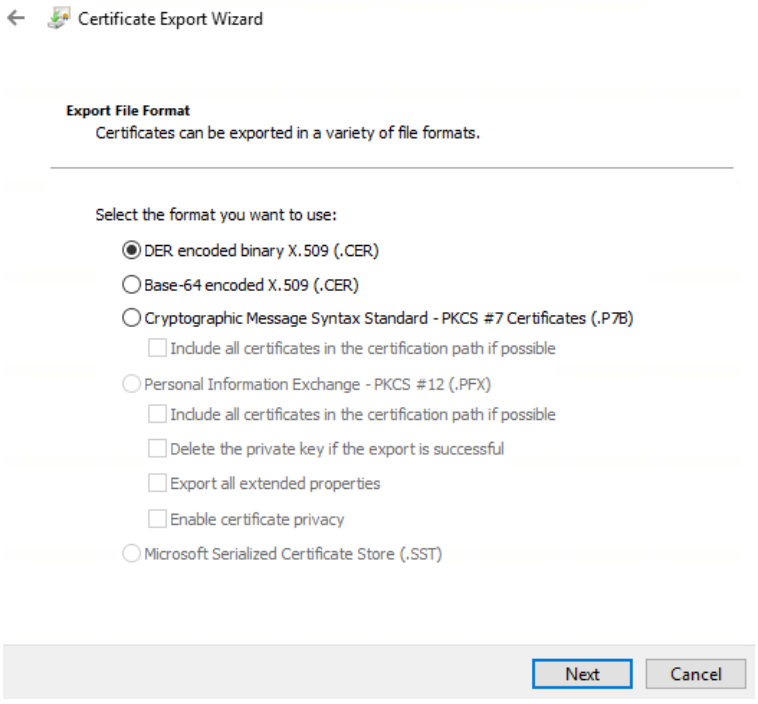
33. In the **Certificate Authority** console, open the **properties** of the CityRootCA and go to the **General** tab



34. Click View Certificate to open the Certificate dialog and go to the **Details** tab

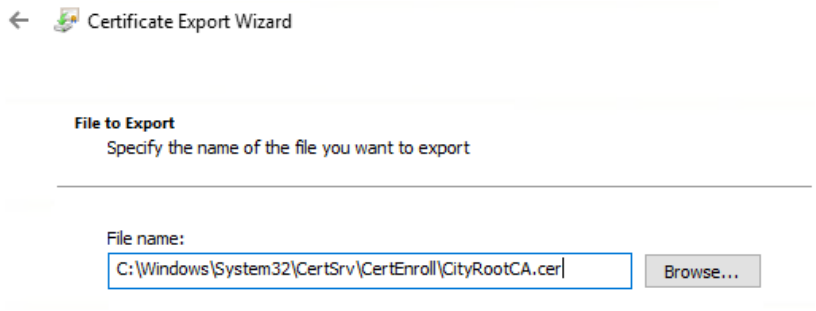


35. Click **Copy to File…** then click Next in the **Certificate Export Wizard** dialog. Ensure the **DER encoded binary X.509 (.CER)** option is selected then click Next

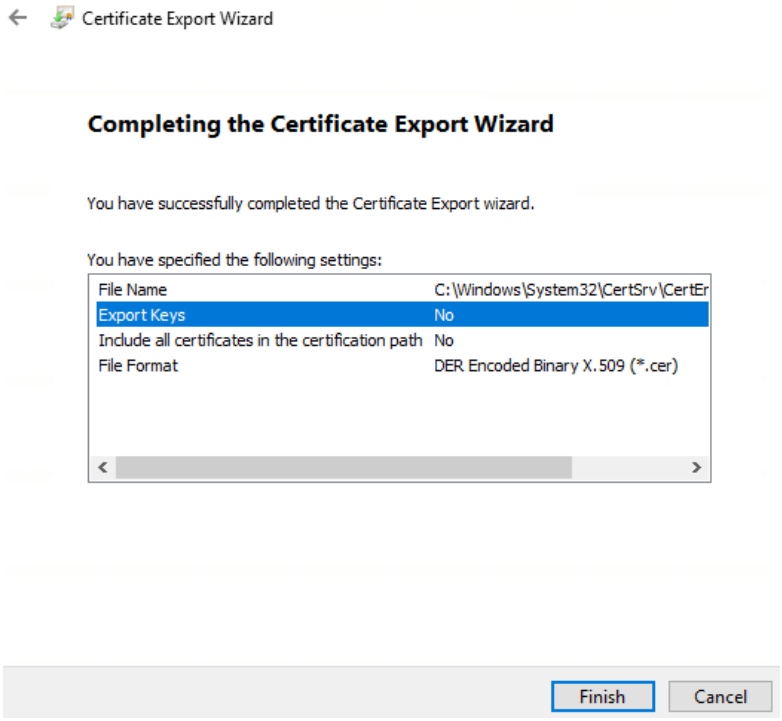


36. Enter the following file path for the Root CA certificate export, then click Next

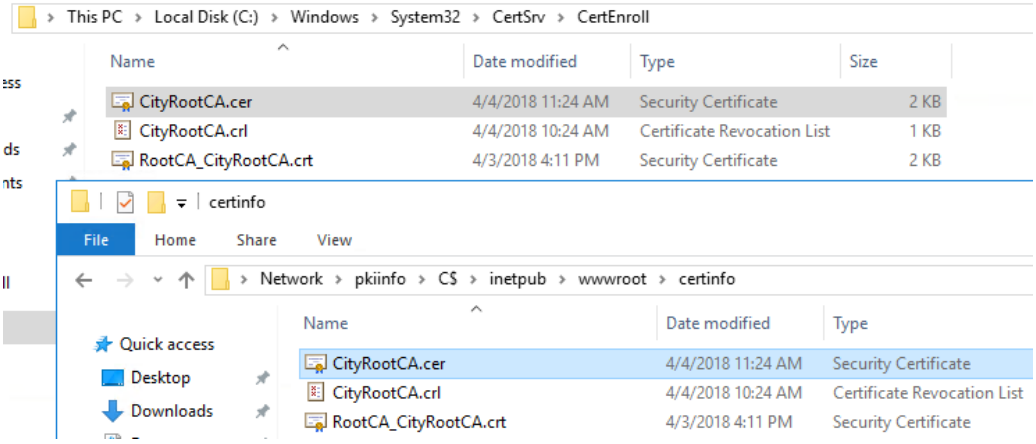
C:\Windows\System32\CertSrv\CertEnroll\CityRootCA.cer



37. Verify the information in the summary screen shows then click Finish



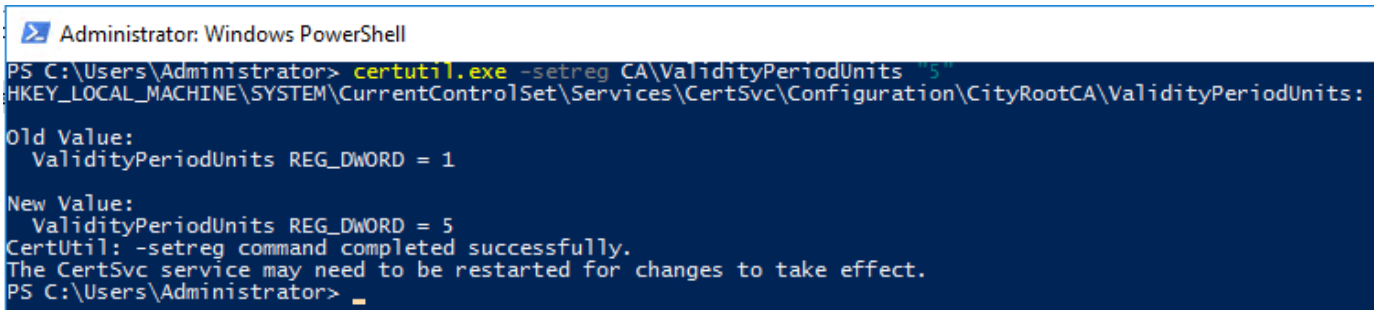
38. Copy the CityRootCA.cer file to the PKI Information Server



NOTE: Lastly, we update the validity period of certificates created by the Root CA to 5 years

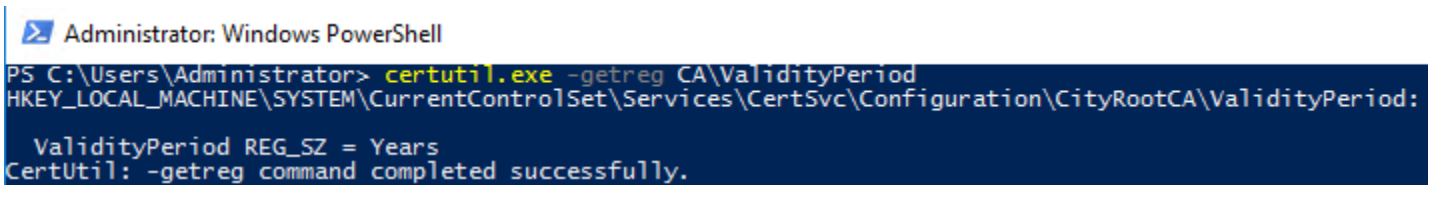
39. In **PowerShell** run the following command

    certutil.exe -setreg CA\ValidityPeriodUnits "5"

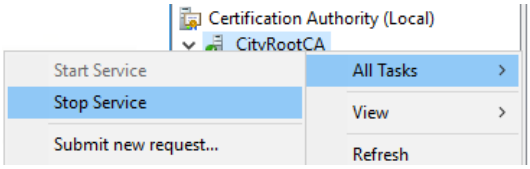


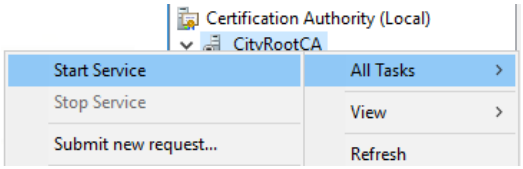
TIP: Whenever modifying validity period units, always verify that the validity period is set correctly, to years in this case

certutil.exe -getreg CA\ValidityPeriod



40. Stop, then Start the Certificate Authority service to pick up these registry changes





TIP: You can also run the following commands to stop and start the CA service:

stop-service certsvc then start-service certsvc

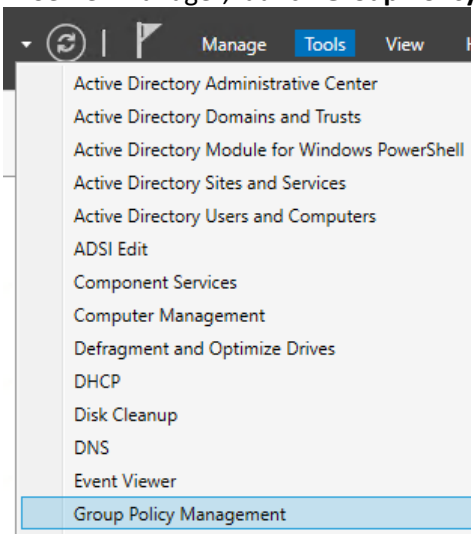
Domain Controller

Deploying the Root Certificate Authority – Trusted Root Certificate Group Policy

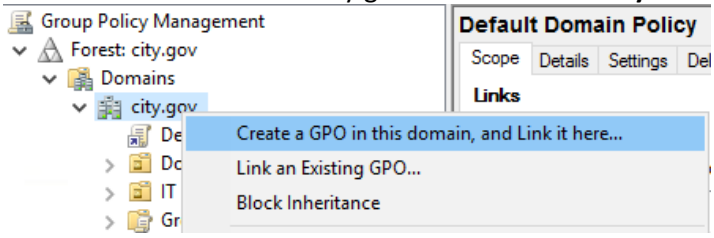
NOTE: Now we need to configure a domain group policy so that all machines in the domain will trust the RootCA

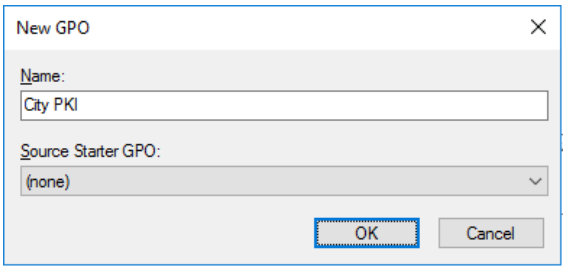
1. Open a Virtual Machine Connection to the Domain Controller (**DC**) and login

2. In Server Manager, launch **Group Policy Manager** from the **Tools** menu

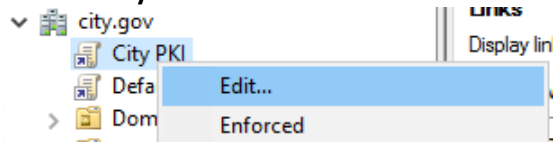


3. Create a new GPO for the city.gov domain named **City PKI**



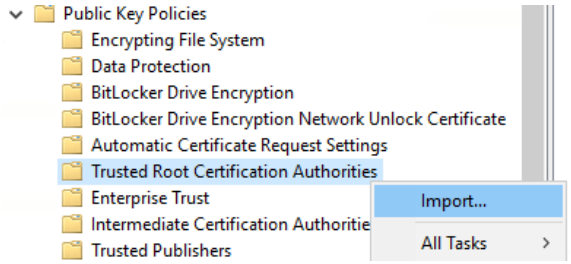


4. Edit the **City PKI** GPO



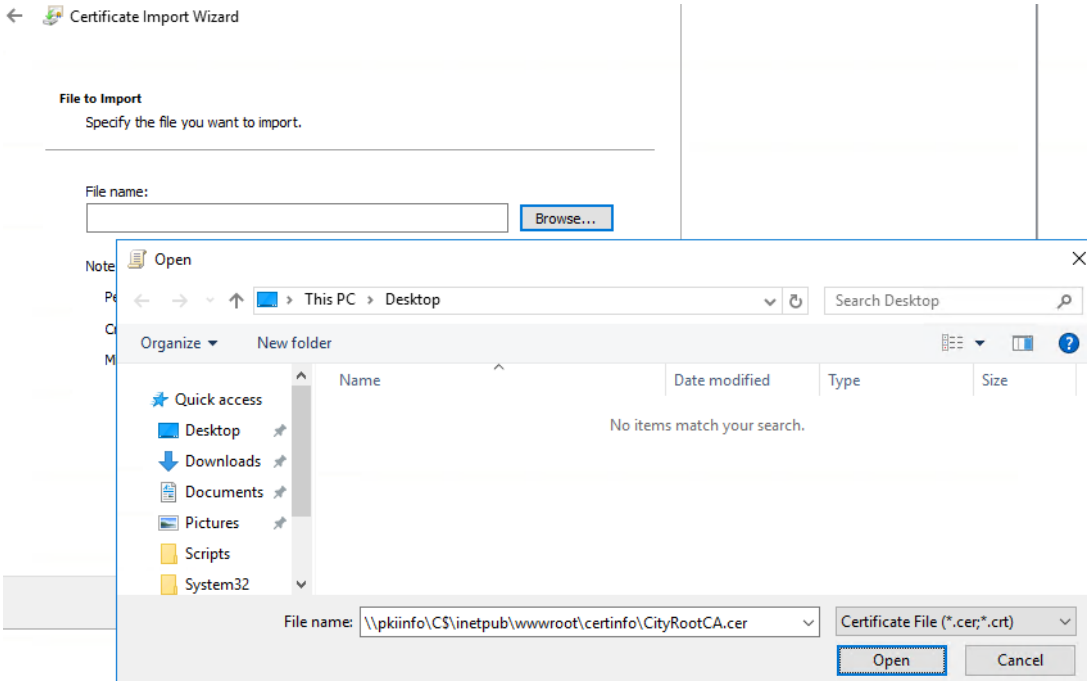
5. In the **Group Policy Management Editor** navigate to the following policy path then right click and select **Import** from the **Trusted Root Certification Authorities** node

   Computer Configuration > Policies > Windows Settings > Security Settings > Public Key Policies > Trusted Root Certification Authorities

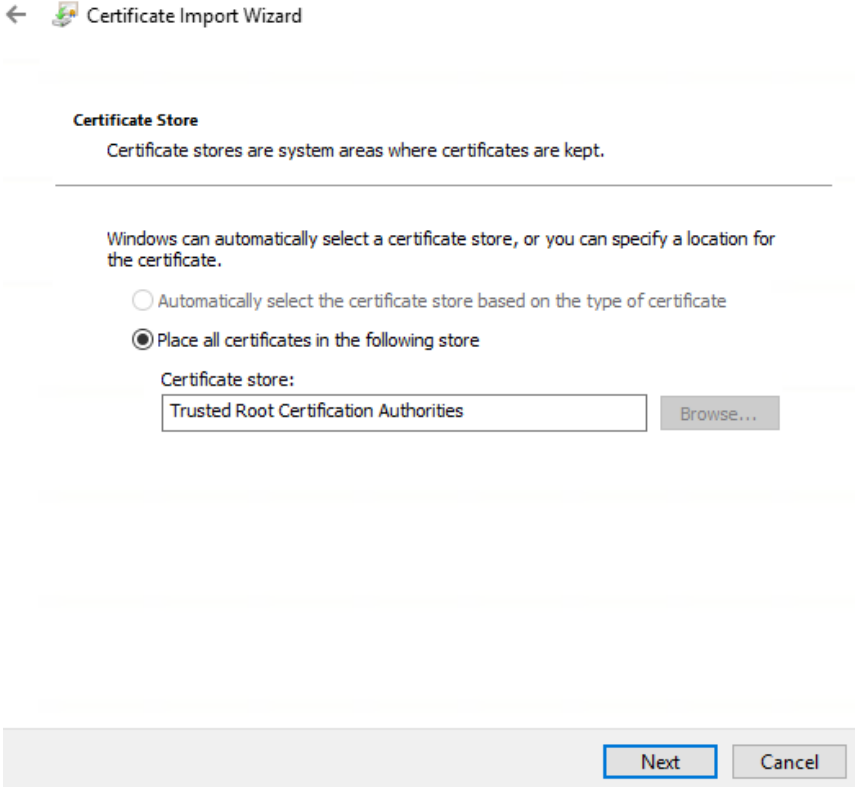


6. In the Certificate Import Wizard dialog click Next and then Browser… and enter the following path to the Root CA certificate, then click Open then click Next

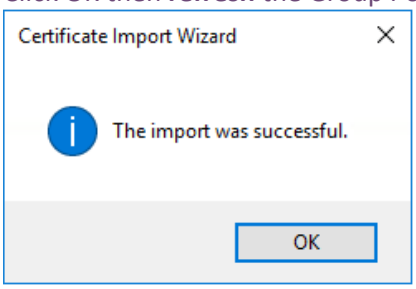
   \\pkiinfo\C$\inetpub\wwwroot\certinfo\CityRootCA.cer



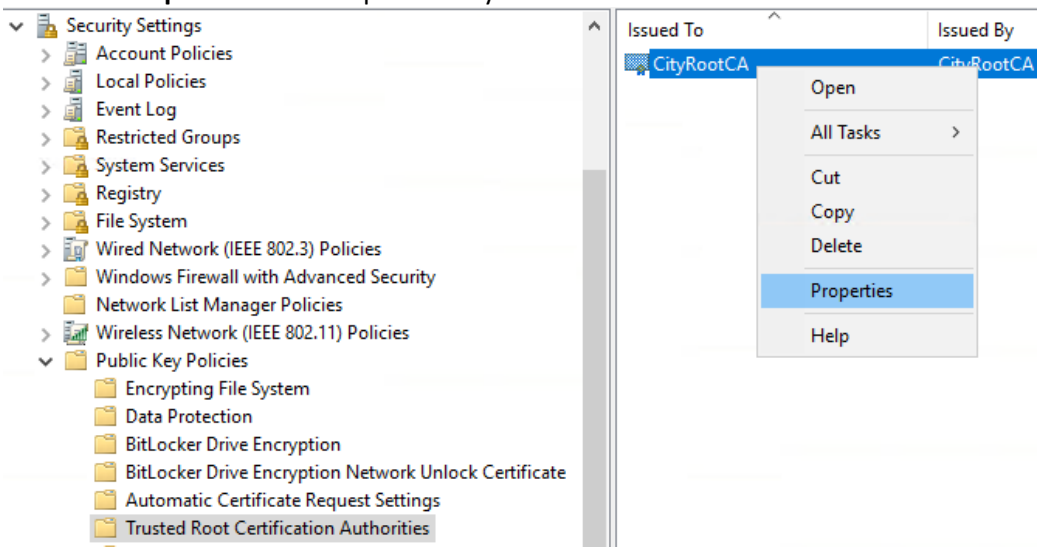
7. On the **Certificate Store** page of the Certificate Import Wizard, ensure the certificate store is set to **Trusted Root Certification Authorities**, then click Next then click Finish



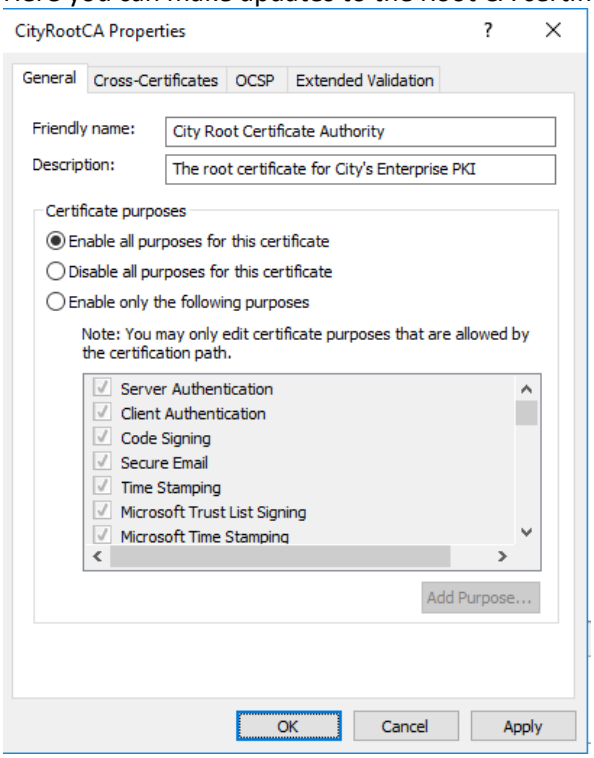
NOTE: It will take a few seconds to import the Root CA certificate. Once imported you will see the following dialog. Click OK then **refresh** the Group Policy Manager Editor



8. Go to the **Properties** of the imported CityRootCA certificate



9. Here you can make updates to the Root CA certificate, we will update Friendly Name and Description

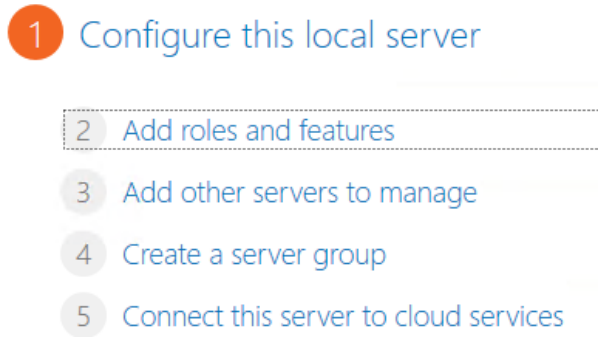


NOTE: We now have a fully configured Root Certificate Authority**!**
You may need to run **gpupdate /force** on domain members to immediately pull these GPO updates.

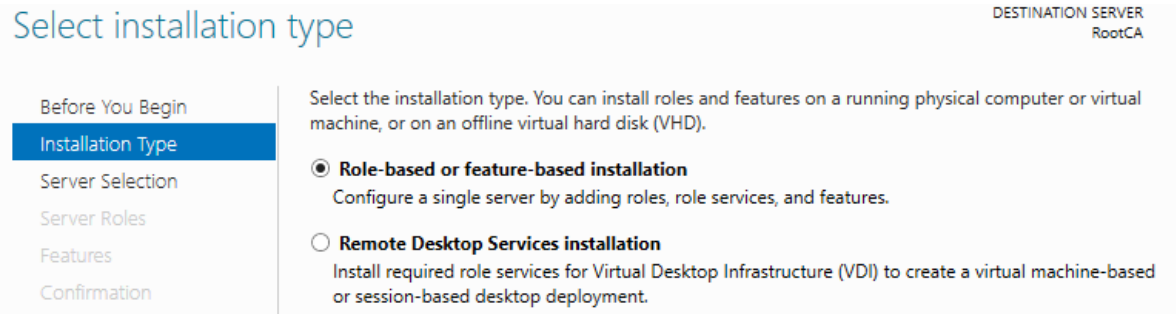
Subordinate CA

Deploying the Enterprise Subordinate Certificate Authority – Installation

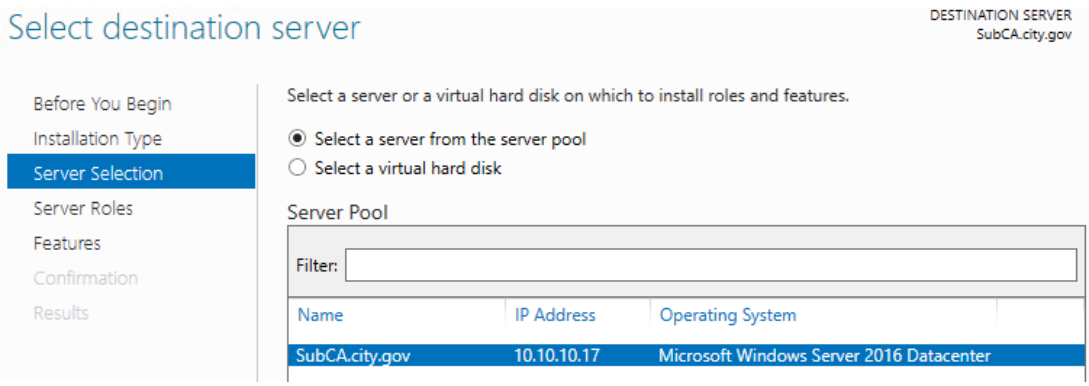
1. In **Hyper-V Manager**, start the Subordinate CA (**SubCA**) virtual machine
2. Open a Virtual Machine Connection to the Subordinate CA (**SubCA**) and login as domain Administrator
3. Start Server Manager and select **Add roles and features**, under the *Configure this local server* section



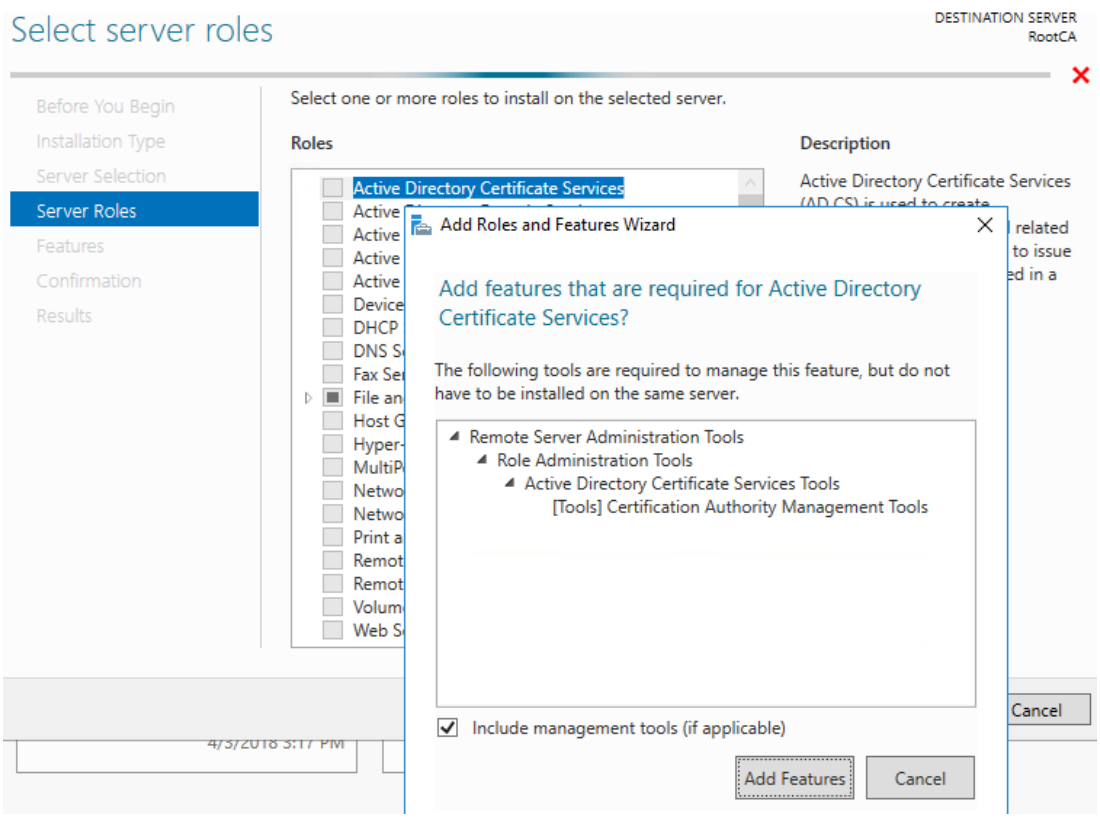
4. On the **Select installation type** screen, select Role-based or feature-based installation and click next



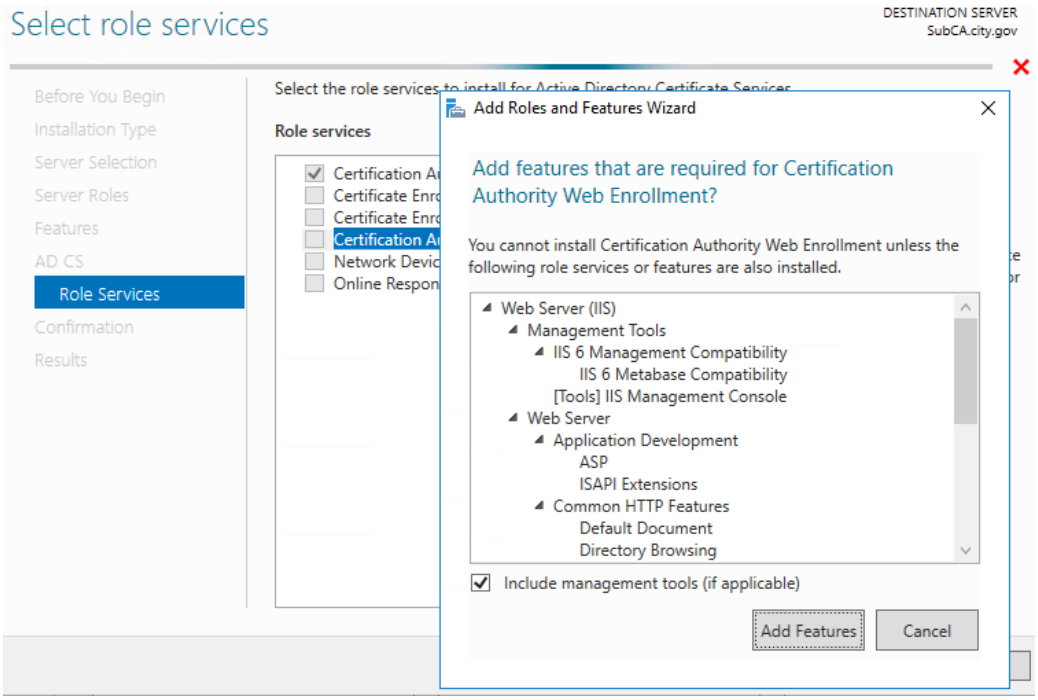
5. On the **Select destination server** screen ensure the **SubCA** server is selected and click next



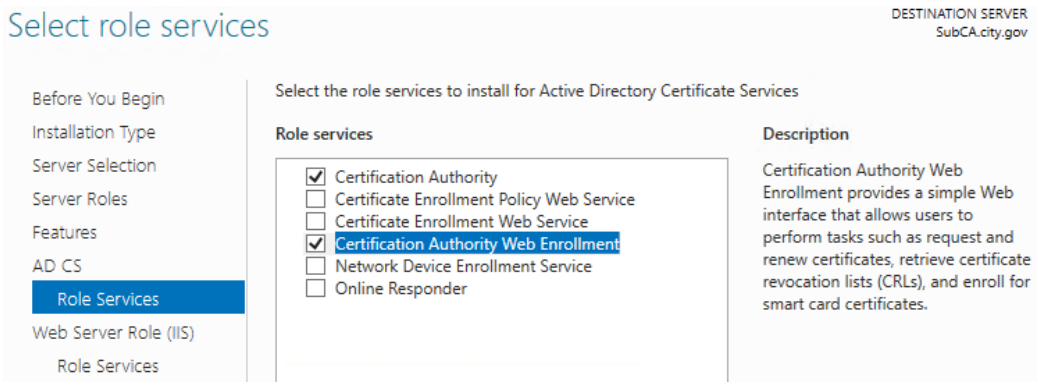
6. On the **Select server roles** screen, select **Activity Directory Certificate Services** then click Add Features in the dialog window. Click Next.



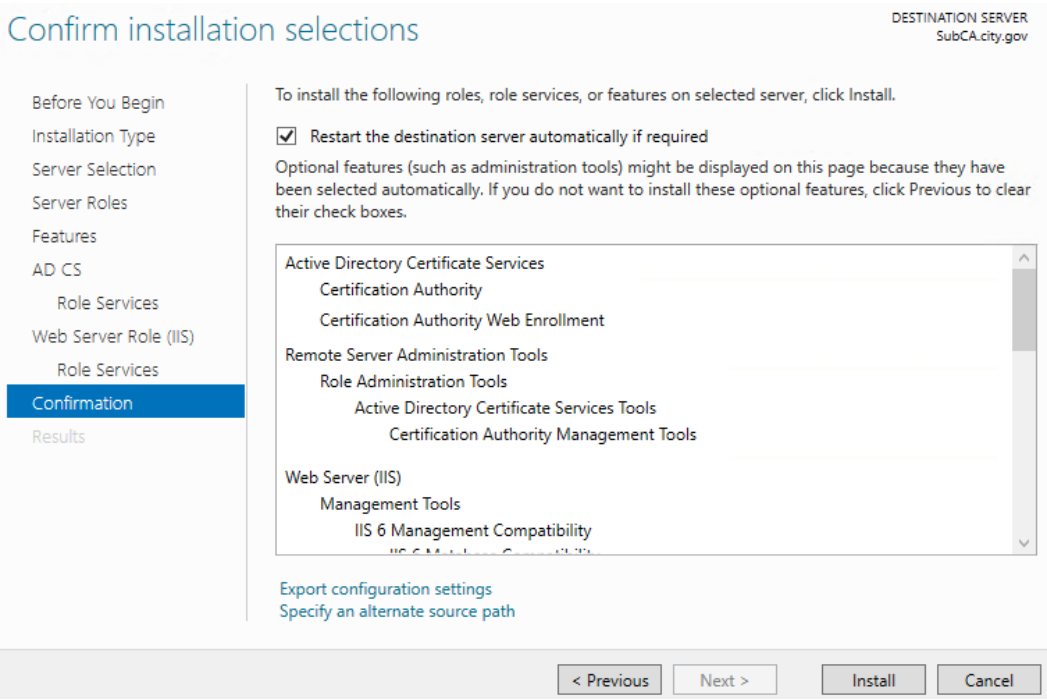
7. Skip to the **Roles Services** screen under **AD CS** and select **Certificate Authority Web Enrollment** then click Add Features to Add the IIS dependency.



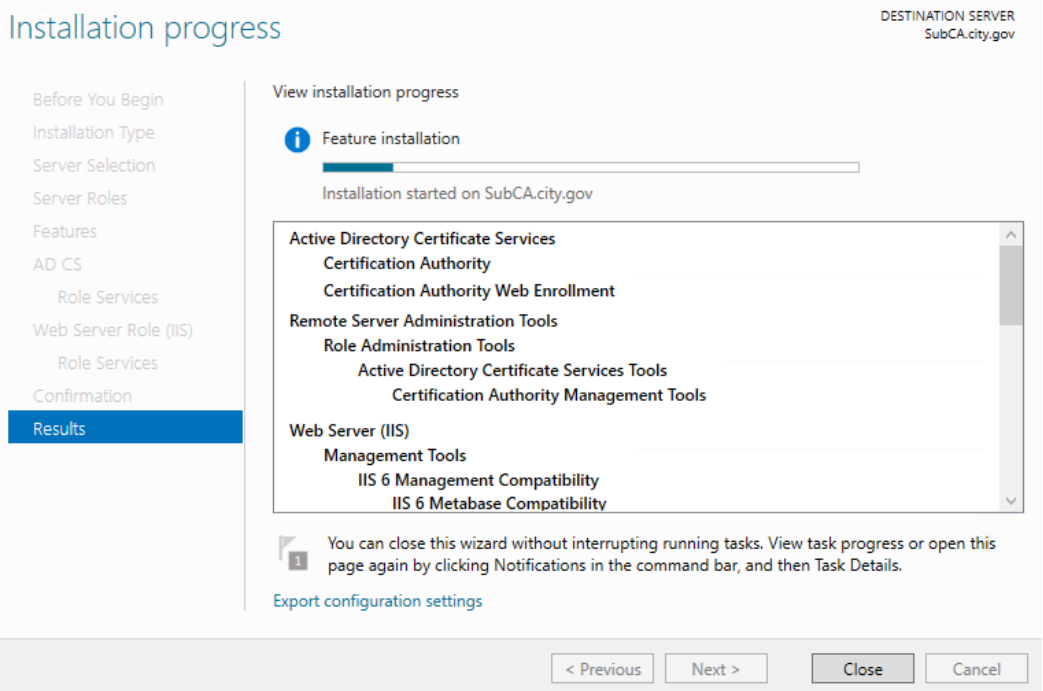
8. Ensure both the Certificate Authority and Certificate Authority Web Enrollment role services are selected, then click Next



9. Skip to the Configuration page and check **Restart the destination server automatically if required**, before clicking Install



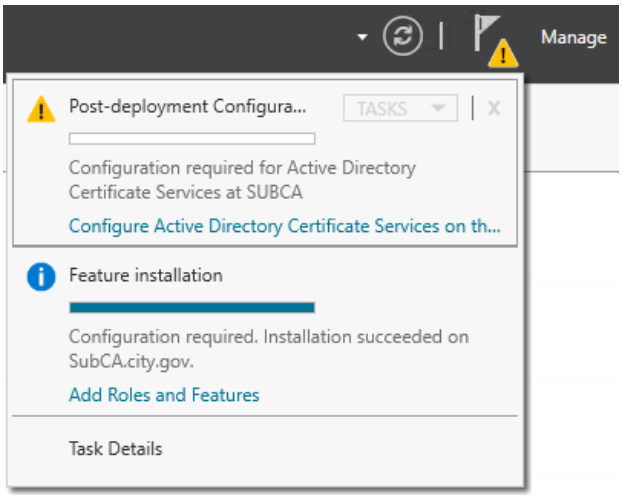
10. Wait for the installation process to complete then click Close



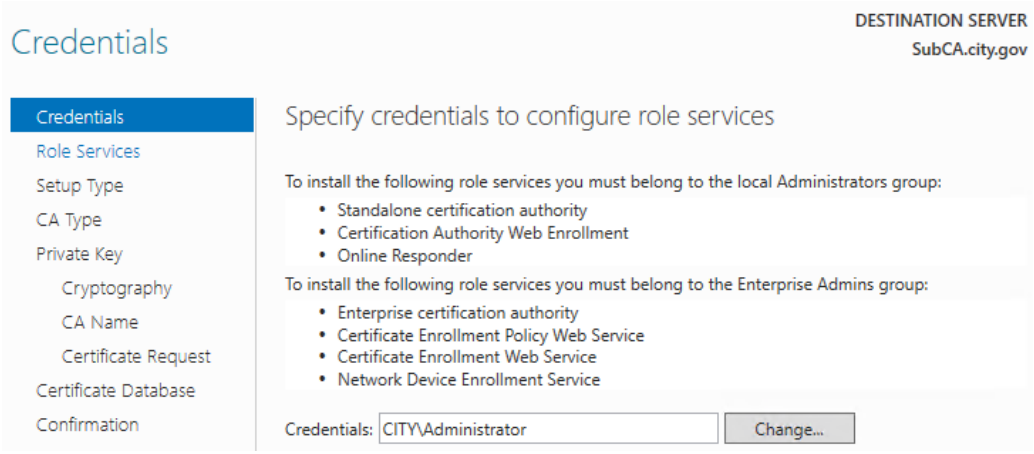
Subordinate CA

Deploying the Enterprise Subordinate Certificate Authority – Configuration

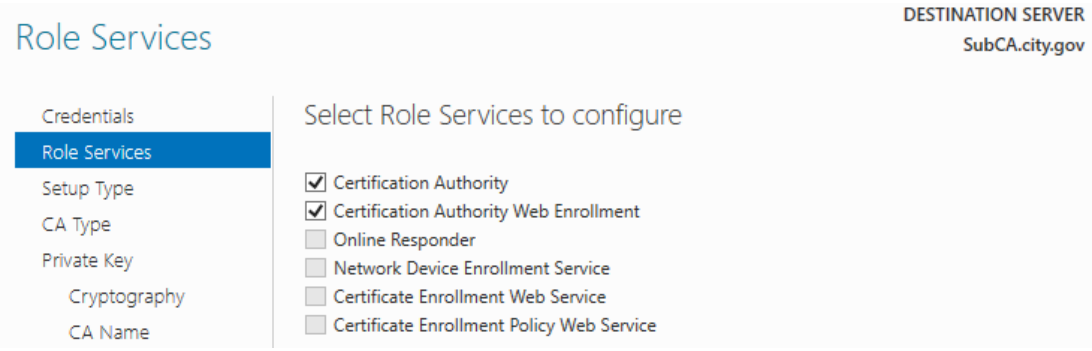
1. In the **Server Manager** notifications menu, find the **Post-deployment Configuration** notification and click the **Configure Active Directory Certificate Services on the destination server** link



2. On the **Credentials** screen of the AD CS Configuration wizard, accept the default domain Administrator credentials and click Next

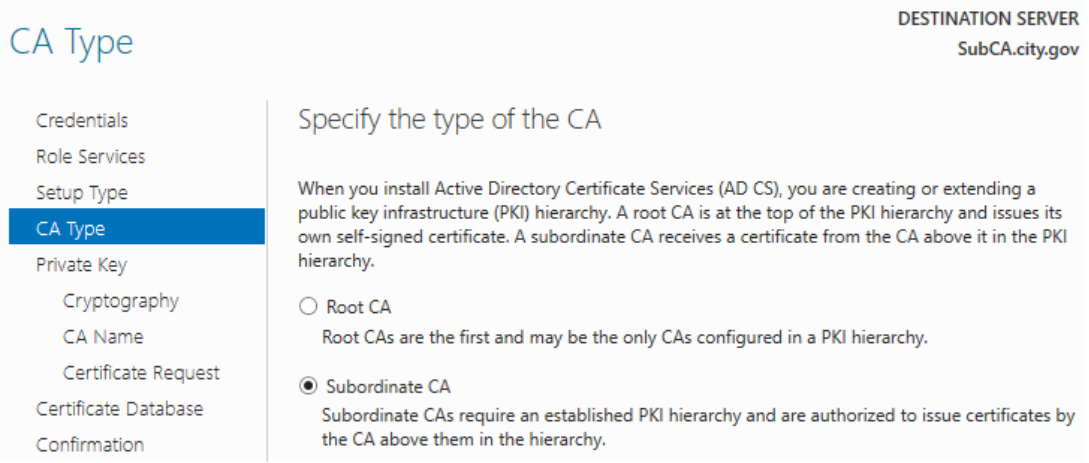


3. On the **Roles Services** screen, select **Certificate Authority** and **Certificate Authority Web Enrollment** for configuration, then click Next

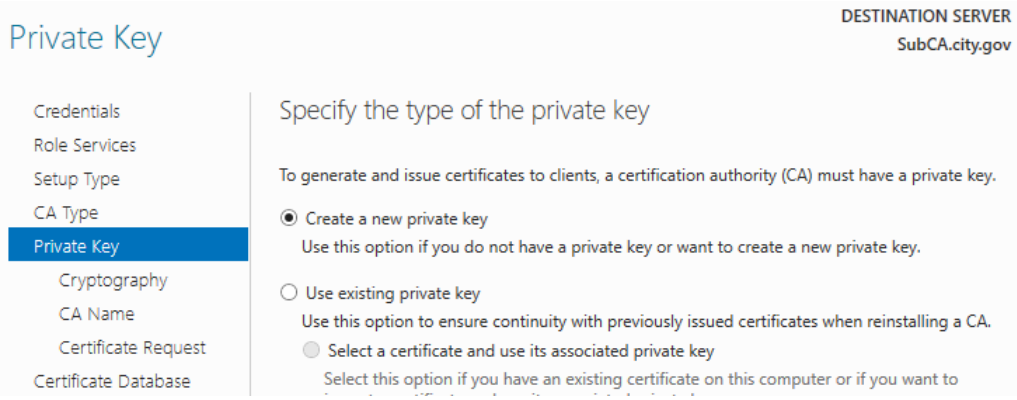


4. On the **Setup Type** screen ensure **Enterprise CA** is selected then click Next.

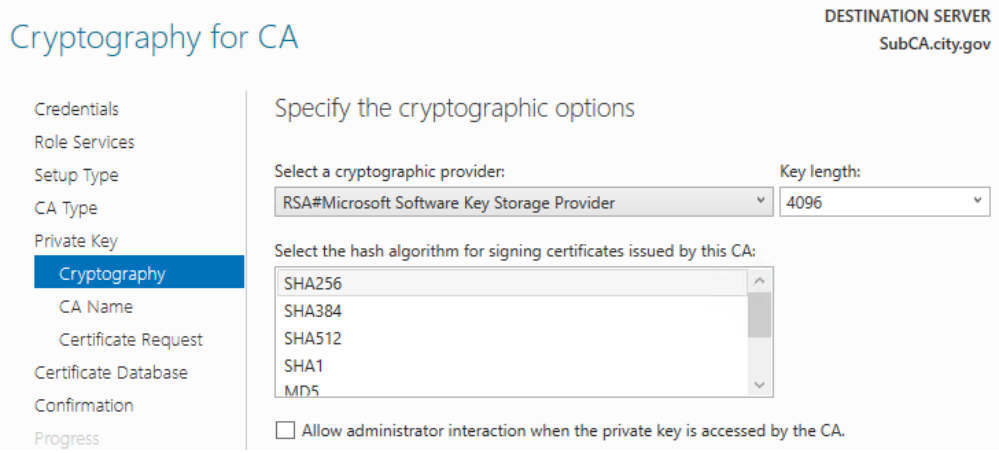
5. On the **CA Type** screen ensure **Subordinate CA** is selected then click Next



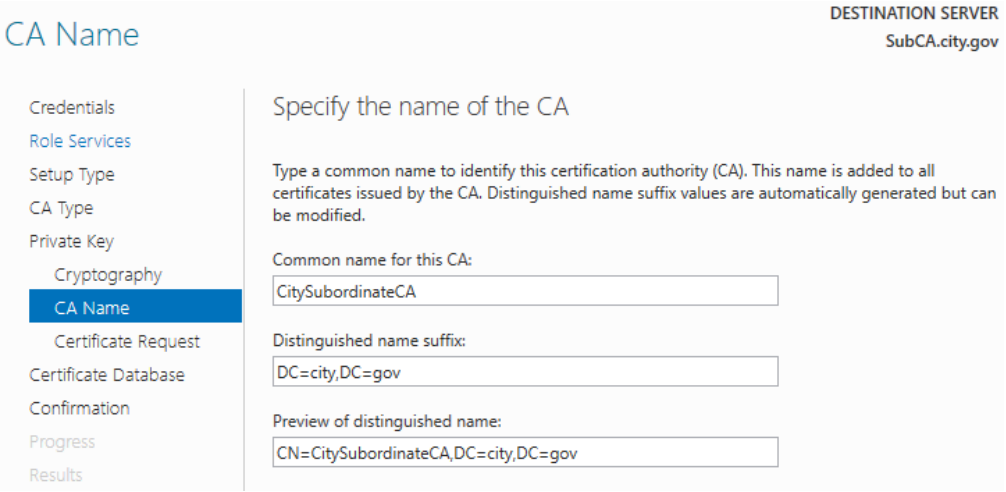
6. On the **Private Key** screen select **Create a new private key** then click Next



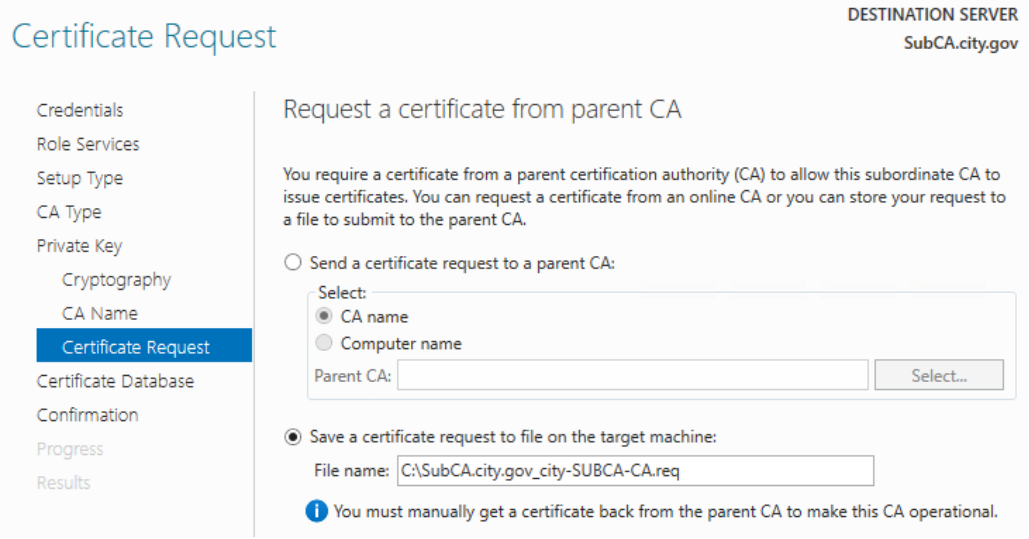
7. On the **Cryptography for CA** screen ensure **RSA#Microsoft Software Key Storage Provider** and **SHA256** are selected, however, change the Key Length to **4096** and **uncheck** the **Allow administrator interaction when the private key is accessed by the CA** option then click Next



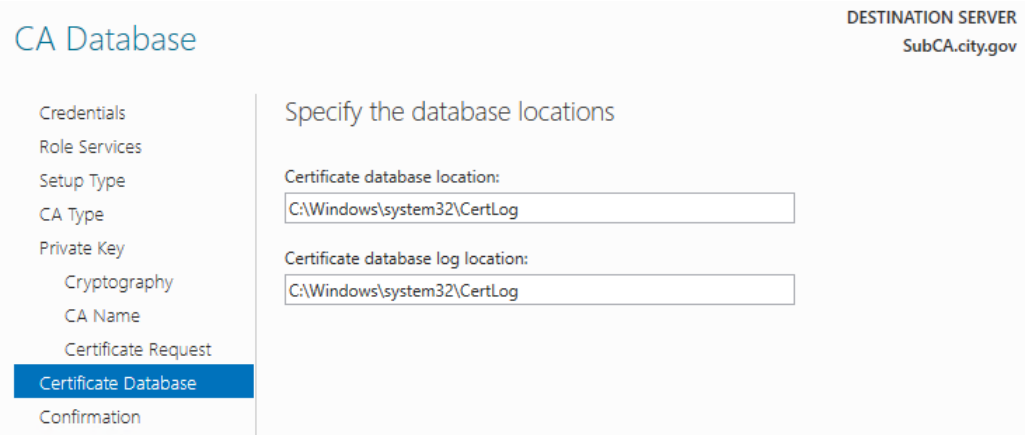
8. On the **CA Name** screen, enter a common name for you Root CA; we will use **CitySubordinateCA** for this lab



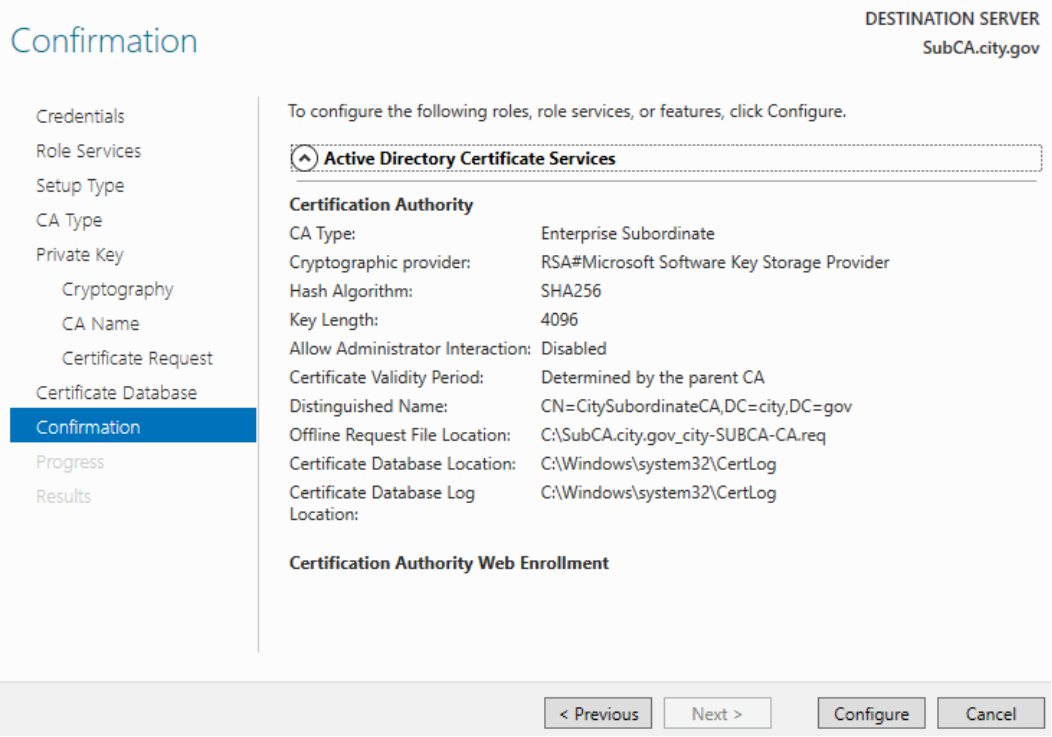
9. On the **Certificate Request** screen, save the request as a file



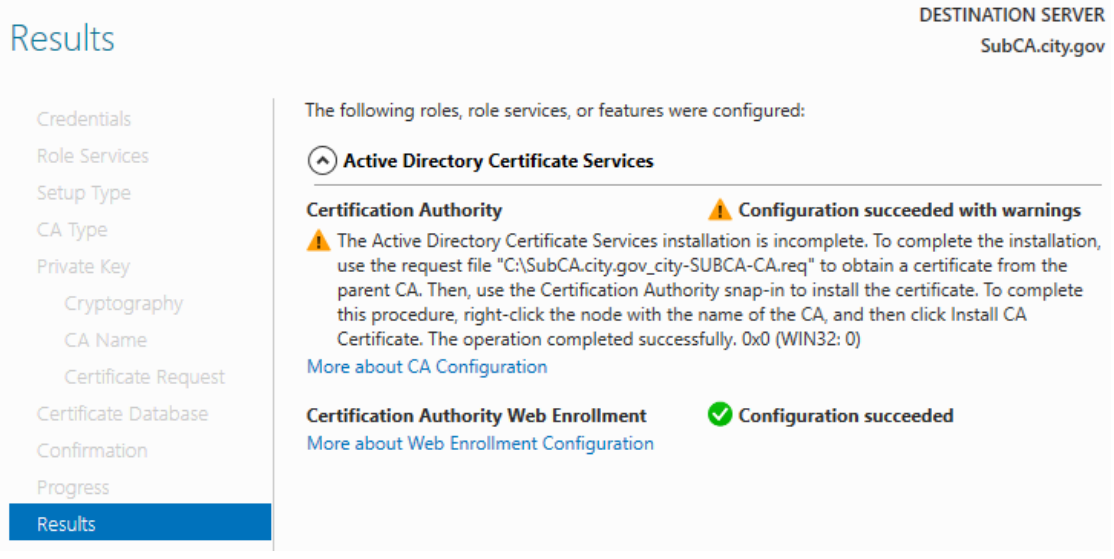
10. On the **CA Database** screen accept the default locations and click Next



11. On the **Confirmation** screen, verify all choices then click Configure



12. Review to configuration results. The **Certificate Authority Web Enrollment** role service should be completely configured, however, we still need to complete the configuration of **Certificate Authority** role service



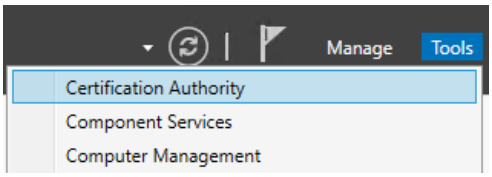
NOTE: We now need to have the Root CA issue a certificate for the Subordinate CA. We will do this next by submitting the certificate request file that was just created to the Root CA for issuance.

Offline Root CA

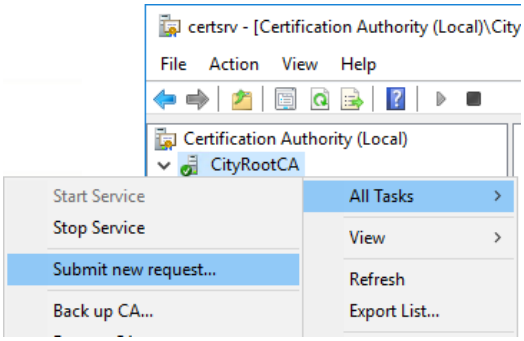
Deploying the Enterprise Subordinate Certificate Authority – Certificate Issuance

1. Open a Virtual Machine Connection to the Root CA (**RootCA**) and login

2. In Server Manager, launch the **Certificate Authority** management console from the **Tools** menu

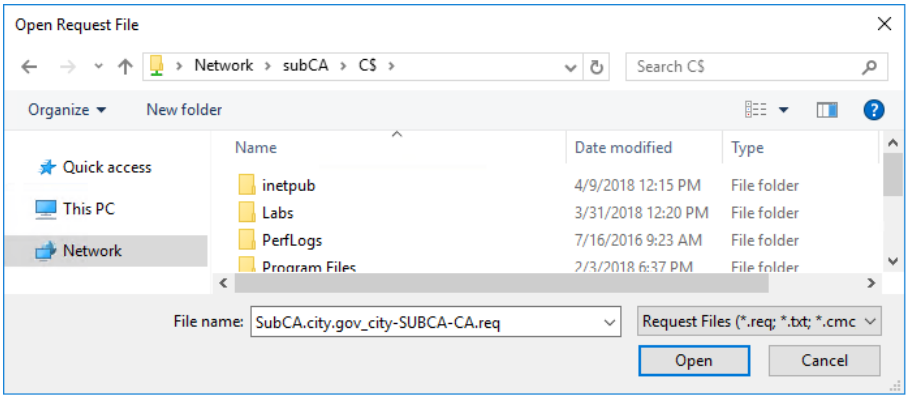


3. Right click the **CityRootCA** node and under the **All Tasks** menu select **Submit new request…**



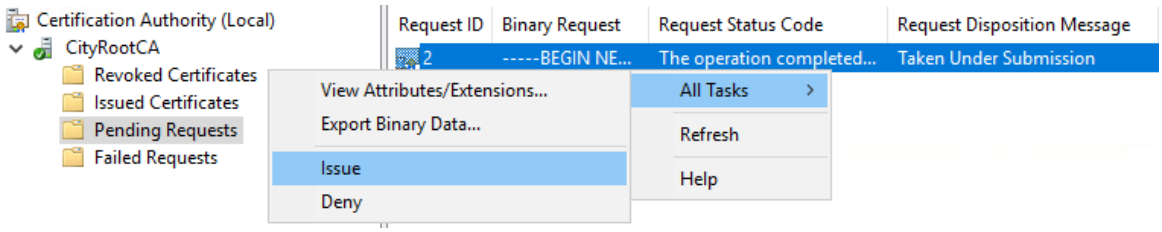
4. In the **Open Request File** dialog box, browse the certificate request created on the Subordinate CA

   \\subCA\C$\SubCA.city.gov_city-SUBCA-CA.req

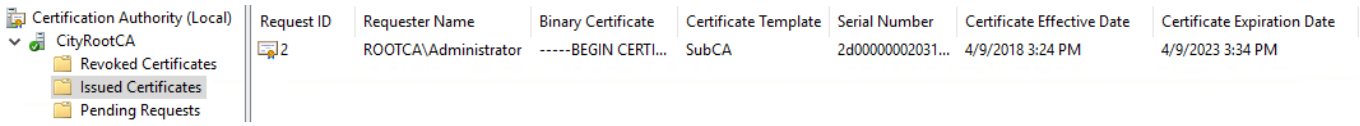


NOTE: It can a take up to 15 seconds for the request to be imported even though the console remains usable. Refresh the console until you see the certificate request in the Pending Requests node.

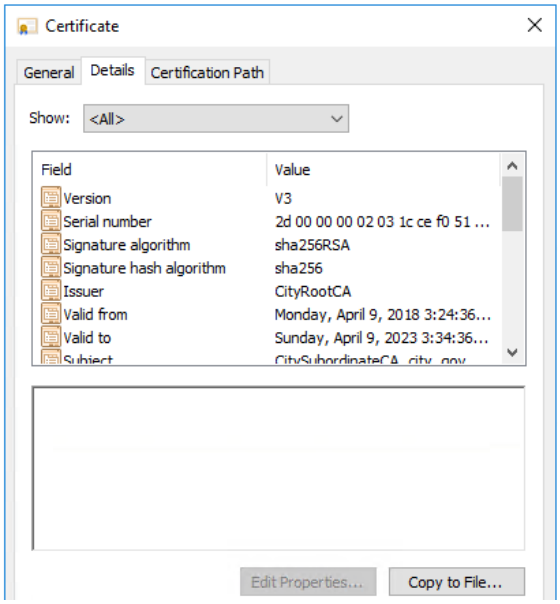
5. In the **Pending Requests** node, right click on the imported certificate request and select **All Tasks > Issue**



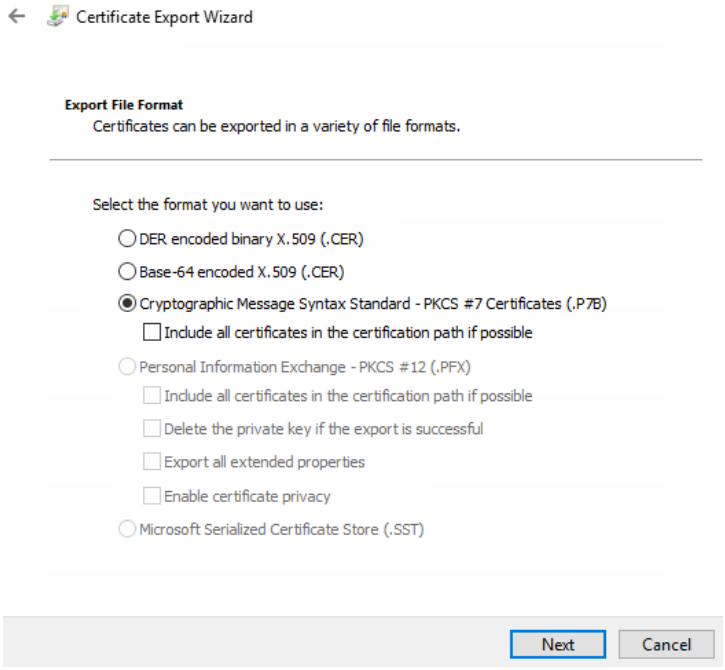
6. In the **Issued Certificates** node, verify that the Subordinate CA certificate has been issued



7. Double-click to open the issued certificate and go to the Details tab of the Certificate dialog



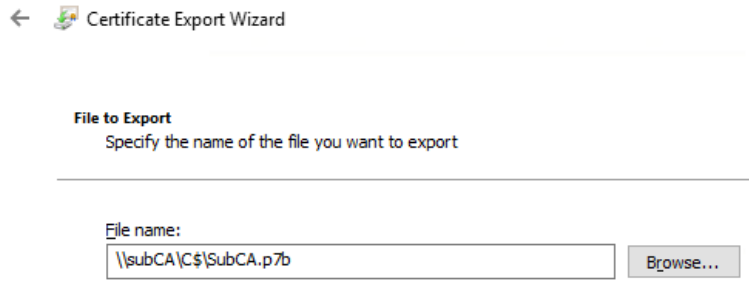
8. Click **Copy to File…** then click Next in the **Certificate Export Wizard** dialog. Ensure the **Cryptographic Message Syntax Standard** option is selected then click Next



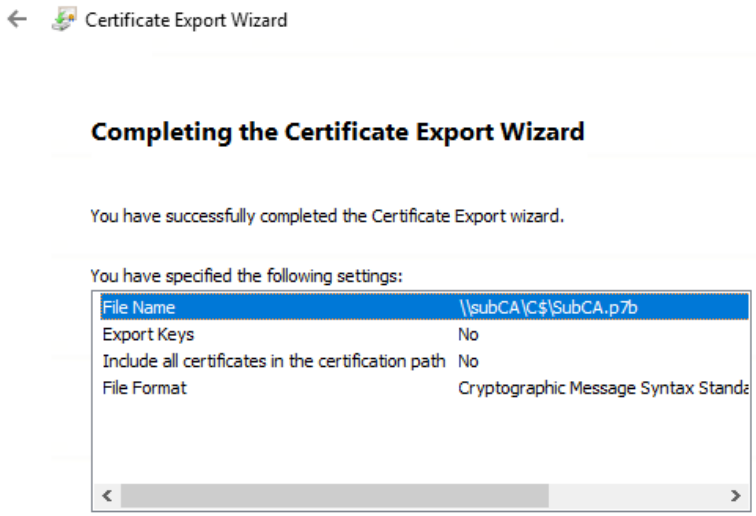
TIP Enabling the Include all certificates in the certification path if possible options will include the root certificate in the export file as well.

9. Enter the following file path for the Root CA certificate export, then click Next

\\subCA\C$\SubCA.p7b



10. Verify the information in the summary screen shows then click Finish

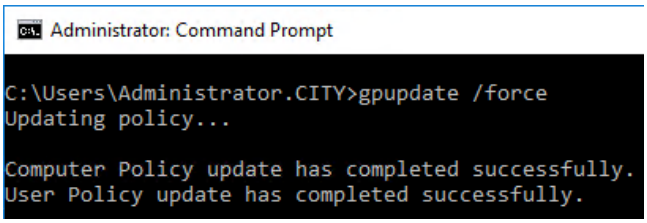


Subordinate CA

Deploying the Enterprise Subordinate Certificate Authority – Certificate Installation

1. Open a Virtual Machine Connection to the Subordinate CA (**SubCA**) and login as the domain Administrator
2. In a command prompt, force a group policy update to ensure the **City PKI** GPO has been applied

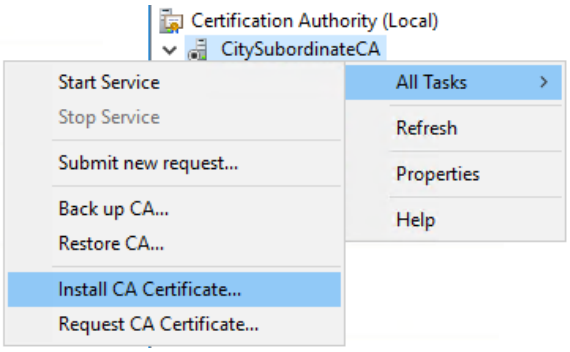
   gpudate /force



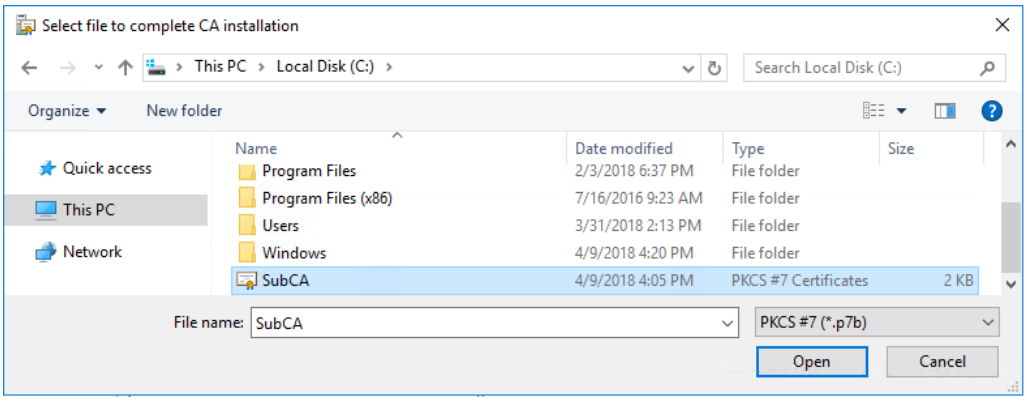
3. In Server Manager, launch the Certificate Authority management console from the Tools menu

NOTE: The Certificate Authority service for the Subordinate CA is currently stopped

4. Right click the **CitySubordinateCA** node and select **All Tasks > Install CA Certificate…**

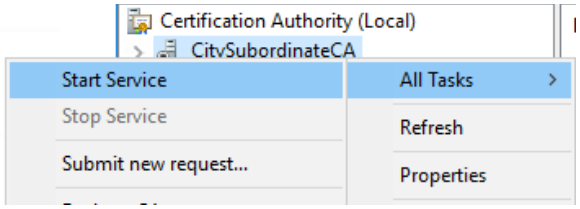


5. In the **Select file to complete CA installation** dialog, browse the certificate file (.p7b) that was issued and exported from the Root CA

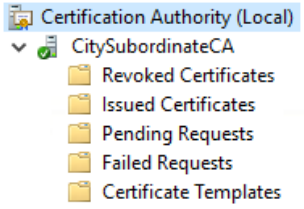


NOTE: The certificate will take a few seconds to install, during which time the mmc console will be unresponsive

6. Right-click the **CitySubordinateCA** node and select **All Tasks > Start Service**

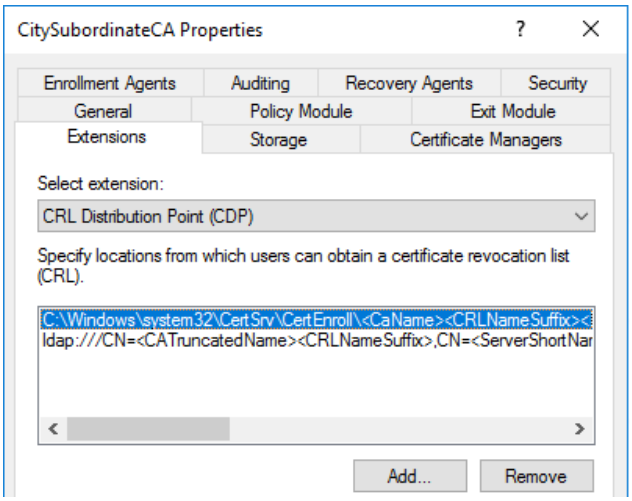


NOTE: The CA service will take a few seconds to start up.

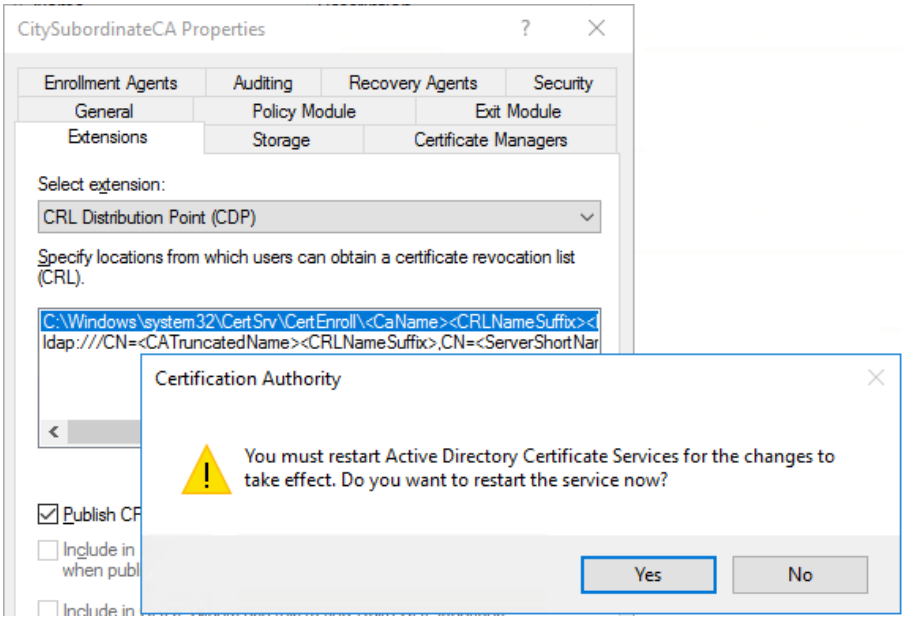


NOTE: Lastly, we need to update the CDP and AIA extensions to point to the PKI Information Server

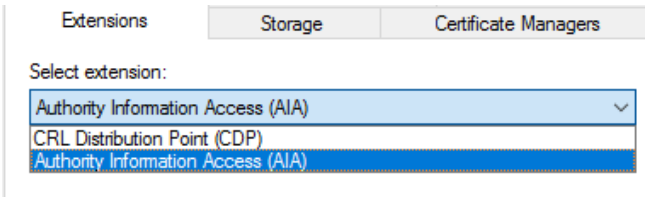
7. In the **CitySubordinateCA Properties** dialog, select the **Extensions** tab and remove the **http** and **file** entries for the CRL Distribution Point then click Apply



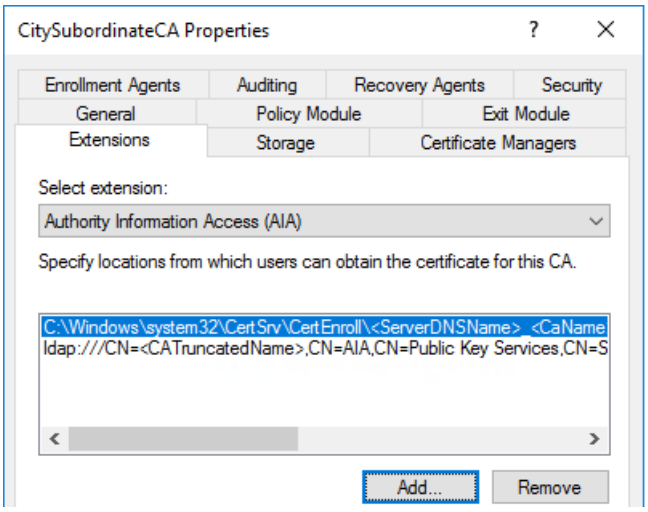
8. Click Yes in the Certificate Authority dialog box to restart the CA service



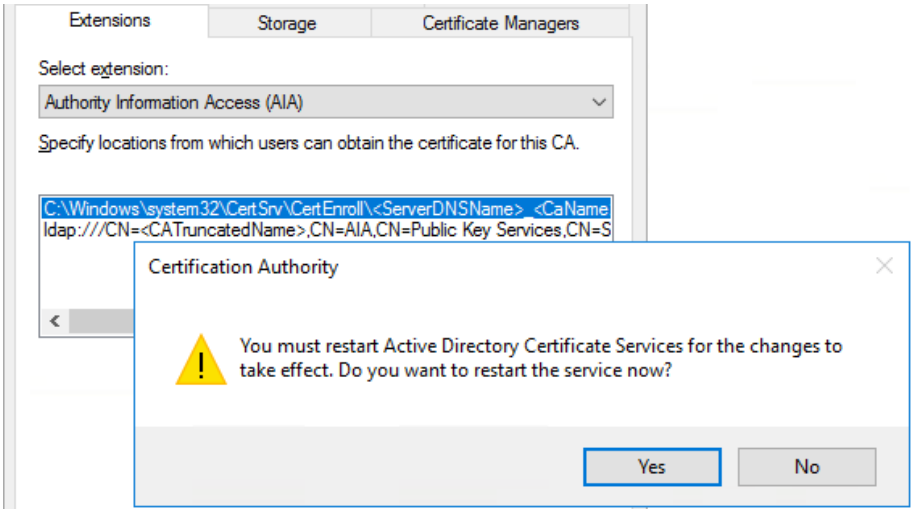
9. In the **Select extension** dropdown, choose Authority Information Access (AIA)



10. Just as we did for the CDP, remove the **http** and **file** entries for the AIA then click Apply

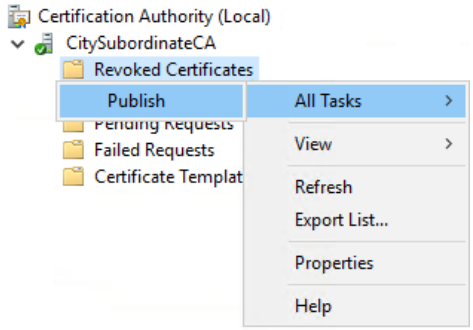


11. Click Yes to restart the CA service



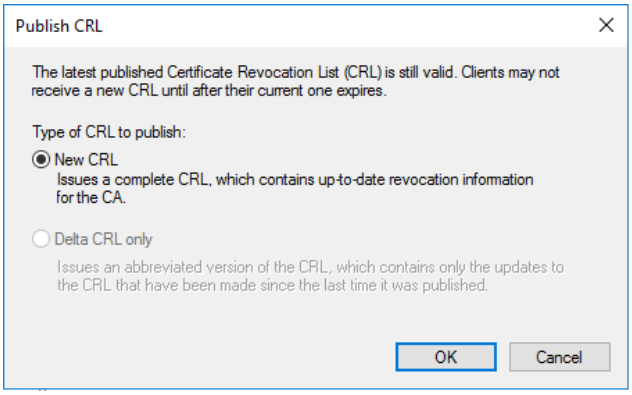
NOTE: We now need to publish the certificate revocation list (CRL) along with the AIA certificate that signs the CRL

12. In the **Certificate Authority** management console, right click **Revoked Certificates** folder under CitySubordinateCA, go to All Tasks and click **Publish**



NOTE: It can take a few seconds for the Publish CRL dialog box to show

13. Ensure the **New CRL** option is selected and click OK



NOTE: **Congratulations!** You have successfully deployed a Two-Tier Enterprise PKI.
You may now shut down the Root CA and keep it offline.