



# Configuring PKI

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This chapter contains the following sections:

- [Information About PKI, on page 1](#)
- [Licensing Requirements for PKI, on page 5](#)
- [Guidelines and Limitations for PKI, on page 5](#)
- [Default Settings for PKI, on page 6](#)
- [Configuring CAs and Digital Certificates, on page 6](#)
- [Verifying the PKI Configuration, on page 20](#)
- [Configuration Examples for PKI, on page 20](#)

## Information About PKI

This section provides information about PKI.

## CAs and Digital Certificates

Certificate authorities (CAs) manage certificate requests and issue certificates to participating entities such as hosts, network devices, or users. The CAs provide centralized key management for the participating entities.

Digital signatures, based on public key cryptography, digitally authenticate devices and individual users. In public key cryptography, such as the RSA encryption system, each device or user has a key pair that contains both a private key and a public key. The private key is kept secret and is known only to the owning device or user only. However, the public key is known to everybody. Anything encrypted with one of the keys can be decrypted with the other. A signature is formed when data is encrypted with a sender's private key. The receiver verifies the signature by decrypting the message with the sender's public key. This process relies on the receiver having a copy of the sender's public key and knowing with a high degree of certainty that it really does belong to the sender and not to someone pretending to be the sender.

Digital certificates link the digital signature to the sender. A digital certificate contains information to identify a user or device, such as the name, serial number, company, department, or IP address. It also contains a copy of the entity's public key. The CA that signs the certificate is a third party that the receiver explicitly trusts to validate identities and to create digital certificates.

To validate the signature of the CA, the receiver must first know the CA's public key. Typically, this process is handled out of band or through an operation done at installation. For instance, most web browsers are configured with the public keys of several CAs by default.

## Trust Model, Trust Points, and Identity CAs

The PKI trust model is hierarchical with multiple configurable trusted CAs. You can configure each participating device with a list of trusted CAs so that a peer certificate obtained during the security protocol exchanges can be authenticated if it was issued by one of the locally trusted CAs. The Cisco NX-OS software locally stores the self-signed root certificate of the trusted CA (or certificate chain for a subordinate CA). The process of securely obtaining a trusted CA's root certificate (or the entire chain in the case of a subordinate CA) and storing it locally is called *CA authentication*.

The information about a trusted CA that you have configured is called the *trust point* and the CA itself is called a *trust point CA*. This information consists of a CA certificate (or certificate chain in case of a subordinate CA) and certificate revocation checking information.

The Cisco NX-OS device can also enroll with a trust point to obtain an identity certificate to associate with a key pair. This trust point is called an *identity CA*.

## RSA Key Pairs and Identity Certificates

You can obtain an identity certificate by generating one or more RSA key pairs and associating each RSA key pair with a trust point CA where the Cisco NX-OS device intends to enroll. The Cisco NX-OS device needs only one identity per CA, which consists of one key pair and one identity certificate per CA.

The Cisco NX-OS software allows you to generate RSA key pairs with a configurable key size (or modulus). The default key size is 512. You can also configure an RSA key-pair label. The default key label is the device fully qualified domain name (FQDN).

The following list summarizes the relationship between trust points, RSA key pairs, and identity certificates:

- A trust point corresponds to a specific CA that the Cisco NX-OS device trusts for peer certificate verification for any application (such as SSH).
- A Cisco NX-OS device can have many trust points and all applications on the device can trust a peer certificate issued by any of the trust point CAs.
- A trust point is not restricted to a specific application.
- A Cisco NX-OS device enrolls with the CA that corresponds to the trust point to obtain an identity certificate. You can enroll your device with multiple trust points which means that you can obtain a separate identity certificate from each trust point. The identity certificates are used by applications depending upon the purposes specified in the certificate by the issuing CA. The purpose of a certificate is stored in the certificate as a certificate extension.
- When enrolling with a trust point, you must specify an RSA key pair to be certified. This key pair must be generated and associated to the trust point before generating the enrollment request. The association between the trust point, key pair, and identity certificate is valid until it is explicitly removed by deleting the certificate, key pair, or trust point.
- The subject name in the identity certificate is the fully qualified domain name for the Cisco NX-OS device.
- You can generate one or more RSA key pairs on a device and each can be associated to one or more trust points. But no more than one key pair can be associated to a trust point, which means only one identity certificate is allowed from a CA.
- If the Cisco NX-OS device obtains multiple identity certificates (each from a distinct CA), the certificate that an application selects to use in a security protocol exchange with a peer is application specific.

- You do not need to designate one or more trust points for an application. Any application can use any certificate issued by any trust point as long as the certificate purpose satisfies the application requirements.
- You do not need more than one identity certificate from a trust point or more than one key pair to be associated to a trust point. A CA certifies a given identity (or name) only once and does not issue multiple certificates with the same name. If you need more than one identity certificate for a CA and if the CA allows multiple certificates with the same names, you must define another trust point for the same CA, associate another key pair to it, and have it certified.

## Multiple Trusted CA Support

The Cisco NX-OS device can trust multiple CAs by configuring multiple trust points and associating each with a distinct CA. With multiple trusted CAs, you do not have to enroll a device with the specific CA that issued the certificate to a peer. Instead, you can configure the device with multiple trusted CAs that the peer trusts. The Cisco NX-OS device can then use a configured trusted CA to verify certificates received from a peer that were not issued by the same CA defined in the identity of the peer device.

## PKI Enrollment Support

Enrollment is the process of obtaining an identity certificate for the device that is used for applications like SSH. It occurs between the device that requests the certificate and the certificate authority.

The Cisco NX-OS device performs the following steps when performing the PKI enrollment process:

- Generates an RSA private and public key pair on the device.
- Generates a certificate request in standard format and forwards it to the CA.



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**Note** The CA administrator may be required to manually approve the enrollment request at the CA server, when the request is received by the CA.

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- Receives the issued certificate back from the CA, signed with the CA's private key.
- Writes the certificate into a nonvolatile storage area on the device (bootflash).

## Manual Enrollment Using Cut-and-Paste

The Cisco NX-OS software supports certificate retrieval and enrollment using manual cut-and-paste. Cut-and-paste enrollment means that you must cut and paste the certificate requests and resulting certificates between the device and the CA.

You must perform the following steps when using cut and paste in the manual enrollment process:

- Create an enrollment certificate request, which the Cisco NX-OS device displays in base64-encoded text form.
- Cut and paste the encoded certificate request text in an e-mail or in a web form and send it to the CA.
- Receive the issued certificate (in base64-encoded text form) from the CA in an e-mail or in a web browser download.

- Cut and paste the issued certificate to the device using the certificate import facility.

## Multiple RSA Key Pair and Identity CA Support

Multiple identity CAs enable the device to enroll with more than one trust point, which results in multiple identity certificates, each from a distinct CA. With this feature, the Cisco NX-OS device can participate in SSH and other applications with many peers using certificates issued by CAs that are acceptable to those peers.

The multiple RSA key-pair feature allows the device to maintain a distinct key pair for each CA with which it is enrolled. It can match policy requirements for each CA without conflicting with the requirements specified by the other CAs, such as the key length. The device can generate multiple RSA key pairs and associate each key pair with a distinct trust point. Thereafter, when enrolling with a trust point, the associated key pair is used to construct the certificate request.

## Peer Certificate Verification

The PKI support on a Cisco NX-OS device can verify peer certificates. The Cisco NX-OS software verifies certificates received from peers during security exchanges for applications, such as SSH. The applications verify the validity of the peer certificates. The Cisco NX-OS software performs the following steps when verifying peer certificates:

- Verifies that the peer certificate is issued by one of the locally trusted CAs.
- Verifies that the peer certificate is valid (not expired) with respect to current time.
- Verifies that the peer certificate is not yet revoked by the issuing CA.

For revocation checking, the Cisco NX-OS software supports the certificate revocation list (CRL). A trust point CA can use this method to verify that the peer certificate has not been revoked.

## Certificate Revocation Checking

The Cisco NX-OS software can check the revocation status of CA certificates. The applications can use the revocation checking mechanisms in the order that you specify. The choices are CRL, none, or a combination of these methods.

## CRL Support

The CAs maintain certificate revocation lists (CRLs) to provide information about certificates revoked prior to their expiration dates. The CAs publish the CRLs in a repository and provide the download public URL in all issued certificates. A client verifying a peer's certificate can obtain the latest CRL from the issuing CA and use it to determine if the certificate has been revoked. A client can cache the CRLs of some or all of its trusted CAs locally and use them later if necessary until the CRLs expire.

The Cisco NX-OS software allows the manual configuration of predownloaded CRLs for the trust points, and then caches them in the device bootflash (cert-store). During the verification of a peer certificate, the Cisco NX-OS software checks the CRL from the issuing CA only if the CRL has already been cached locally and the revocation checking is configured to use the CRL. Otherwise, the Cisco NX-OS software does not perform CRL checking and considers the certificate to be not revoked unless you have configured other revocation checking methods.

## Import and Export Support for Certificates and Associated Key Pairs

As part of the CA authentication and enrollment process, the subordinate CA certificate (or certificate chain) and identity certificates can be imported in standard PEM (base64) format.

The complete identity information in a trust point can be exported to a file in the password-protected PKCS#12 standard format. It can be later imported to the same device (for example, after a system crash) or to a replacement device. The information in a PKCS#12 file consists of the RSA key pair, the identity certificate, and the CA certificate (or chain).

## Licensing Requirements for PKI

The following table shows the licensing requirements for this feature:

Product	License Requirement
Cisco NX-OS	The PKI feature requires no license. Any feature not included in a license package is bundled with the Cisco NX-OS system images and is provided at no extra charge to you. For an explanation of the Cisco NX-OS licensing scheme, see the <i>Cisco NX-OS Licensing Guide</i> .

## Guidelines and Limitations for PKI

PKI has the following configuration guidelines and limitations:

- The maximum number of key pairs you can configure on a Cisco NX-OS device is 16.
- The maximum number of trust points you can declare on a Cisco NX-OS device is 16.
- The maximum number of identify certificates that you can configure on a Cisco NX-OS device is 16.
- The maximum number of certificates in a CA certificate chain is 10.
- The maximum number of trust points you can authenticate to a specific CA is 10.
- Configuration rollbacks do not support the PKI configuration.

**Note**

If you are familiar with the Cisco IOS CLI, be aware that the Cisco NX-OS commands for this feature might differ from the Cisco IOS commands that you would use.

## Default Settings for PKI

This table lists the default settings for PKI parameters.

*Table 1: Default PKI Parameters*

Parameters	Default
Trust point	None
RSA key pair	None
RSA key-pair label	Device FQDN
RSA key-pair modulus	512
RSA key-pair exportable	Enabled
Revocation check method	CRL

## Configuring CAs and Digital Certificates

This section describes the tasks that you must perform to allow CAs and digital certificates on your Cisco NX-OS device to interoperate.

### Configuring the Hostname and IP Domain Name

You must configure the hostname and IP domain name of the device if you have not yet configured them because the Cisco NX-OS software uses the fully qualified domain name (FQDN) of the device as the subject in the identity certificate. Also, the Cisco NX-OS software uses the device FQDN as a default key label when you do not specify a label during key-pair generation. For example, a certificate named DeviceA.example.com is based on a device hostname of DeviceA and a device IP domain name of example.com.



#### Caution

Changing the hostname or IP domain name after generating the certificate can invalidate the certificate.

#### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 2</b>	<b>hostname</b> <i>hostname</i>  <b>Example:</b> switch(config)# hostname DeviceA	Configures the hostname of the device.
<b>Step 3</b>	<b>ip domain-name</b> <i>name</i> [ <b>use-vrf</b> <i>vrf-name</i> ]  <b>Example:</b> DeviceA(config)# ip domain-name example.com	Configures the IP domain name of the device. If you do not specify a VRF name, the command uses the default VRF.
<b>Step 4</b>	<b>exit</b>  <b>Example:</b> switch(config)# exit switch#	Exits configuration mode.
<b>Step 5</b>	(Optional) <b>show hosts</b>  <b>Example:</b> switch# show hosts	Displays the IP domain name.
<b>Step 6</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Generating an RSA Key Pair

You can generate an RSA key pairs to sign and/or encrypt and decrypt the security payload during security protocol exchanges for applications. You must generate the RSA key pair before you can obtain a certificate for your device.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>crypto key generate rsa</b> [ <b>label</b> <i>label-string</i> ] [ <b>exportable</b> ] [ <b>modulus</b> <i>size</i> ]  <b>Example:</b> switch(config)# crypto key generate rsa exportable	Generates an RSA key pair. The maximum number of key pairs on a device is 16.  The label string is alphanumeric, case sensitive, and has a maximum length of 64 characters. The default label string is the hostname and the FQDN separated by a period character (.).  Valid modulus values are 512, 768, 1024, 1536, and 2048. The default modulus size is 512.

	Command or Action	Purpose
		<p><b>Note</b> The security policy on the Cisco NX-OS device and on the CA (where enrollment is planned) should be considered when deciding the appropriate key modulus.</p> <p>By default, the key pair is not exportable. Only exportable key pairs can be exported in the PKCS#12 format.</p> <p><b>Caution</b> You cannot change the exportability of a key pair.</p>
<b>Step 3</b>	<b>exit</b> <b>Example:</b> <pre>switch(config)# exit switch#</pre>	Exits configuration mode.
<b>Step 4</b>	(Optional) <b>show crypto key mypubkey rsa</b> <b>Example:</b> <pre>switch# show crypto key mypubkey rsa</pre>	Displays the generated key.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b> <b>Example:</b> <pre>switch# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Creating a Trust Point CA Association

You must associate the Cisco NX-OS device with a trust point CA.

### Before you begin

Generate the RSA key pair.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
<b>Step 2</b>	<b>crypto ca trustpoint <i>name</i></b> <b>Example:</b>	Declares a trust point CA that the device should trust and enters trust point configuration mode.



	Command or Action	Purpose
	<pre>switch(config)# crypto ca trustpoint admin-ca switch(config-trustpoint) #</pre>	<p><b>Note</b> The maximum number of trust points that you can configure on a device is 16.</p>
<b>Step 3</b>	<p><b>enrollment terminal</b></p> <p><b>Example:</b></p> <pre>switch(config-trustpoint) # enrollment terminal</pre>	<p>Enables manual cut-and-paste certificate enrollment. The default is enabled.</p> <p><b>Note</b> The Cisco NX-OS software supports only the manual cut-and-paste method for certificate enrollment.</p>
<b>Step 4</b>	<p><b>rsa keypair label</b></p> <p><b>Example:</b></p> <pre>switch(config-trustpoint) # rsa keypair SwitchA</pre>	<p>Specifies the label of the RSA key pair to associate to this trust point for enrollment.</p> <p><b>Note</b> You can specify only one RSA key pair per CA.</p>
<b>Step 5</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>switch(config-trustpoint) # exit switch(config) #</pre>	<p>Exits trust point configuration mode.</p>
<b>Step 6</b>	<p>(Optional) <b>show crypto ca trustpoints</b></p> <p><b>Example:</b></p> <pre>switch(config) # show crypto ca trustpoints</pre>	<p>Displays trust point information.</p>
<b>Step 7</b>	<p>(Optional) <b>copy running-config startup-config</b></p> <p><b>Example:</b></p> <pre>switch(config) # copy running-config startup-config</pre>	<p>Copies the running configuration to the startup configuration.</p>

## Authenticating the CA

The configuration process of trusting a CA is complete only when the CA is authenticated to the Cisco NX-OS device. You must authenticate your Cisco NX-OS device to the CA by obtaining the self-signed certificate of the CA in PEM format, which contains the public key of the CA. Because the certificate of the CA is self-signed (the CA signs its own certificate) the public key of the CA should be manually authenticated by contacting the CA administrator to compare the fingerprint of the CA certificate.



**Note** The CA that you are authenticating is not a self-signed CA when it is a subordinate CA to another CA, which itself may be a subordinate to yet another CA, and so on, finally ending in a self-signed CA. This type of CA certificate is called the *CA certificate chain* of the CA being authenticated. In this case, you must input the full list of the CA certificates of all the CAs in the certification chain during the CA authentication. The maximum number of certificates in a CA certificate chain is 10.

**Before you begin**

Create an association with the CA.

Obtain the CA certificate or CA certificate chain.

**Procedure**

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
<b>Step 2</b>	<b>crypto ca authenticate name</b>  <b>Example:</b> <pre>switch(config)# crypto ca authenticate admin-ca input (cut &amp; paste) CA certificate (chain) in PEM format; end the input with a line containing only END OF INPUT : -----BEGIN CERTIFICATE----- MIIC4jCCAygwWIEAgICWDSIayOZPESR1jK0zeJAjBgkqhkiG9w0BAQEEAD0B kEgMB4GCSqGSIb3DQEJARYWllhmRzUBjaWVjby5jb20uY2AuaG9wLmVhcnRlLm MRIwEAYDQDEwLjYxLjYyLjEzLjEzLjEzLjEzLjEzLjEzLjEzLjEzLjEzLjEzLjEz CMFQZlZlZmEzAFBjNEAsItr6lchN0b3JhZ2UkejaQBgNEMAMICUeFwXUjvSEB QIeFw0NTAIMDMjQzadaf0wNzAIMDMjUIMicMIGQMAwHgYKcZlHvcN AQeFhHwFuzGLQqpc2NvtrNtIEIMAKAUEBhMCSU#ejaQBgNEMAgICUth crhdGFYTESMAGAUeBwMQnfuz2Fsb3JlM04wDAMUQKewDawVjoeTIMBEG AUECM4ntOc3FvcrfZIESMAGAUeBwMQKehcrhIEBwDQYKcZlHvcN AQEBQADS#wSAJFAW/7b3HKJEBNstHHzlNctN87ypzwocSNXOMpeRXX CzjEAgjXlZASFLUwQlHIMR0/4ljEBRwMkysCwEFAaOBzCBdAlBjNMQ2E EAMCAwDwMDR0TAQH/EPUwEE/zadBjNMQ4EPQUUyjjF0MzrQMRU0yRQ GysWdEwMDR0BQWjAucOyKcYcaHFOcdovL3vZS0wCC9ZXURW5jt2s I0RwXUjvSUjMNEImjDawC6gJLYgmlsZl0vLlxcc3NLIITAP4ENlcrFBnJv bGrcQehcrhJlTWQElY3JEMAGCSsGAQQBjclAQQAgFAwAGCSqGSIb3DQEJ BQFAOEFAH6QjHRE399Iw#KaG0gNULeQgth0ARt0eEjyjt/WGPKzsf9Ea NBG7E0oN66zex0EOEFG1Vs6mXpl//w== -----END CERTIFICATE----- END OF INPUT Fingerprint(s) : MD5 Fingerprint=65:84:9A:27:D5:71:03:33:9C:12:23:92:38:6F:78:12 Do you accept this certificate? [yes/no]: yes</pre>	Prompts you to cut and paste the certificate of the CA. Use the same name that you used when declaring the CA.  The maximum number of trust points that you can authenticate to a specific CA is 10.  <b>Note</b> For subordinate CA authentication, the Cisco NX-OS software requires the full chain of CA certificates ending in a self-signed CA because the CA chain is needed for certificate verification as well as for PKCS#12 format export.
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> <pre>switch(config)# exit switch#</pre>	Exits configuration mode.
<b>Step 4</b>	(Optional) <b>show crypto ca trustpoints</b>  <b>Example:</b> <pre>switch# show crypto ca trustpoints</pre>	Displays the trust point CA information.

	Command or Action	Purpose
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Configuring Certificate Revocation Checking Methods

During security exchanges with a client (for example, an SSH user), the Cisco NX-OS device performs the certificate verification of the peer certificate sent by the client. The verification process may involve certificate revocation status checking.

You can configure the device to check the CRL downloaded from the CA. Downloading the CRL and checking locally does not generate traffic in your network. However, certificates can be revoked between downloads and your device would not be aware of the revocation.

### Before you begin

Authenticate the CA.

Ensure that you have configured the CRL if you want to use CRL checking.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>crypto ca trustpoint <i>name</i></b>  <b>Example:</b> switch(config)# crypto ca trustpoint admin-ca switch(config-trustpoint)#	Specifies a trust point CA and enters trust point configuration mode.
<b>Step 3</b>	<b>revocation-check {crl [none]   none}</b>  <b>Example:</b> switch(config-trustpoint)# revocation-check none	Configures the certificate revocation checking methods. The default method is <b>crl</b> .  The Cisco NX-OS software uses the certificate revocation methods in the order that you specify.
<b>Step 4</b>	<b>exit</b>  <b>Example:</b> switch(config-trustpoint)# exit switch(config)#	Exits trust point configuration mode.

	Command or Action	Purpose
<b>Step 5</b>	(Optional) <b>show crypto ca trustpoints</b>  <b>Example:</b> switch(config)# show crypto ca trustpoints	Displays the trust point CA information.
<b>Step 6</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch(config)# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Generating Certificate Requests

You must generate a request to obtain identity certificates from the associated trust point CA for each of your device's RSA key pairs. You must then cut and paste the displayed request into an e-mail or in a website form for the CA.

### Before you begin

Create an association with the CA.

Obtain the CA certificate or CA certificate chain.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>crypto ca enroll name</b>  <b>Example:</b> switch(config)# crypto ca enroll admin-ca Create the certificate request .. Create a challenge password. You will need to verbally provide this password to the CA Administrator in order to revoke your certificate. For security reasons your password will not be saved in the configuration. Please make a note of it. Password:nbv123 The subject name in the certificate will be: DeviceA.cisco.com Include the switch serial number in the subject name? [yes/no]: no Include an IP address in the subject name [yes/no]: yes ip address:172.22.31.162 The certificate request will be displayed...	Generates a certificate request for an authenticated CA.  <b>Note</b> You must remember the challenge password. It is not saved with the configuration. You must enter this password if your certificate needs to be revoked.

	Command or Action	Purpose
	<pre>-----BEGIN CERTIFICATE REQUEST----- MIIBqCCAFQAwHDEAMBGAUUEAQMhY2M5jaXNjcy5jb20wZ28uOUMK KzIhcnAQBBQDgOCMIGTAcGAL8YUAJ2NC7jUUDV6SMqNgJ2kt8rl4IKf UJ08anN4qk8WmZSiL74gJzWdhdKtYsnjuCXG7jbtwj0fEhw/y5lT9y E2NU8amq8hrvZgC7ysN/PYMKcozhb0pj+zaqZMHGJ9IXIq4W6kSC2x68\$ VqyH0M5AgEFAgJzAVBjckkiG9wCBQcCBMGMU2MITzMDKCSGStb3DEJ DjipMCowQDVARACH/EBsGIRUfMhY2M5jaXNjcy5jb20wZ28uOUMK KzIhcnAQBBQDgMEAKT6KERQo8rj0sKZMHSfJzh867Dz3Gcd99GfWgt PftN0WE/pw8HayfQl2T3ccgWel2dl5L33BF2bktExiI6U188rIT0jglXmjja8 8a23NDpN8BkIwA8WwV18UZFRtcbjfrgNIZacJUS82qfNct8ytlk0- -----END CERTIFICATE REQUEST-----</pre>	
<b>Step 3</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>switch(config-trustpoint) # exit switch(config) #</pre>	Exits trust point configuration mode.
<b>Step 4</b>	<p>(Optional) <b>show crypto ca certificates</b></p> <p><b>Example:</b></p> <pre>switch(config) # show crypto ca certificates</pre>	Displays the CA certificates.
<b>Step 5</b>	<p>(Optional) <b>copy running-config startup-config</b></p> <p><b>Example:</b></p> <pre>switch(config) # copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Installing Identity Certificates

You can receive the identity certificate from the CA by e-mail or through a web browser in base64 encoded text form. You must install the identity certificate from the CA by cutting and pasting the encoded text.

### Before you begin

Create an association with the CA.

Obtain the CA certificate or CA certificate chain.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>switch# configure terminal switch(config) #</pre>	Enters global configuration mode.
<b>Step 2</b>	<p><b>crypto ca import name certificate</b></p> <p><b>Example:</b></p>	Prompts you to cut and paste the identity certificate for the CA named admin-ca.

	Command or Action	Purpose
	<pre>switch(config)# crypto ca import admin-ca certificate input (cut &amp; paste) certificate in PEM format: -----BEGIN CERTIFICATE----- MIIEADCCAgwWIBgqICjOoQAAAAADABgqjkiC9wOBAQFADOBKDEgMB4G CSqGSIb3DQEFAiRFRWlhrRzLBJaXNjby5jb20xOzA.BjMBAYTAkLOmRwEAYD VQDEwILYUyXPaZEMeJAQBjNBACTUthrdhG9zTEOMwGAIUECHMFQ2Lz Y28xEzAFBjNBAStUrfldhN0b3JhZ2UwEjAQBjNBAFMIUwXUjSBOQIPeFw0w NIEEMTWMAyNBAFw0wNjEMITwEYNDABwGjAYBjNBAFMEVZLZ2FzITBj Y2IzI28u29tMIGMAQCSqGSIb3DQEFAwAqVADOBiQyBGC/GNAQdHjQ4IC dQlWjKjSICqLfk5a.BhNQjyQzocKsZEPjE2UbiyeCMEByLndWwSE08uJ4T glxr42/sI9IRIy/8uU/cj9jSSRk56ca7wWA8rDfEzjMChIM#NLav/q2y4G6 x7Rif6V06RfZEGsL7/Elash9LxLwITPQBo4ICEzCCAgwUQMDVROPqH/BBw GZTRMhNYMM55jaXNjby5jb2ZEBwWHGtWfQMDVROBBMEFKLi+2ssqWEfgR hwhnLVyoc9jngMIHBMjNBAFwGqgcAFKoc8aDG6wJTEANjskiUBoLrnxoIGV piGIMICQMAwHjyKZLhwDPAQEhHhWfRZGLQGjpc2MmNjBTEIMAKGAIUE BhMCSU4wEjAQBjNBAFgIUthrdhG9zTEOMwGAIUEBwMjQnRuzZFs63JIMQ4v DpYDQQEwMDaXNjBzEIMBEGAIUECMKnt0c3RvcrnHziESMBGAIUEPwMQEh crfhIENBjAFYKkHjQZIE9UEIMwRl6G8GAIUdHwRKGtWlQpsocGqCh0ch26 Ly9acZUwDyQZyEEMu8sC9BcGFjntElmJHDS5jcnwWKAucCyGfrzqbG6 Ly9cHNz30wCEMZXUwF5yb2sSEFWXUjSjMENEInjBDBigYIwWBEQUH AQEEfjBMDsCCsCAUEBzAchi9codHwOi8vc3NLLITAILQNLcrFEnJtbGwc3NL LITAF0FwXUjSjMENEInjyDPA9BggBjFEBQwPoYzmlsZl0wLlxcc3NLLITAF XENLcrFEnJtbGcc3NLLITAF0FwXUjSjMENEInjyDPA9BggqjkiC9wOBAQF AENBAUGG8be7NLh9eOIMENm24U69ZSUDrOdZUUTqprITdYcPyejtsyflw E36cIZu4WsExREqxbTk8ycx7V5o= -----END CERTIFICATE-----</pre>	<p>The maximum number of identify certificates that you can configure on a device is 16.</p>
<b>Step 3</b>	<pre>exit</pre> <p><b>Example:</b></p> <pre>switch(config)# exit switch#</pre>	<p>Exits configuration mode.</p>
<b>Step 4</b>	<p>(Optional) <b>show crypto ca certificates</b></p> <p><b>Example:</b></p> <pre>switch# show crypto ca certificates</pre>	<p>Displays the CA certificates.</p>
<b>Step 5</b>	<p>(Optional) <b>copy running-config startup-config</b></p> <p><b>Example:</b></p> <pre>switch# copy running-config startup-config</pre>	<p>Copies the running configuration to the startup configuration.</p>

## Ensuring Trust Point Configurations Persist Across Reboots

You can ensure that the trustpoint configuration persists across Cisco NX-OS device reboots.

The trust point configuration is a normal Cisco NX-OS device configuration that persists across system reboots only if you copy it explicitly to the startup configuration. The certificates, key pairs, and CRL associated with a trust point are automatically persistent if you have already copied the trust point configuration in the startup configuration. Conversely, if the trust point configuration is not copied to the startup configuration, the certificates, key pairs, and CRL associated with it are not persistent since they require the corresponding trust point configuration after a reboot. Always copy the running configuration to the startup configuration to ensure

that the configured certificates, key pairs, and CRLs are persistent. Also, save the running configuration after deleting a certificate or key pair to ensure that the deletions permanent.

The certificates and CRL associated with a trust point automatically become persistent when imported (that is, without explicitly copying to the startup configuration) if the specific trust point is already saved in startup configuration.

We recommend that you create a password-protected backup of the identity certificates and save it to an external server.



**Note** Copying the configuration to an external server does include the certificates and key pairs.

## Exporting Identity Information in PKCS 12 Format

You can export the identity certificate along with the RSA key pair and CA certificate (or the entire chain in the case of a subordinate CA) of a trust point to a PKCS#12 file for backup purposes. You can import the certificate and RSA key pair to recover from a system crash on your device or when you replace the supervisor modules.



**Note** You can use only the `bootflash:filename` format when specifying the export URL.

### Before you begin

Authenticate the CA.

Install an identity certificate.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
<b>Step 2</b>	<b>crypto ca export name pkcs12 bootflash:filename password</b> <b>Example:</b> <pre>switch(config)# crypto ca export admin-ca pkcs12 bootflash:adminid.p12 nbv123</pre>	Exports the identity certificate and associated key pair and CA certificates for a trust point CA. The password is alphanumeric, case sensitive, and has a maximum length of 128 characters.
<b>Step 3</b>	<b>exit</b> <b>Example:</b> <pre>switch(config)# exit switch#</pre>	Exits configuration mode.

	Command or Action	Purpose
<b>Step 4</b>	<b>copy bootflash:filename scheme://server/ [url /]filename</b>  <b>Example:</b> <pre>switch# copy bootflash:adminid.p12 tftp:adminid.p12</pre>	Copies the PKCS#12 format file to a remote server.  For the <i>scheme</i> argument, you can enter <b>tftp:</b> , <b>ftp:</b> , <b>scp:</b> , or <b>sftp:</b> . The <i>server</i> argument is the address or name of the remote server, and the <i>url</i> argument is the path to the source file on the remote server.  The <i>server</i> , <i>url</i> , and <i>filename</i> arguments are case sensitive.

## Importing Identity Information in PKCS 12 Format

You can import the certificate and RSA key pair to recover from a system crash on your device or when you replace the supervisor modules.



**Note** You can use only the bootflash:filename format when specifying the import URL.

### Before you begin

Ensure that the trust point is empty by checking that no RSA key pair is associated with it and no CA is associated with the trust point using CA authentication.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>copy scheme:// server/[url /]filename bootflash:filename</b>  <b>Example:</b> <pre>switch# copy tftp:adminid.p12 bootflash:adminid.p12</pre>	Copies the PKCS#12 format file from the remote server.  For the <i>scheme</i> argument, you can enter <b>tftp:</b> , <b>ftp:</b> , <b>scp:</b> , or <b>sftp:</b> . The <i>server</i> argument is the address or name of the remote server, and the <i>url</i> argument is the path to the source file on the remote server.  The <i>server</i> , <i>url</i> , and <i>filename</i> arguments are case sensitive.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>crypto ca import name pksc12 bootflash:filename</b>  <b>Example:</b>	Imports the identity certificate and associated key pair and CA certificates for trust point CA.



	Command or Action	Purpose
	<code>switch(config)# crypto ca import admin-ca pkcs12 bootflash:adminid.p12 nbv123</code>	
<b>Step 4</b>	<b>exit</b> <b>Example:</b> <code>switch(config)# exit</code> <code>switch#</code>	Exits configuration mode.
<b>Step 5</b>	(Optional) <b>show crypto ca certificates</b> <b>Example:</b> <code>switch# show crypto ca certificates</code>	Displays the CA certificates.
<b>Step 6</b>	(Optional) <b>copy running-config startup-config</b> <b>Example:</b> <code>switch# copy running-config startup-config</code>	Copies the running configuration to the startup configuration.

## Configuring a CRL

You can manually configure CRLs that you have downloaded from the trust points. The Cisco NX-OS software caches the CRLs in the device bootflash (cert-store). During the verification of a peer certificate, the Cisco NX-OS software checks the CRL from the issuing CA only if you have downloaded the CRL to the device and you have configured certificate revocation checking to use the CRL.

### Before you begin

Ensure that you have enabled certificate revocation checking.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>copy <i>scheme</i>:[//<i>server</i>[<i>url</i> /]]<i>filename</i></b> <b>bootflash:<i>filename</i></b> <b>Example:</b> <code>switch# copy tftp:adminca.crl</code> <code>bootflash:adminca.crl</code>	Downloads the CRL from a remote server.  For the <i>scheme</i> argument, you can enter <b>tftp:</b> , <b>ftp:</b> , <b>scp:</b> , or <b>sftp:</b> . The <i>server</i> argument is the address or name of the remote server, and the <i>url</i> argument is the path to the source file on the remote server.  The <i>server</i> , <i>url</i> , and <i>filename</i> arguments are case sensitive.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> <code>switch# configure terminal</code> <code>switch(config)#</code>	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<b>crypto ca crl request <i>name</i> bootflash:<i>filename</i></b> <b>Example:</b> switch(config)# crypto ca crl request admin-ca bootflash:adminca.crl	Configures or replaces the current CRL with the one specified in the file.
<b>Step 4</b>	<b>exit</b> <b>Example:</b> switch(config)# exit switch#	Exits configuration mode.
<b>Step 5</b>	(Optional) <b>show crypto ca crl <i>name</i></b> <b>Example:</b> switch# show crypto ca crl admin-ca	Displays the CA CRL information.
<b>Step 6</b>	(Optional) <b>copy running-config startup-config</b> <b>Example:</b> switch# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Deleting Certificates from the CA Configuration

You can delete the identity certificates and CA certificates that are configured in a trust point. You must first delete the identity certificate, followed by the CA certificates. After deleting the identity certificate, you can disassociate the RSA key pair from a trust point. You must delete certificates to remove expired or revoked certificates, certificates that have compromised (or suspected to be compromised) key pairs, or CAs that are no longer trusted.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b> <b>Example:</b> switch# configure terminal switch(config)#	Enters global configuration mode.
<b>Step 2</b>	<b>crypto ca trustpoint <i>name</i></b> <b>Example:</b> switch(config)# crypto ca trustpoint admin-ca switch(config-trustpoint)#	Specifies a trust point CA and enters trust point configuration mode.
<b>Step 3</b>	<b>delete ca-certificate</b> <b>Example:</b> switch(config-trustpoint)# delete ca-certificate	Deletes the CA certificate or certificate chain.

	Command or Action	Purpose
<b>Step 4</b>	<b>delete certificate [force]</b>  <b>Example:</b> <pre>switch(config-trustpoint)# delete certificate</pre>	Deletes the identity certificate.  You must use the <b>force</b> option if the identity certificate you want to delete is the last certificate in a certificate chain or only identity certificate in the device. This requirement ensures that you do not mistakenly delete the last certificate in a certificate chain or only the identity certificate and leave the applications (such as SSH) without a certificate to use.
<b>Step 5</b>	<b>exit</b>  <b>Example:</b> <pre>switch(config-trustpoint)# exit switch(config)#</pre>	Exits trust point configuration mode.
<b>Step 6</b>	(Optional) <b>show crypto ca certificates [name]</b>  <b>Example:</b> <pre>switch(config)# show crypto ca certificates admin-ca</pre>	Displays the CA certificate information.
<b>Step 7</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> <pre>switch(config)# copy running-config startup-config</pre>	Copies the running configuration to the startup configuration.

## Deleting RSA Key Pairs from a Cisco NX-OS Device

You can delete the RSA key pairs from a Cisco NX-OS device if you believe the RSA key pairs were compromised in some way and should no longer be used.



**Note** After you delete RSA key pairs from a device, ask the CA administrator to revoke your device's certificates at the CA. You must supply the challenge password that you created when you originally requested the certificates.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>configure terminal</b>  <b>Example:</b> <pre>switch# configure terminal switch(config)#</pre>	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 2</b>	<b>crypto key zeroize rsa label</b>  <b>Example:</b> switch(config)# crypto key zeroize rsa MyKey	Deletes the RSA key pair.
<b>Step 3</b>	<b>exit</b>  <b>Example:</b> switch(config)# exit switch#	Exits configuration mode.
<b>Step 4</b>	(Optional) <b>show crypto key mypubkey rsa</b>  <b>Example:</b> switch# show crypto key mypubkey rsa	Displays the RSA key pair configuration.
<b>Step 5</b>	(Optional) <b>copy running-config startup-config</b>  <b>Example:</b> switch# copy running-config startup-config	Copies the running configuration to the startup configuration.

## Verifying the PKI Configuration

To display PKI configuration information, perform one of the following tasks:

Command	Purpose
<b>show crypto key mypubkey rsa</b>	Displays information about the RSA public keys generated on the Cisco NX-OS device.
<b>show crypto ca certificates</b>	Displays information about CA and identity certificates.
<b>show crypto ca crl</b>	Displays information about CA CRLs.
<b>show crypto ca trustpoints</b>	Displays information about CA trust points.

## Configuration Examples for PKI

This section shows examples of the tasks that you can use to configure certificates and CRLs on Cisco NX-OS devices using a Microsoft Windows Certificate server.



**Note** You can use any type of certificate server to generate digital certificates. You are not limited to using the Microsoft Windows Certificate server.

## Configuring Certificates on a Cisco NX-OS Device

To configure certificates on a Cisco NX-OS device, follow these steps:

### Procedure

- 
- Step 1** Configure the device FQDN.
- ```
switch# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
switch(config)# hostname Device-1
Device-1(config)#
```
- Step 2** Configure the DNS domain name for the device.
- ```
Device-1(config)# ip domain-name cisco.com
```
- Step 3** Create a trust point.
- ```
Device-1(config)# crypto ca trustpoint myCA
Device-1(config-trustpoint)# exit
Device-1(config)# show crypto ca trustpoints
trustpoint: myCA; key:
revokation methods:  crl
```
- Step 4** Create an RSA key pair for the device.
- ```
Device-1(config)# crypto key generate rsa label myKey exportable modulus 1024
Device-1(config)# show crypto key mypubkey rsa
key label: myKey
key size: 1024
exportable: yes
```
- Step 5** Associate the RSA key pair to the trust point.
- ```
Device-1(config)# crypto ca trustpoint myCA
Device-1(config-trustpoint)# rsakeypair myKey
Device-1(config-trustpoint)# exit
Device-1(config)# show crypto ca trustpoints
trustpoint: myCA; key: myKey
revokation methods:  crl
```
- Step 6** Download the CA certificate from the Microsoft Certificate Service web interface.
- Step 7** Authenticate the CA that you want to enroll to the trust point.
- ```
Device-1(config)# crypto ca authenticate myCA
input (cut & paste) CA certificate (chain) in PEM format;
end the input with a line containing only END OF INPUT :
```

```

-----BEGIN CERTIFICATE-----
MIIC4jCCAoygAwIBAgIQBWD5iay0GZRPSRI1jK0ZejanBgkqhkiG9w0BAQUFADCB
kDEGMb4GCSqGSIB3DQEJARYRYW1hbmRrZUBjaXNjby5jb20xCzAJBgNVBAYTAk1O
MRIwEAYDVQQIEw1LYXJuYXRha2ExEjAQBGNVBACTCUJhbmdhbG9yZTEOMAwGA1UE
ChMFQ21zY28xEzARBGNVBAStcm5ldHN0b3JhZ2UxEjAQBGNVBAMTCUFWYXJuYSBD
QTAeFw0wNTA1MDMyMjQ2MzdaFw0wNzA1MDMyMjU1MTdaMIGQMSAwHgYJKoZIhvcN
AQkBFhFhbWFuZGt1QGNpc2NvLmNvbTElMAkGA1UEBhMCSU4xEjAQBGNVBAGTCUth
cm5hdGFrYTESMBAGA1UEBxMJQmFuZ2Fsb3JlMQ4wDAYDVQQKEwVDaXNjbzETMBEG
A1UECxMKbWV0c3RvcnFnZTESMBAGA1UEAxMjQXBhcm5hIENBMFwwDQYJKoZIhvcN
AQEBBQADSwAwSAJBAMW/7b3+DXJPANBSIHHzluNccNM87ypyzwuoSNZXOMpeRXXI
OzyBAgiXT2ASFuUowQ1iDM8ro/41jf8RxxYKvysCAwEAaAaOBvzCBvDALBgNVHQ8E
BAMCACYwDwYDVROTAQH/BAUwAwEB/zAdBgNVHQ4EFgQUJyJyRoMbrCNMRU2OyRhQ
GgsWbHEwawYDVROFBGQwYjAuoCygKoYoHR0cDovL3NzZS0wOC9DZXJ0RW5yb2xs
L0FwYXJuYXUyMENBImNybDAwC6gLIYqZmlsZTovL1xccc3N1LTA4XEN1cnRfbnJv
bGxcQXBhcm5hJTIwQ0EuY3JSMGAGCSsGAQQBgjcvVAQODAgEAMA0GCSqGSIB3DQE
BQUAAOEAHv6UQ+8nE39Tww+KaGr0g0NIJaNgLh0AFcT0rEyuuyt/WYGFzksF9EA
NBG7E0cN66zex0EOEFG1Vs6mXp1//w==
-----END CERTIFICATE-----
END OF INPUT
Fingerprint(s): MD5 Fingerprint=65:84:9A:27:D5:71:03:33:9C:12:23:92:38:6F:78:12
Do you accept this certificate? [yes/no]:y

Device-1(config)# show crypto ca certificates
Trustpoint: myCA
CA certificate 0:
subject= /emailAddress=admin@yourcompany.com/C=IN/ST=Karnataka/
L=Bangalore/O=Yourcompany/OU=netstorage/CN=Aparna CA
issuer= /emailAddress=admin@yourcompany.com/C=IN/ST=Karnataka/
L=Bangalore/O=Yourcompany/OU=netstorage/CN=Aparna CA
serial=0560D289ACB419944F4912258CAD197A
notBefore=May  3 22:46:37 2005 GMT
notAfter=May  3 22:55:17 2007 GMT
MD5 Fingerprint=65:84:9A:27:D5:71:03:33:9C:12:23:92:38:6F:78:12
purposes: sslserver sslclient ike

```

## Step 8 Generate a request certificate to use to enroll with a trust point.

```

Device-1(config)# crypto ca enroll myCA
Create the certificate request ..
Create a challenge password. You will need to verbally provide this
password to the CA Administrator in order to revoke your certificate.
For security reasons your password will not be saved in the configuration.
Please make a note of it.
Password: nbv123
The subject name in the certificate will be: Device-1.cisco.com
Include the switch serial number in the subject name? [yes/no]: no
Include an IP address in the subject name [yes/no]: yes
ip address: 10.10.1.1
The certificate request will be displayed...
-----BEGIN CERTIFICATE REQUEST-----
MIIBqzCCARQCAQAwHDEaMBGGA1UEAxMRVnVnYXNjby5jb20wgZ8wDQYJ
KoZIhvcNAQEBBQADgY0AMIGJAoGBAL8Y1UAJ2NC7jUJ1DVaSMqNIgJ2kt8rl4lKY
0JC6ManNy4qxk8VeMXZSiLJ4JgTzKWdxblDkTTysnjuCXGvjb+wj0hEhv/y51T9y
P2NJJ8ornqShrvFZgC7ysN/PyMwKcgzhbVpj+rargZvHtGJ91XTq4WoVksCzXv8S
VqyH0vEvAgMBAAGgTzAVBgkqhkiG9w0BCQcxCBMGBmJ2MTIzMDYGCsqGSIB3DQEJ
DjEpMCCwJQYDVROTAQH/BBswGYIRVnVnYXNjby5jb22HBKwWH6IwDQYJ
KoZIhvcNAQEBBQADgYEAKT60KER6Qo8nj0sDXZVHSfJZh6K6JtDz3Gkd99G1FWgt
PftRnCWUE/pw6HayfQ12T3ecgNwel2d15133YBF2bktExiI6U188nTOjglXMjja8
8a23bNDpNsM8rklwA6hWkrVL8NUZEFJxqbjfngPNTZacJCUS6ZqKCMetbKytUx0=
-----END CERTIFICATE REQUEST-----

```

- Step 9** Request an identity certificate from the Microsoft Certificate Service web interface.
- Step 10** Import the identity certificate.

```
Device-1(config)# crypto ca import myCA certificate
input (cut & paste) certificate in PEM format:
-----BEGIN CERTIFICATE-----
MIIEADCCA6ggAwIBAgIKCjOOoQAAAAAdDANBgkqhkiG9w0BAQUFADCBCkDEgMB4G
CSqGSIB3DQEJARYRYW1hbmRrZUBjaXNjby5jb20xCzAJBgNVBAYTAK1OMRIWEAYD
VQQIEWwLYXJuYXRha2ExEjAQBGNVBAcTCUJhbmdhbG9yZTEOMAwGA1UEChMFQ21z
Y28xEzARBGNVBAsTCm5ldHN0b3JhZ2UxEjAQBGNVBAMTCUFWYXJuYSBDQTAeFw0w
NTEeMTIwMzAyNDBaFw0wNjExMTIwMzEyNDBaMBwxGjAYBgNVBAMTEVZlZ2FzLTFE
Y21zY28uY29tMIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQC/GNVACdjQu41C
dQ1WkjkjSICdpLfk5eJSmNCQujGpzcKsZPFXjF2UoIyeCYE8y1ncWYw5E08rJ47
glxr42/sI9IRIb/8udU/cj9jSSfKK56koa7xWYAu8rDfz8jMCnIM4W1aY/q2q4Gb
x7Ri.fdv06uFqFZEgs17/Elash9LxLwIDAQBo4ICEzCCAgs8wJQYDVR0RAQH/BBsw
GYIRVmnVnYXmtMS5jaXNjby5jb22HBKwWH6IwHQYDVR0OBBYEFKCLi+2sspWEfgrR
bhWmlVyo9jngMIHMBGNVHSMEGcQwgcGAFCCo8kaDG6wjTEVNjskYUBoLFmxxoYGW
pIGTMIGQMSAwHgYJKoZiIhvcNAQkBFhFhbWVfZGt1QGNpc2NvLmNvbTELMakGA1UE
BhMCSU4xEjAQBGNVBAGTCUthcm5hdGFryTESMBAGA1UEBxMJQmFuZ2Fsb3JlMQ4w
DAYDVQQKEWVdaXNjZETMBEGA1UECXMkbnV0c3RvcmluZ2Fsb3JlMQ4wEAAxMjQX
cm5hIENBghAFYnKJrLQZLE9JEiWMrR16MGsGA1UdHwRkMGIwLqAsocqGKGh0dHA6
Ly9zc2UtdGvQ2VydeVucm9sbC9BcGFybmlmBDQ55jcmwMKAUoCyGKmZpbGU6
Ly9cXHNzZS0wOFxDZlJ0RW5yb2xsXEFwYXJuYSUyMENBLmNybdCBiYIKwYBBQUH
AQEEfjB8MdsGCCsGAQUFBzAChi9odHRwOi8vc3N1LTA4L0N1cnRFbnJvbGwvc3N1
LTA4X0FwYXJuYSUyMENBLmNyda9BggrBgEFBQcwAoYxZmlsZTovL1xccc3N1LTA4
XEN1cnRFbnJvbGxccc3N1LTA4X0FwYXJuYSUyMENBLmNyda9BgdANBgkqhkiG9w0BAQUF
AANBADbGBGsbE7GNLh9xeOTWBNm24U69ZSuDdcOcuZUUTgrpnTqVpPyejtsyflw
E36cIZu4WsExREqxbTk8ycx7V5o=
-----END CERTIFICATE-----
Device-1(config)# exit
Device-1#
```

- Step 11** Verify the certificate configuration.
- Step 12** Save the certificate configuration to the startup configuration.

## Downloading a CA Certificate

To download a CA certificate from the Microsoft Certificate Services web interface, follow these steps:

### Procedure

- Step 1** From the Microsoft Certificate Services web interface, click **Retrieve the CA certificate or certificate revocation task** and click **Next**.

Microsoft Certificate Services -- Apama CA

## Welcome

---

You use this web site to request a certificate for your web browser, e-mail client, or other secure program. Once you will be able to securely identify yourself to other people over the web, sign your e-mail messages, encrypt your e-mail depending upon the type of certificate you request.

### Select a task:

- Retrieve the CA certificate or certificate revocation list
  - Request a certificate
  - Check on a pending certificate
-



- Step 2** From the display list, choose the CA certificate file to download from the displayed list. Then click **Base 64 encoded** and click **Download CA certificate**.

Microsoft Certificate Services -- Apama CA

### Retrieve The CA Certificate Or Certificate Revocation List

[Install this CA certification path](#) to allow your computer to trust certificates issued from this certification authority.

It is not necessary to manually install the CA certification path if you request and install a certificate from this certification authority. The CA certification path will be installed for you automatically.

**Choose file to download:**

CA Certificate:

DER encoded or  Base 64 encoded

[Download CA certificate](#)

[Download CA certification path](#)

[Download latest certificate revocation list](#)

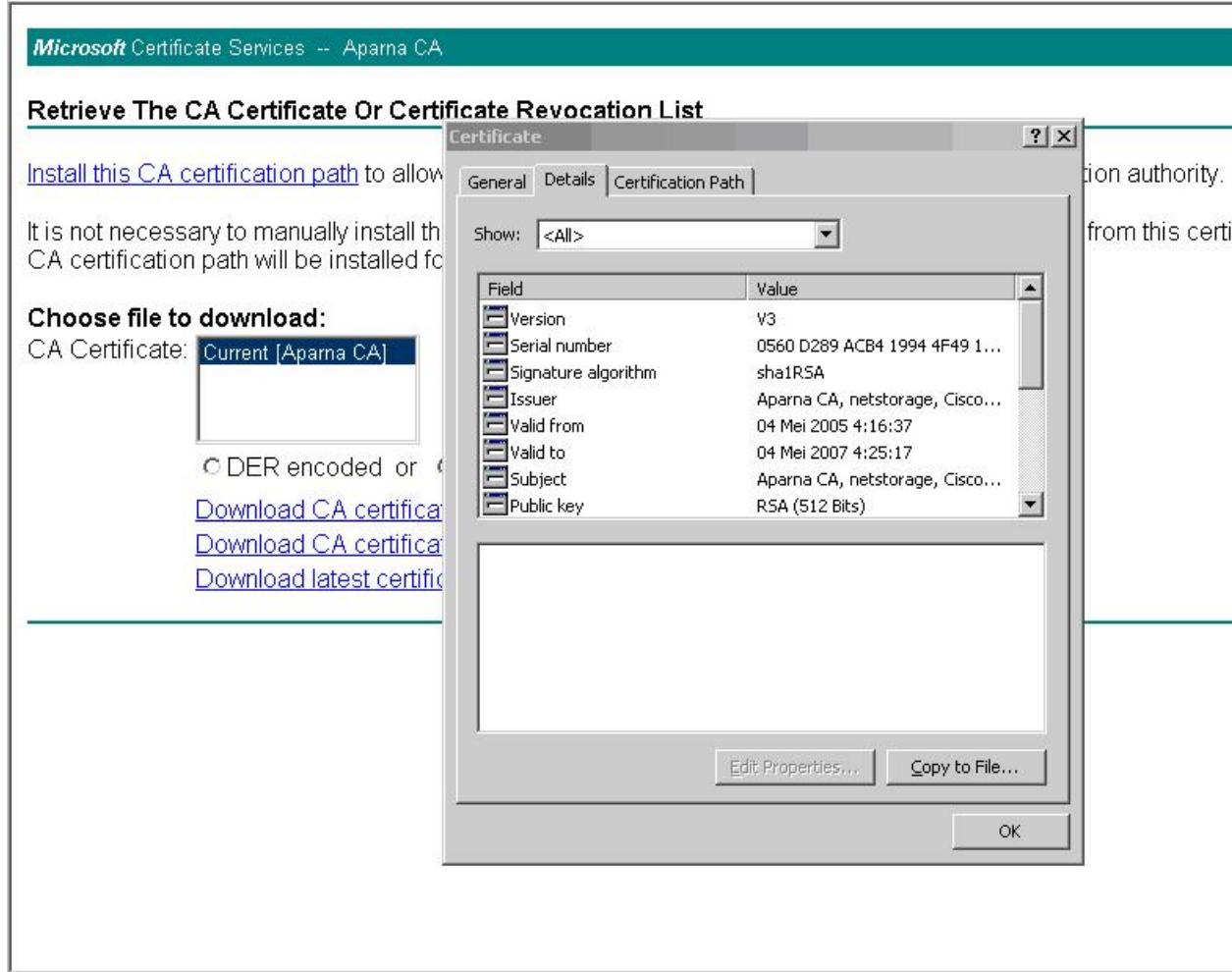
**Step 3** Click **Open** in the File Download dialog box.

The screenshot shows a web browser window titled "Microsoft Certificate Services -- Aparna CA". The page content includes the heading "Retrieve The CA Certificate Or Certificate Revocation List" and a link "Install this CA certification path" with the text "to allow your computer to trust certificates issued from this certification authority." Below this, it states "It is not necessary to manually install the CA" and "CA certification path will be installed for you".

Under the heading "Choose file to download:", there is a dropdown menu for "CA Certificate:" with "Current [Aparna CA]" selected. Below the dropdown are two radio buttons: "DER encoded" (unselected) and "Base64 encoded" (selected). There are three blue links: "Download CA certificate", "Download CA certification path", and "Download latest certificate revocation list".

Overlaid on the right side of the browser window is a "File Download" dialog box. It contains a warning icon and the text: "Some files can harm your computer. If the file information below looks suspicious, or you do not fully trust the source, do not open or save this file." The file information is: "File name: certnew.cer", "File type: Security Certificate", and "From: 10.76.45.108". A yellow warning triangle icon is followed by the text: "This type of file could harm your computer if it contains malicious code." Below this is the question "Would you like to open the file or save it to your computer?" and four buttons: "Open", "Save", "Cancel", and "More Info". At the bottom of the dialog box, there is a checked checkbox labeled "Always ask before opening this type of file".

**Step 4** In the Certificate dialog box, click **Copy to File** and click **OK**.



**Step 5** From the Certificate Export Wizard dialog box, choose the **Base-64 encoded X.509 (CER)** and click **Next**.

The screenshot shows the Microsoft Certificate Services console for 'Aparna CA'. The main page is titled 'Retrieve The CA Certificate Or Certificate Revocation List'. It contains instructions on how to install a CA certification path and a section titled 'Choose file to download:' with a dropdown menu showing 'Current [Aparna CA]'. Below this are radio buttons for 'DER encoded or...' and three links: 'Download CA certificate', 'Download CA certificate', and 'Download latest certificate'.

Overlaid on the console is the 'Certificate' dialog box, which has tabs for 'General', 'Details', and 'Certification Path'. The 'Show:' dropdown is set to '<All>'. A 'Certificate Export Wizard' dialog box is also open, showing the 'Export File Format' section. It states 'Certificates can be exported in a variety of file formats.' and asks to 'Select the format you want to use:'. The options are:

- DER encoded binary X.509 (.CER)
- Base-64 encoded X.509 (.CER)
- Cryptographic Message Syntax Standard - PKCS #7 Certificates (.P7B)
  - Include all certificates in the certification path if possible
- Personal Information Exchange - PKCS #12 (.PFX)
  - Include all certificates in the certification path if possible
  - Enable strong protection (requires IE 5.0, NT 4.0 SP4 or above)
  - Delete the private key if the export is successful

The wizard has '< Back' and 'Next >' buttons.

**Step 6** In the File name: text box on the Certificate Export Wizard dialog box, enter the destination file name and click **Next**.

**Step 7** In the Certificate Export Wizard dialog box, click **Finish**.



## Procedure

---

### Step 1

From the Microsoft Certificate Services web interface, click **Request a certificate** and click **Next**.

*Microsoft* Certificate Services -- Apama CA

#### Welcome

---

You use this web site to request a certificate for your web browser, e-mail client, or other secure program. Once you will be able to securely identify yourself to other people over the web, sign your e-mail messages, encrypt your e-mail depending upon the type of certificate you request.

#### Select a task:

- Retrieve the CA certificate or certificate revocation list
  - Request a certificate
  - Check on a pending certificate
-

**Step 2** Click **Advanced request** and click **Next**.

Microsoft Certificate Services -- Apama CA

### Choose Request Type

Please select the type of request you would like to make:

User certificate request:

- Web Browser Certificate
- E-Mail Protection Certificate

Advanced request

**Step 3**

Click **Submit a certificate request using a base64 encoded PKCS#10 file or a renewal request using a base64 encoded PKCS#7 file** and click **Next**.

Microsoft Certificate Services -- Apama CA

**Advanced Certificate Requests**

You can request a certificate for yourself, another user, or a computer using one of the following methods. Note that the certification authority (CA) will determine the certificates that you can obtain.

- Submit a certificate request to this CA using a form.
- Submit a certificate request using a base64 encoded PKCS #10 file or a renewal request using a base64 encoded PKCS #7 file.
- Request a certificate for a smart card on behalf of another user using the Smart Card Enrollment Station.  
*You must have an enrollment agent certificate to submit a request for another user.*



**Step 4**

In the Saved Request text box, paste the base64 PKCS#10 certificate request and click **Next**. The certificate request is copied from the Cisco NX-OS device console.

Microsoft Certificate Services -- Apama CA

---

**Submit A Saved Request**

Paste a base64 encoded PKCS #10 certificate request or PKCS #7 renewal request generated by an external server) into the request field to submit the request to the certification authority (CA).

**Saved Request:**

Base64 Encoded Certificate Request (PKCS #10 or #7):	<pre>VqyHOvEvAgMBAAAGTzAVBgkqhkiG9w0BCQcxCBMG DjEpMCcwJQYDVRORAQH/BBSwGYIRVmVnYXMtMS5j KoZIhvcNAQEEBQADgYEAkT6OKER6Qo8nj0sDXZVH PftrNcWUE/pw6HayfQ12T3ecgNwe12d15133YBF2: 8a23bNDpNsM8rk1wA6hWkrVL8NUZEFJxqbjfngPN -----END CERTIFICATE REQUEST-----</pre>
--	--

[Browse](#) for a file to insert.

**Additional Attributes:**

Attributes:

---

**Step 5** Wait one or two days until the certificate is issued by the CA administrator.

*Microsoft* Certificate Services -- Apama CA

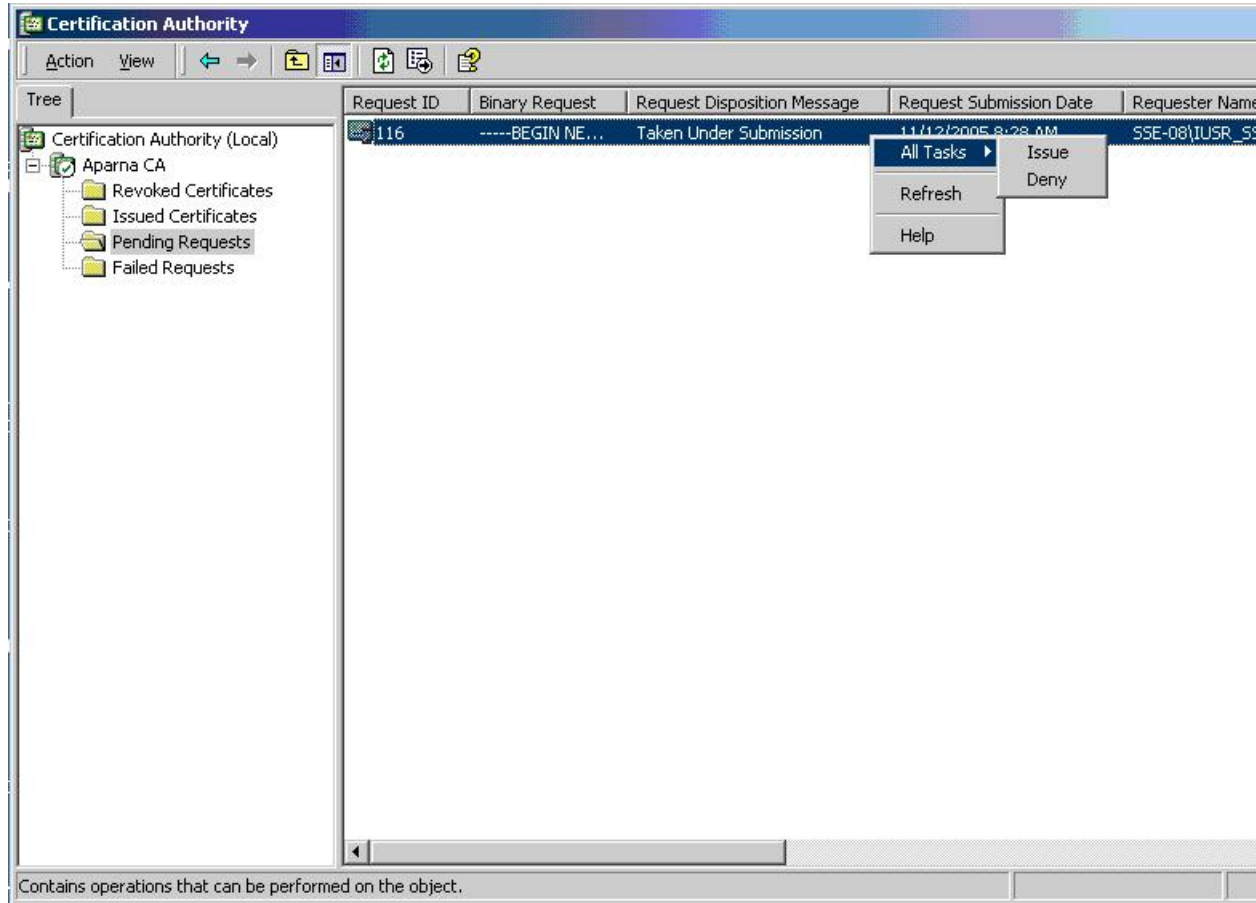
### Certificate Pending

Your certificate request has been received. However, you must wait for an administrator to issue the certificate you requested.

Please return to this web site in a day or two to retrieve your certificate.

**Note:** You must return with **this** web browser within 10 days to retrieve your certificate.

**Step 6** Note that the CA administrator approves the certificate request.



**Step 7** From the Microsoft Certificate Services web interface, click **Check on a pending certificate** and click **Next**.

Microsoft Certificate Services -- Apama CA

## Welcome

---

You use this web site to request a certificate for your web browser, e-mail client, or other secure program. Once you will be able to securely identify yourself to other people over the web, sign your e-mail messages, encrypt your e-mail depending upon the type of certificate you request.

### Select a task:

- Retrieve the CA certificate or certificate revocation list
  - Request a certificate
  - Check on a pending certificate
-

**Step 8**

Choose the certificate request that you want to check and click **Next**.

Microsoft Certificate Services -- Apama CA

**Check On A Pending Certificate Request**

Please select the certificate request you want to check:

Saved-Request Certificate (12 November 2005 20:30:22)

**Step 9**

Click **Base 64 encoded** and click **Download CA certificate**.

**Microsoft** Certificate Services -- Apama CA

**Certificate Issued**

The certificate you requested was issued to you.

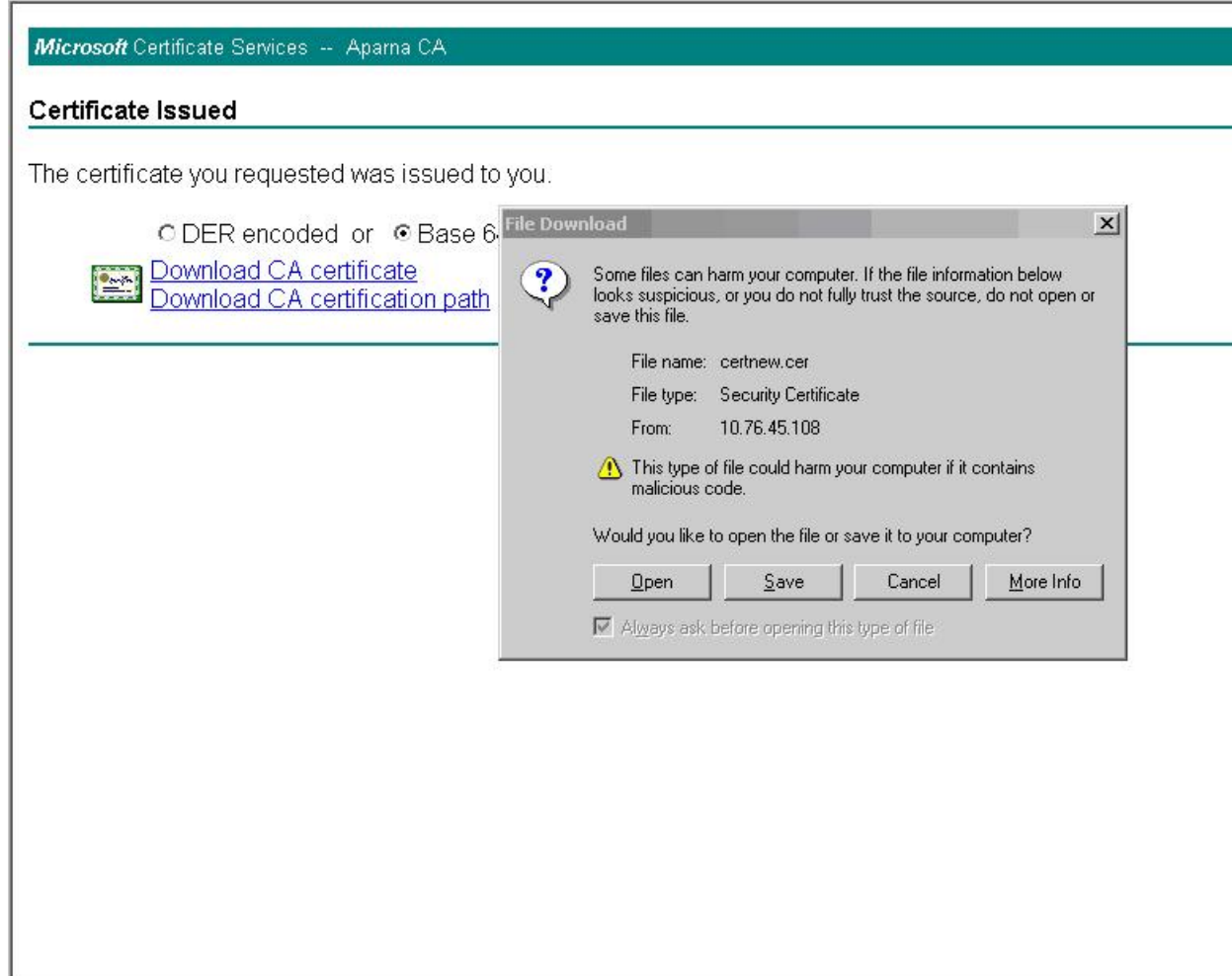
DER encoded or  Base 64 encoded



[Download CA certificate](#)

[Download CA certification path](#)

**Step 10** In the File Download dialog box, click **Open**.




The screenshot shows the Microsoft Certificate Services console window titled "Microsoft Certificate Services -- Aparna CA". The main content area displays "Certificate Issued" and the message "The certificate you requested was issued to you." Below this, there are radio buttons for "DER encoded" and "Base 64" (which is selected). There are two blue links: "Download CA certificate" and "Download CA certification path".

Overlaid on the console is a "File Download" dialog box. The dialog box contains the following text:

Some files can harm your computer. If the file information below looks suspicious, or you do not fully trust the source, do not open or save this file.

File name: certnew.cer  
File type: Security Certificate  
From: 10.76.45.108

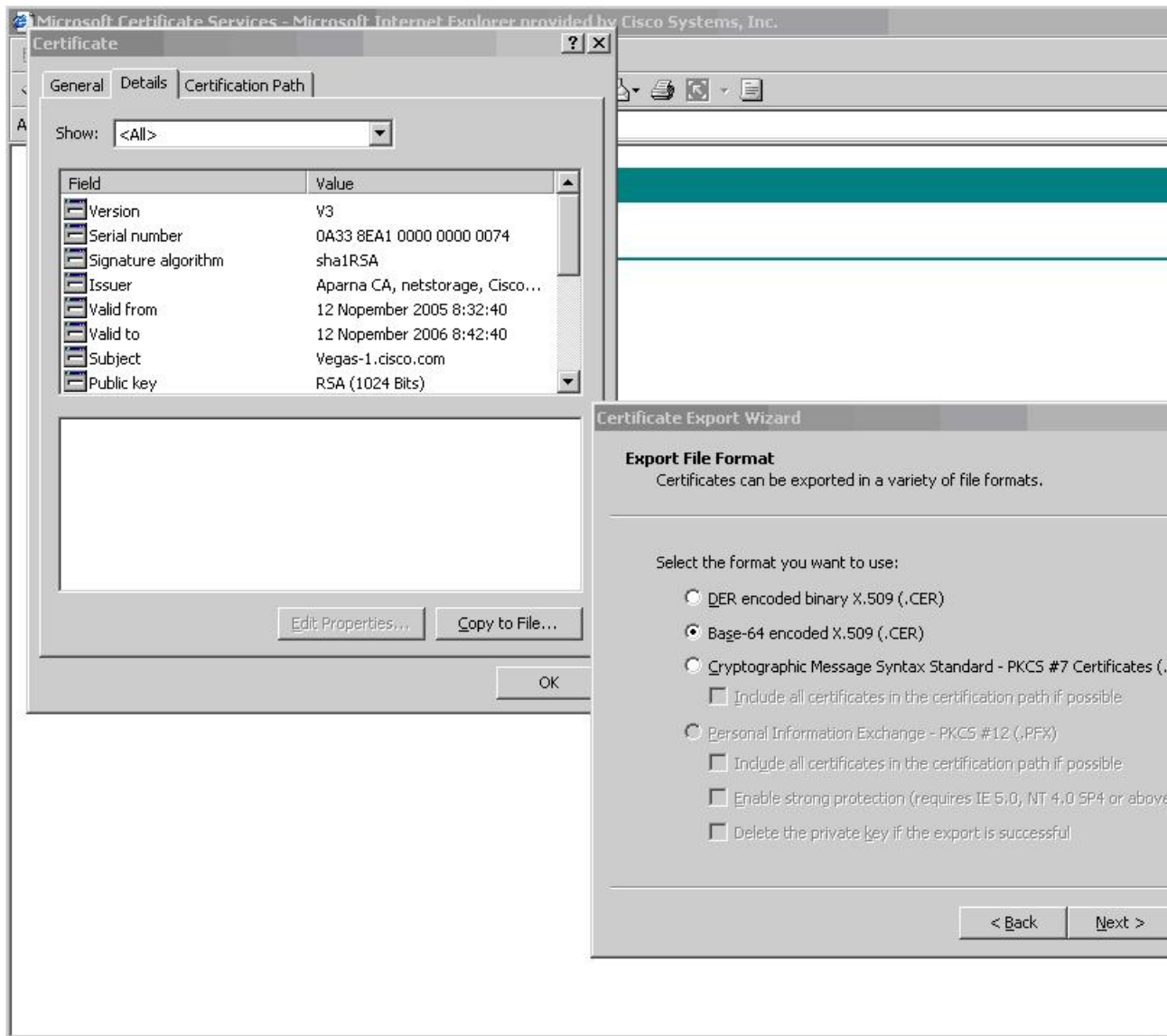
 This type of file could harm your computer if it contains malicious code.

Would you like to open the file or save it to your computer?

Buttons:

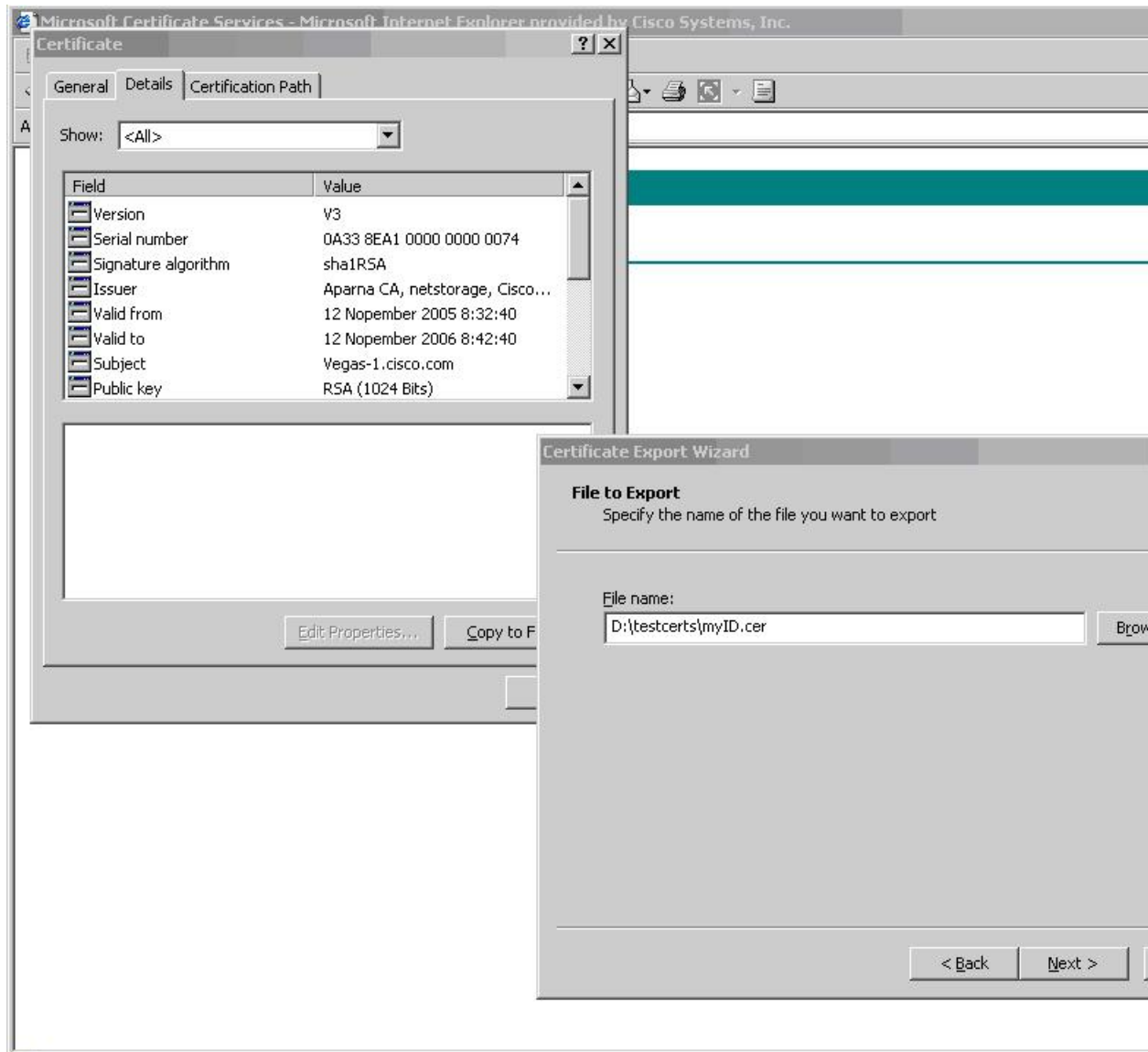
Always ask before opening this type of file

**Step 11** In the Certificate box, click **Details** tab and click **Copy to File...**. In the Certificate Export Dialog box, click **Base-64 encoded X.509 (.CER)**, and click **Next**.

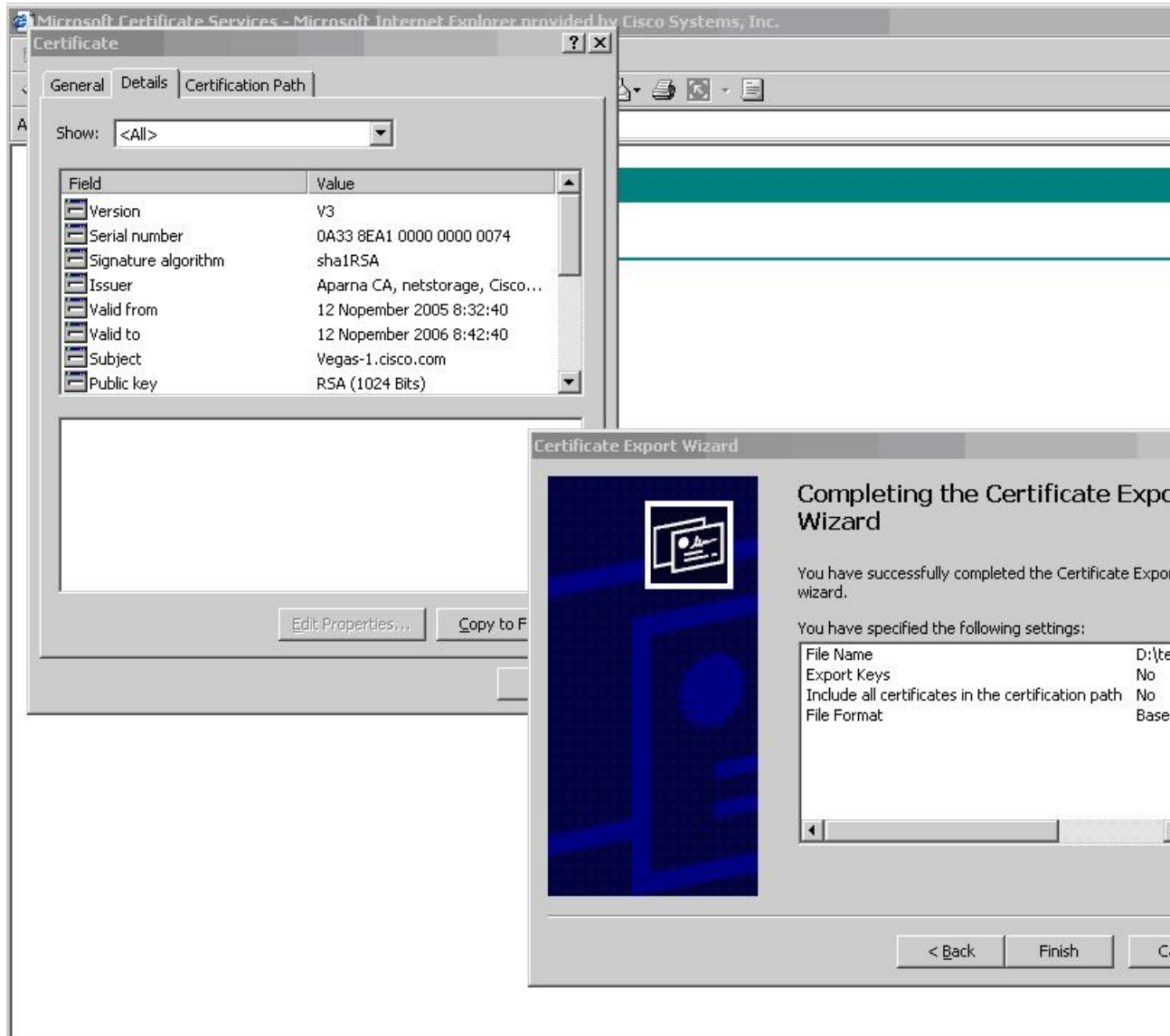


**Step 12** In the File name: text box on the Certificate Export Wizard dialog box, enter the destination file name and click **Next**.

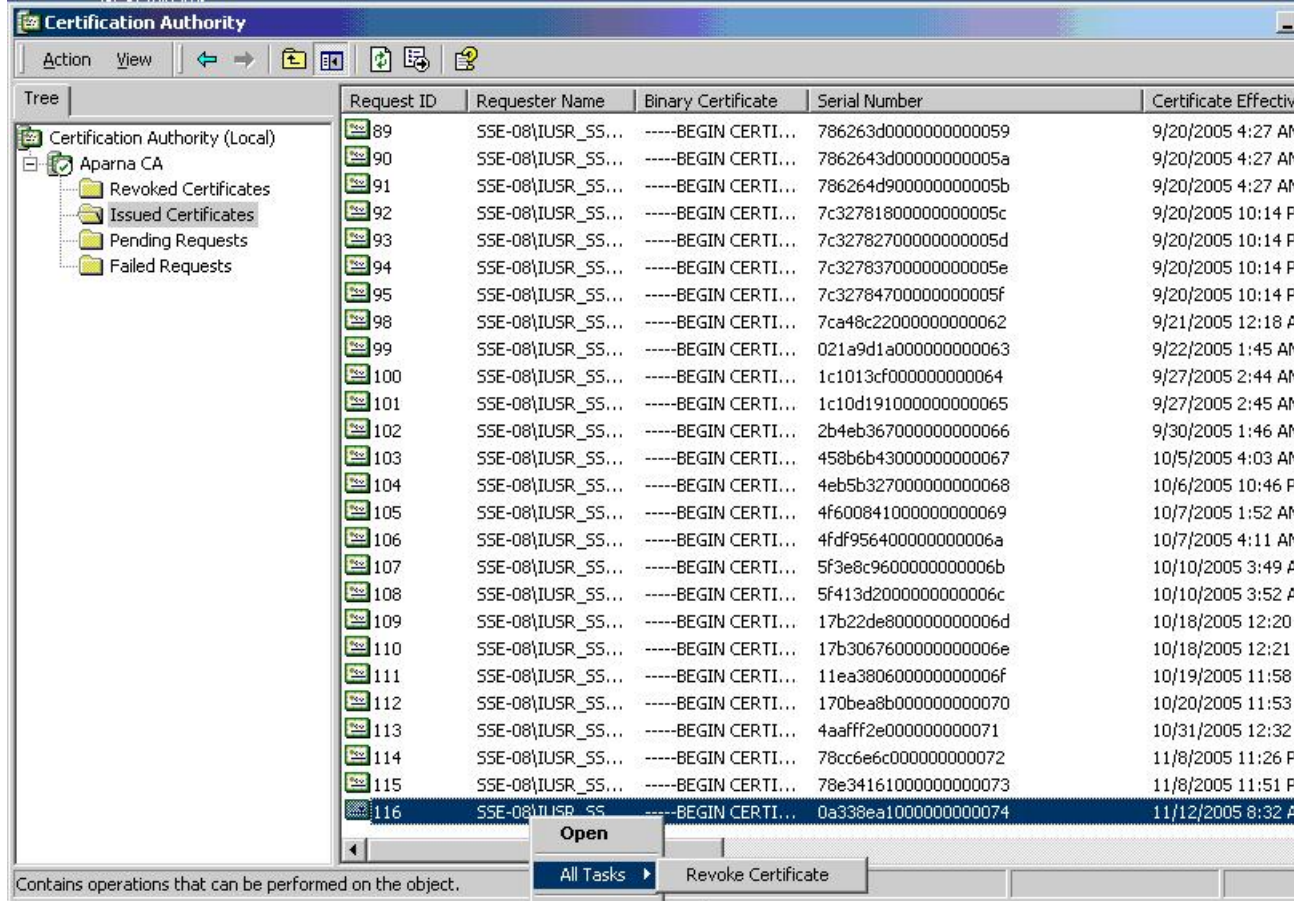




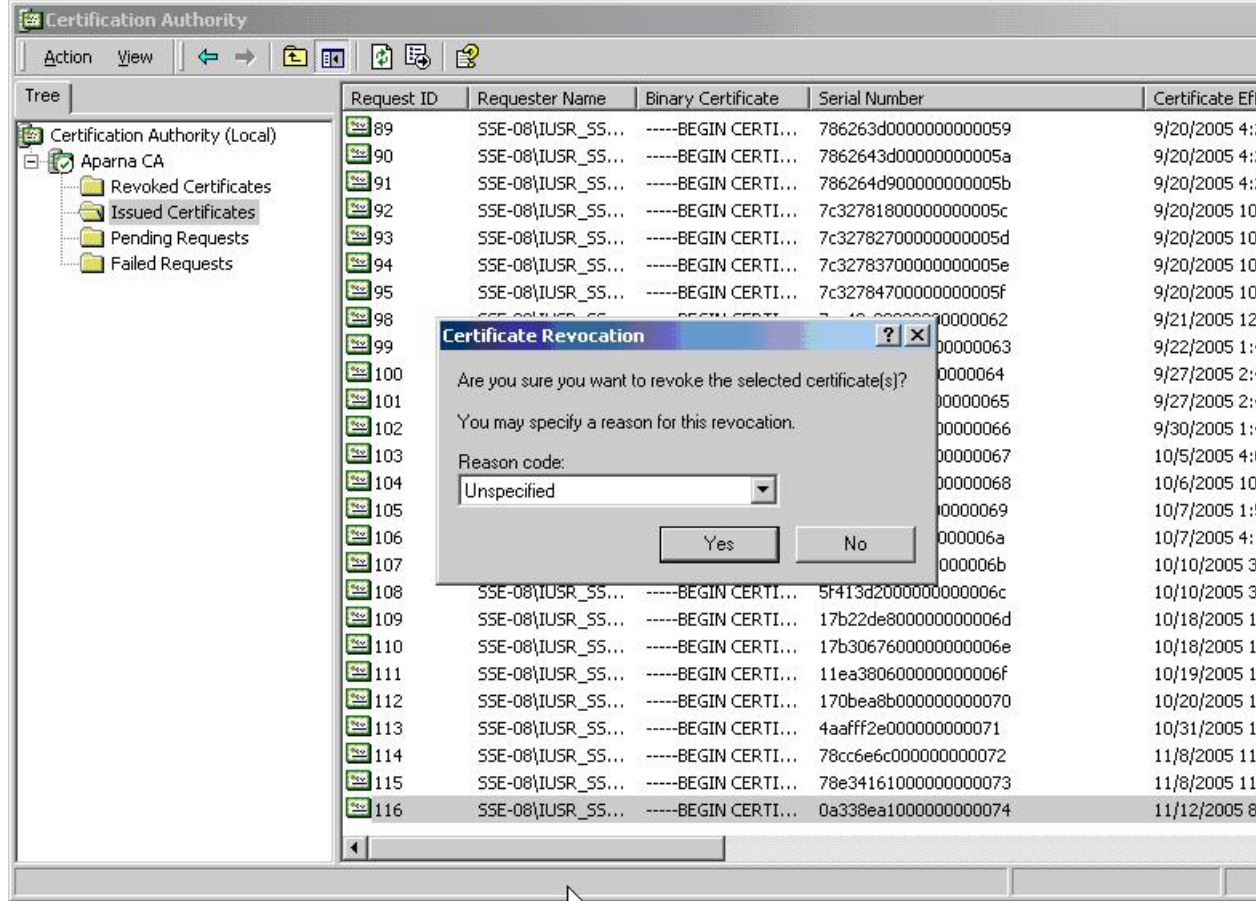
**Step 13** Click **Finish**.



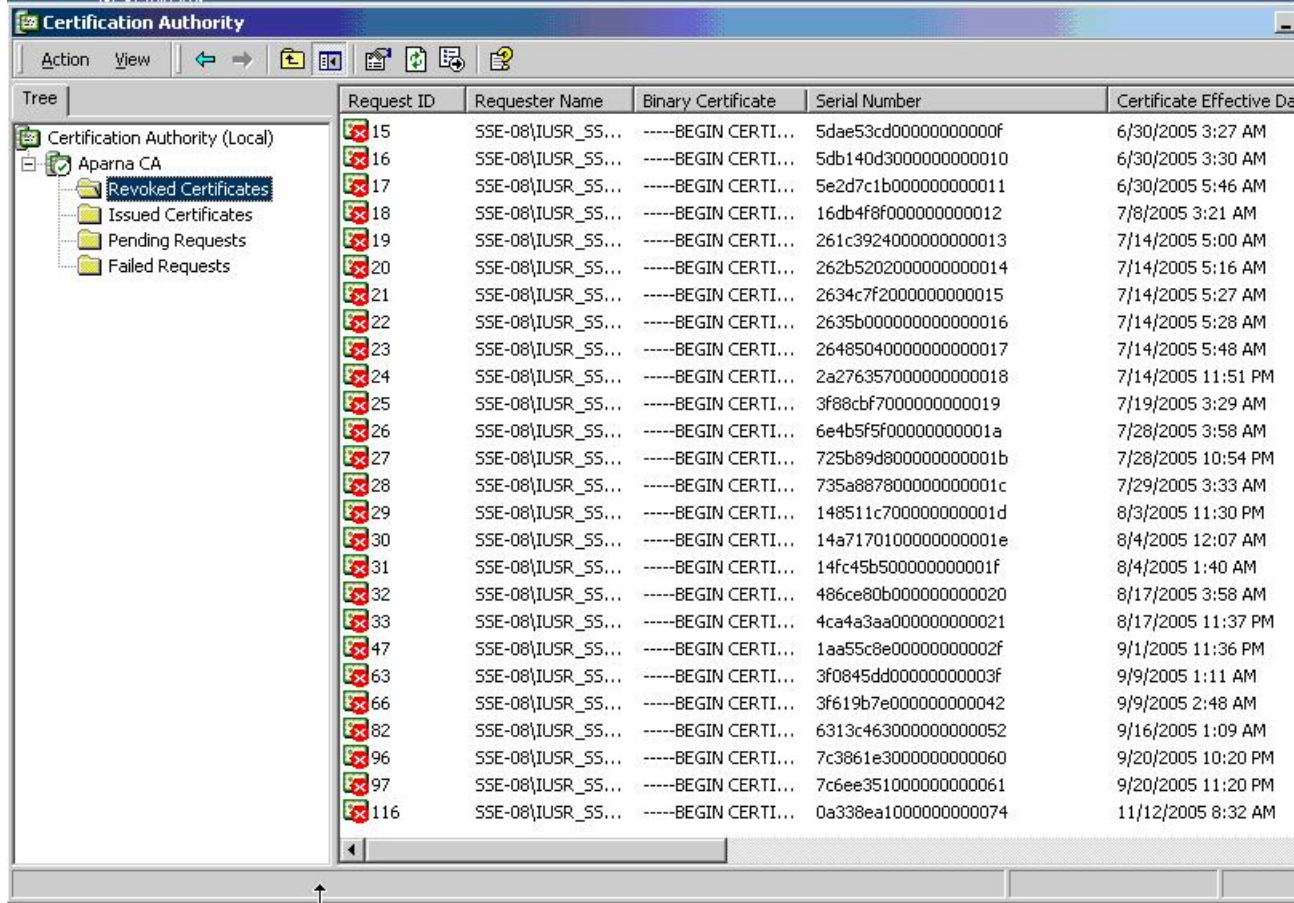


**Step 2** Choose **All Tasks > Revoke Certificate**.

**Step 3** From the Reason code drop-down list, choose a reason for the revocation and click **Yes**.



**Step 4** Click the **Revoked Certificates** folder to list and verify the certificate revocation.

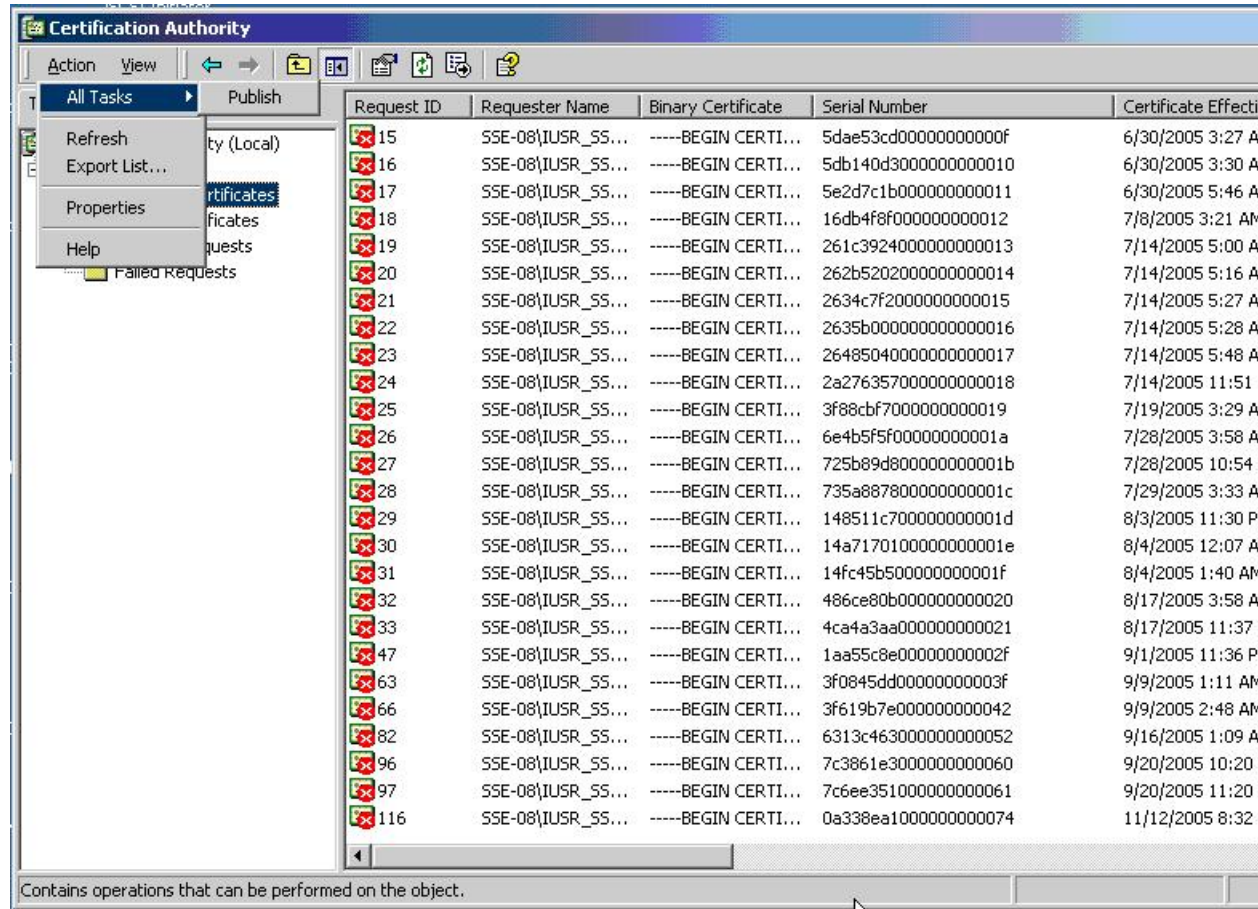


## Generating and Publishing the CRL

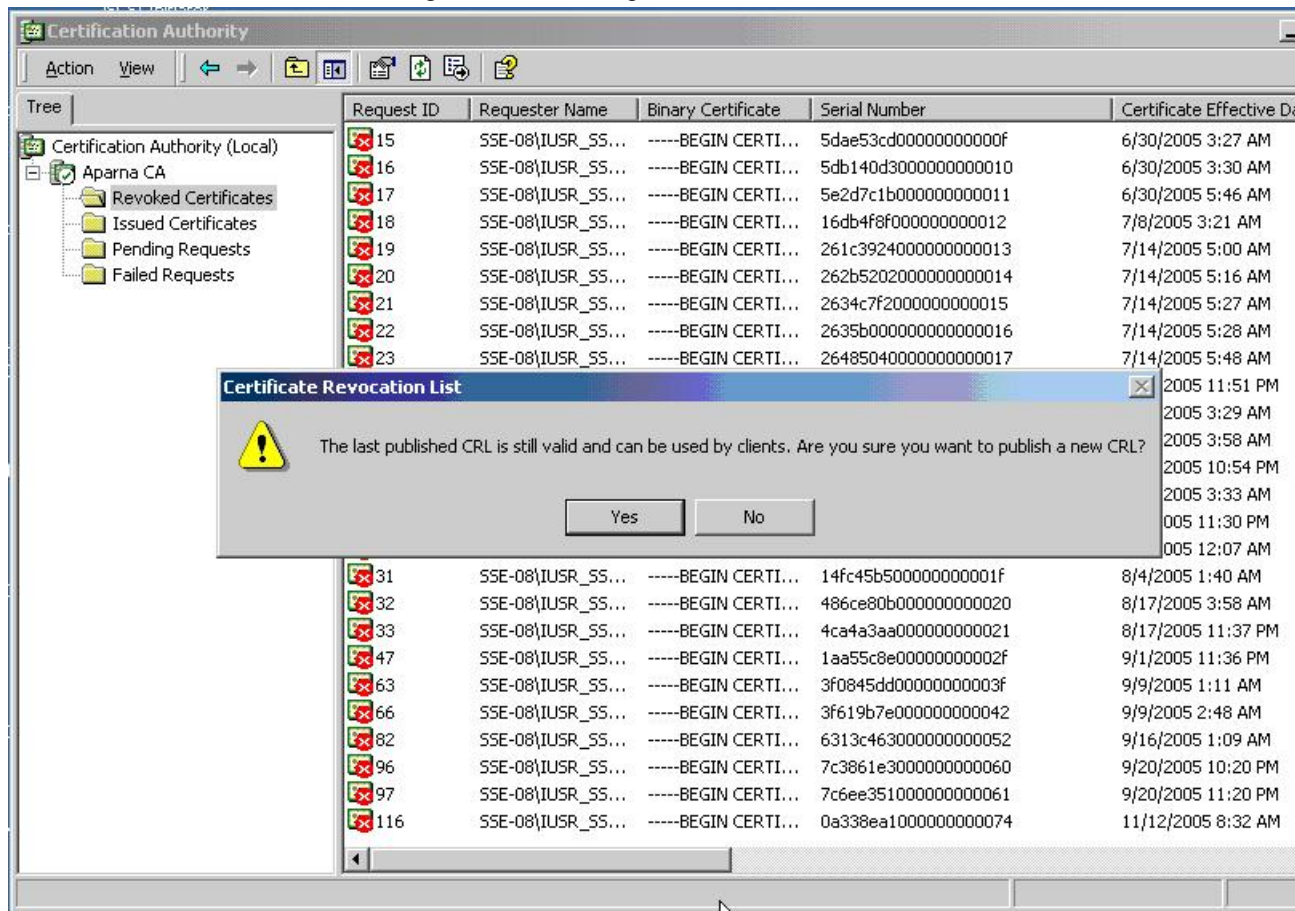
To generate and publish the CRL using the Microsoft CA administrator program, follow these steps:

**Procedure**

**Step 1** From the Certification Authority screen, choose **Action > All Tasks > Publish**.



**Step 2** In the Certificate Revocation List dialog box, click **Yes** to publish the latest CRL.



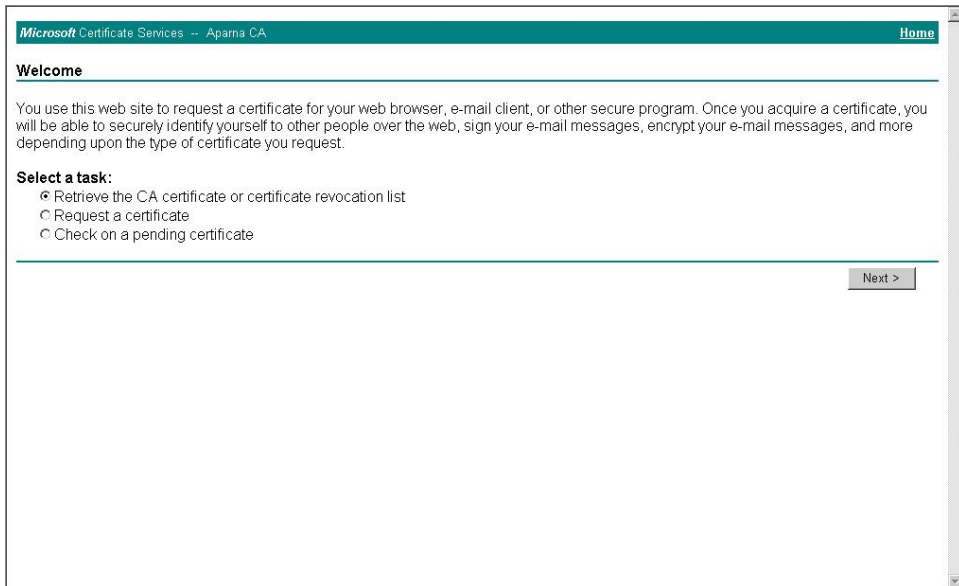
## Downloading the CRL

To download the CRL from the Microsoft CA website, follow these steps:

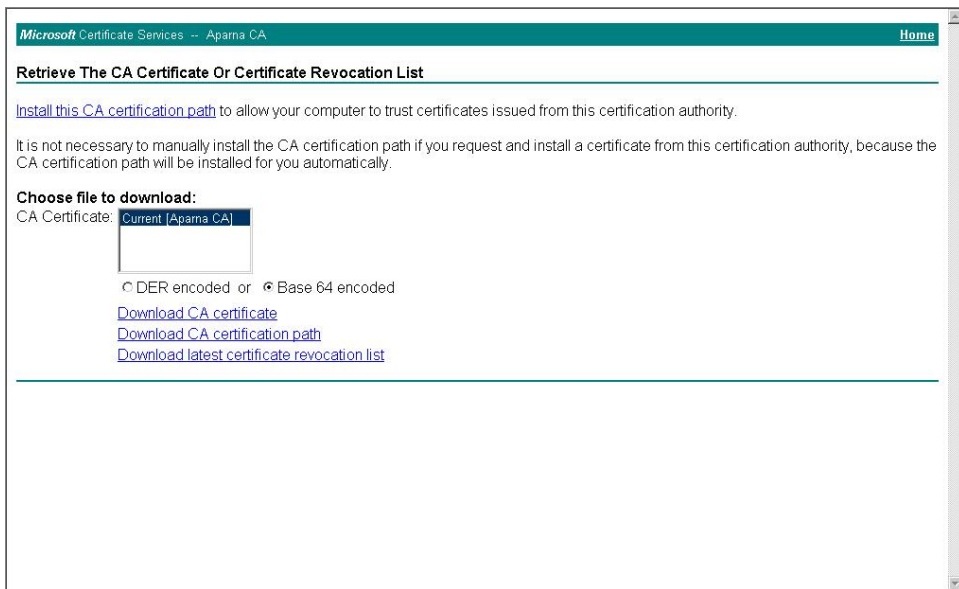


### Procedure

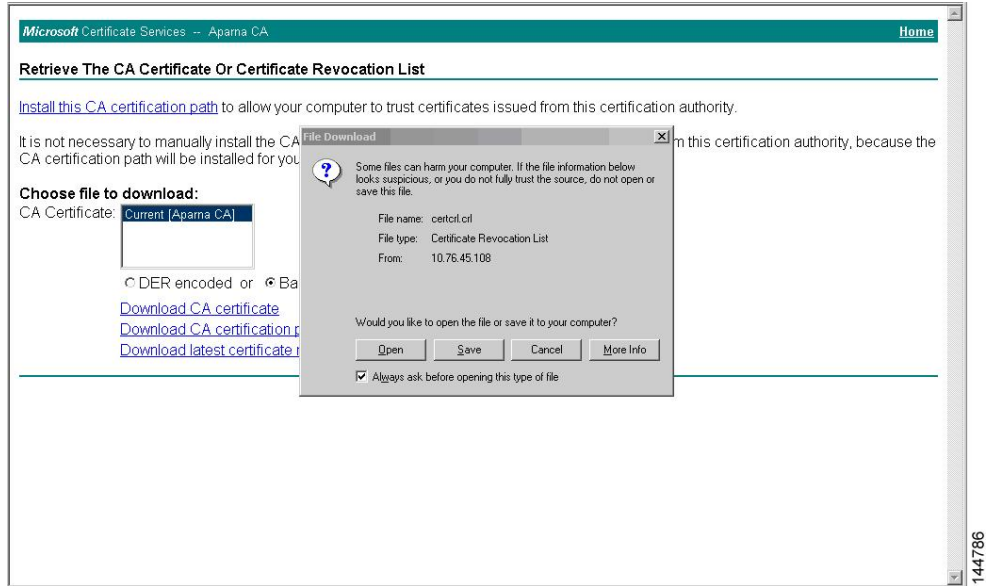
**Step 1** From the Microsoft Certificate Services web interface, click **Retrieve the CA certificate or certificate revocation list** and click **Next**.



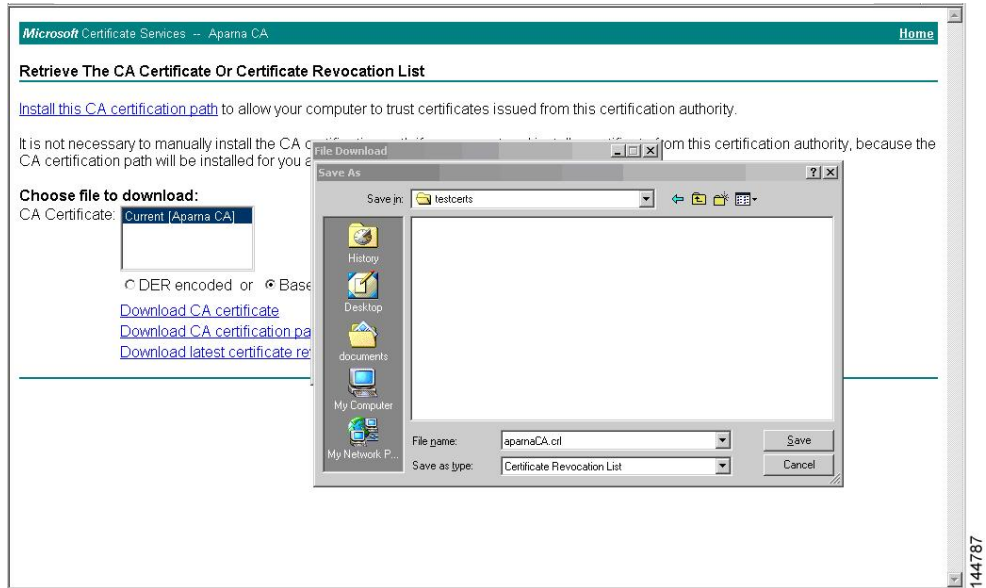
**Step 2** Click **Download latest certificate revocation list**.



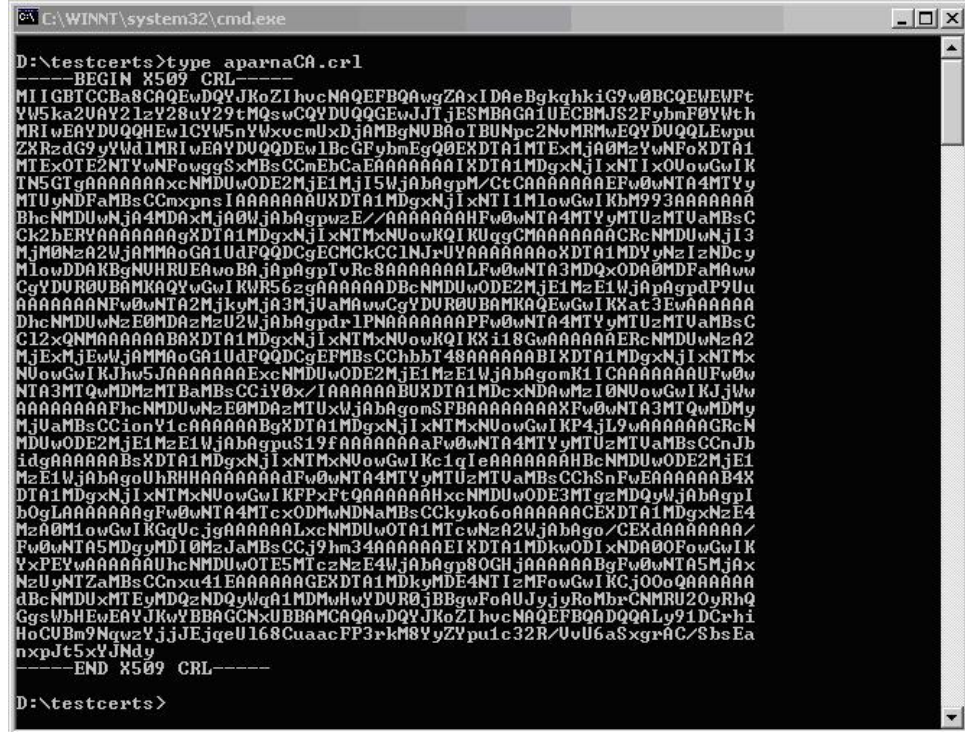
**Step 3** In the File Download dialog box, click **Save**.



**Step 4** In the Save As dialog box, enter the destination file name and click **Save**.



**Step 5** Enter the Microsoft Windows **type** command to display the CRL.



```

C:\WINNT\system32\cmd.exe
D:\testcerts>type aparnaCA.crl
-----BEGIN X509 CRL-----
MIIGBTCCBa8CAQEwDQYJKoZIhvcNAQEFBQAwwZANIDAEBgkqhkiG9w0BCQEWEWFt
YW5ka2UAY21zY28uY29tMQswCQYDUQGEwJITjESMBAGA1UECBMJS2FybmF0YVth
MRIwEAYDUQEHw1CYW5nYWxvcmluXDJjAMBgNURBAoIBUNpc2NvMRRMwEQYDUQQLWpu
ZXRzdG9yYVdlMmRlYEAyDUQDEwLBCGFybmEgQ0EXDTA1MTExMjA0MzYwNFoXDTA1
MTExOTI2NTYwNFowggSxMBsCCmEBCAFAAAAAAAAAIXDTA1MDgxnJlXNTI1MlowGwI
KbM993AAAAAAAAA
BhcNMDUwNjA4MDAxMjA0WjAbaGpwezE/AAAAAAAAAFw0wNTA4MTYyMTUzMTUaMBsC
Ck2bERYAAAAAAAAgXDTA1MDgxnJlXNTMxNUowKQIKUggCMAAAAAAAAAACRcNMDUwNjI3
MjM0NDA2WjAMMAoGA1UdFQDDCgEChCC1NjxUYAAAAAAAAoXDTA1MDYyMzIzNDcy
MlowDDAKBgNURUEAwwBAjAbaGpTvrRc8AAAAAAAAALFw0wNTA3MDQxODAwMDFAFAww
CgYDUUR0UwBAMKAQYwGwIKWR56zgAAAAAAAAADBCNMDUwODE2MjE1MzE1WjAbaGpP9Uu
AAAAAAAAAFw0wNTA2MjkyMjA3MjUaMAwwCgYDUUR0UwBAMKAQYwGwIKKXat3EwAAAAA
DhcNMDUwNzE0MDAzMzU2WjAbaGpdr1PNAAAAAAAAAFw0wNTA4MTYyMTUzMTUaMBsC
C12xQNMAAAAAAAAABAxDTA1MDgxnJlXNTMxNUowKQIKXi18GwAAAAAAAAERcNMDUwNzA2
MjE1MjE1WjAbaGpdr1PNAAAAAAAAAFw0wNTA4MTYyMTUzMTUaMBsC
NUowGwIKJhw5JAAAAAAAAEhcNMDUwODE2MjE1MzE1WjAbaGpdr1PNAAAAAAAAAFw0w
NTA3MTQwMDMzMTBaMBsCCiY0x/IAAAAAAAAABUXDTA1MDc1NDAwMzI0NUowGwIKKjJW
AAAAAAAAAFhcNMDUwNzE0MDAzMzU2WjAbaGpdr1PNAAAAAAAAAFw0wNTA3MTQwMDMz
MjUaMBsCCionY1cAAAAAAAABgXDTA1MDgxnJlXNTMxNUowGwIKP4jL9wAAAAAAAAAGReM
MDUwODE2MjE1MzE1WjAbaGpdr1PNAAAAAAAAAFw0wNTA4MTYyMTUzMTUaMBsCCnJb
idgAAAAAAAABsXDTA1MDgxnJlXNTMxNUowGwIKc1q1eAAAAAAAAAHBcNMDUwODE2MjE1
MzE1WjAbaGpUhhRHHAAAAAAAAADfW0wNTA4MTYyMTUzMTUaMBsCCChSnFwEAAAAAAAAAB4X
DTA1MDgxnJlXNTMxNUowGwIKFPxftQAAAAAAAAHxcNMDUwODE3MTgzMDQyWjAbaGpI
b0gLAAAAAAAAAAgFw0wNTA4MTcxODMwNDNaMBsCCkyko6oAAAAAAAAACEXDTA1MDgxnZ
E4MzA0M1owGwIKGgUcJgAAAAAAAAALxcNMDUwOTA1MTcwNzA2WjAbaGpO/CEXAAAAAAAA/
Fw0wNTA5MDg0MDI0MzA4MjA0MjE1MzE1WjAbaGp8OGHjAAAAAAAABgFw0wNTA5MjA0
NzUwNTZaMBsCCnxu41EAAAAAAAAGEXDTA1MDk0MDE4NTIzMFowGwIKCj00oQAAAAAAAA
dBcNMDUwMTExMDQzNDQyYUgA1MDMwHwYDUUR0jBBgwFoAUJyJyRoMbrCNMRU20yRhQ
GgsWbhEwEAYJKoYBBAQCNxUBBAMCAQAwwDQYJKoZIhvcNAQEFBQAwwDQYJKoZIhvcNAQ
HoCUBm9NgwYjJjEjEjU168CuaacFP3rkM8YyZYpu1c32R/Uu0a6SxgrAC/SbsEa
nXpJt5xYJNdY
-----END X509 CRL-----
D:\testcerts>

```

## Importing the CRL

To import the CRL to the trust point corresponding to the CA, follow these steps:

### Procedure

**Step 1** Copy the CRL file to the Cisco NX-OS device bootflash.

```
Device-1# copy tftp:aparnaCA.crl bootflash:aparnaCA.crl
```

**Step 2** Configure the CRL.

```
Device-1# configure terminal
Device-1(config)# crypto ca crl request myCA bootflash:aparnaCA.crl
Device-1(config)#
```

**Step 3** Display the contents of the CRL.

```
Device-1(config)# show crypto ca crl myCA
Trustpoint: myCA
CRL:
Certificate Revocation List (CRL):
    Version 2 (0x1)
```

```

Signature Algorithm: sha1WithRSAEncryption
Issuer: /emailAddress=admin@yourcompany.com/C=IN/ST=Karnatak
Yourcompany/OU=netstorage/CN=Aparna CA
Last Update: Nov 12 04:36:04 2005 GMT
Next Update: Nov 19 16:56:04 2005 GMT
CRL extensions:
  X509v3 Authority Key Identifier:
    keyid:27:28:F2:46:83:1B:AC:23:4C:45:4D:8E:C9:18:50:1
    1.3.6.1.4.1.311.21.1:
      ...
Revoked Certificates:
  Serial Number: 611B09A1000000000002
    Revocation Date: Aug 16 21:52:19 2005 GMT
  Serial Number: 4CDE464E000000000003
    Revocation Date: Aug 16 21:52:29 2005 GMT
  Serial Number: 4CFC2B42000000000004
    Revocation Date: Aug 16 21:52:41 2005 GMT
  Serial Number: 6C699EC2000000000005
    Revocation Date: Aug 16 21:52:52 2005 GMT
  Serial Number: 6CCF7DDC000000000006
    Revocation Date: Jun  8 00:12:04 2005 GMT
  Serial Number: 70CC4FFF000000000007
    Revocation Date: Aug 16 21:53:15 2005 GMT
  Serial Number: 4D9B1116000000000008
    Revocation Date: Aug 16 21:53:15 2005 GMT
  Serial Number: 52A80230000000000009
    Revocation Date: Jun 27 23:47:06 2005 GMT
  CRL entry extensions:
    X509v3 CRL Reason Code:
      CA Compromise
  Serial Number: 5349AD4600000000000A
    Revocation Date: Jun 27 23:47:22 2005 GMT
  CRL entry extensions:
    X509v3 CRL Reason Code:
      CA Compromise
  Serial Number: 53BD173C00000000000B
    Revocation Date: Jul  4 18:04:01 2005 GMT
  CRL entry extensions:
    X509v3 CRL Reason Code:
      Certificate Hold
  Serial Number: 591E7ACE00000000000C
    Revocation Date: Aug 16 21:53:15 2005 GMT
  Serial Number: 5D3FD52E00000000000D
    Revocation Date: Jun 29 22:07:25 2005 GMT
  CRL entry extensions:
    X509v3 CRL Reason Code:
      Key Compromise
  Serial Number: 5DAB771300000000000E
    Revocation Date: Jul 14 00:33:56 2005 GMT
  Serial Number: 5DAE53CD00000000000F
    Revocation Date: Aug 16 21:53:15 2005 GMT
  Serial Number: 5DB140D3000000000010
    Revocation Date: Aug 16 21:53:15 2005 GMT
  Serial Number: 5E2D7C1B000000000011
    Revocation Date: Jul  6 21:12:10 2005 GMT
  CRL entry extensions:
    X509v3 CRL Reason Code:
      Cessation Of Operation
  Serial Number: 16DB4F8F000000000012
    Revocation Date: Aug 16 21:53:15 2005 GMT
  Serial Number: 261C3924000000000013
    Revocation Date: Aug 16 21:53:15 2005 GMT
  Serial Number: 262B5202000000000014
    Revocation Date: Jul 14 00:33:10 2005 GMT

```

```

Serial Number: 2634C7F2000000000015
  Revocation Date: Jul 14 00:32:45 2005 GMT
Serial Number: 2635B000000000000016
  Revocation Date: Jul 14 00:31:51 2005 GMT
Serial Number: 26485040000000000017
  Revocation Date: Jul 14 00:32:25 2005 GMT
Serial Number: 2A276357000000000018
Revocation Date: Aug 16 21:53:15 2005 GMT
Serial Number: 3F88CBF7000000000019
  Revocation Date: Aug 16 21:53:15 2005 GMT
Serial Number: 6E4B5F5F00000000001A
  Revocation Date: Aug 16 21:53:15 2005 GMT
Serial Number: 725B89D800000000001B
  Revocation Date: Aug 16 21:53:15 2005 GMT
Serial Number: 735A887800000000001C
  Revocation Date: Aug 16 21:53:15 2005 GMT
Serial Number: 148511C700000000001D
  Revocation Date: Aug 16 21:53:15 2005 GMT
Serial Number: 14A7170100000000001E
  Revocation Date: Aug 16 21:53:15 2005 GMT
Serial Number: 14FC45B500000000001F
  Revocation Date: Aug 17 18:30:42 2005 GMT
Serial Number: 486CE80B000000000020
  Revocation Date: Aug 17 18:30:43 2005 GMT
Serial Number: 4CA4A3AA000000000021
  Revocation Date: Aug 17 18:30:43 2005 GMT
Serial Number: 1AA55C8E00000000002F
  Revocation Date: Sep  5 17:07:06 2005 GMT
Serial Number: 3F0845DD00000000003F
  Revocation Date: Sep  8 20:24:32 2005 GMT
Serial Number: 3F619B7E000000000042
  Revocation Date: Sep  8 21:40:48 2005 GMT
Serial Number: 6313C463000000000052
  Revocation Date: Sep 19 17:37:18 2005 GMT
Serial Number: 7C3861E3000000000060
  Revocation Date: Sep 20 17:52:56 2005 GMT
Serial Number: 7C6EE351000000000061
  Revocation Date: Sep 20 18:52:30 2005 GMT
Serial Number: 0A338EA1000000000074  <-- Revoked identity certificate
  Revocation Date: Nov 12 04:34:42 2005 GMT
Signature Algorithm: sha1WithRSAEncryption
0b:cb:dd:43:0a:b8:62:1e:80:95:06:6f:4d:ab:0c:d8:8e:32:
44:8e:a7:94:97:af:02:b9:a6:9c:14:fd:eb:90:cf:18:c9:96:
29:bb:57:37:d9:1f:d5:bd:4e:9a:4b:18:2b:00:2f:d2:6e:c1:
1a:9f:1a:49:b7:9c:58:24:d7:72
    
```

**Note** The identity certificate for the device that was revoked (serial number 0A338EA1000000000074) is listed at the end.

