



PKI Trustpool Management

The PKI Trustpool Management feature is used to authenticate sessions, such as HTTPS, that occur between devices by using commonly recognized trusted agents called certificate authorities (CAs).

Trustpool certificates are well-known CA certificates with which you can establish trust. IOS PKI has both built-in CAs and also has an option to download trustpool bundle. Built-in CA certificates are used to verify PKCS7 signature of downloaded trustpool bundle. You can download the trustpool bundle if signature verification fails. You can delete Built-in trustpool certificates. Trustpool certificates are used by applications such as SSLVPN, PnP, Smart License, MacSec and so on.

This feature, which is enabled by default, is used to create a scheme to provision, store, and manage a pool of certificates from known CAs in a way similar to the services a browser provides for securing sessions.



Note Effective with Cisco IOS XE Denali 16.3, the way PKI Trustpools are managed have changed. If you are planning to upgrade to this release, please review the changes to the feature captured below as part of *PKI Trustpool Enhancements* section.

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Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for PKI Trustpool Management

The use of certificates requires that a crypto subsystem is included in the Cisco IOS software image.

Restrictions for PKI Trustpool Management

Device certificates that use CA certificates cannot be enrolled in a PKI trustpool.

Information About PKI Trustpool Management

CA Certificate Storage in a PKI Trustpool

The router uses a built-in CA certificate bundle that is contained in a special certificate store called a PKI trustpool, which is updated automatically from Cisco. This PKI trustpool is known by Cisco and other vendors. A CA certificate bundle can be in the following formats:

- X.509 certificates in Distinguished Encoding Rules (DER) binary format enveloped within a public-key cryptographic message syntax standard 7 (pkcs7), which is used to sign and encrypt messages under a PKI. An X.509 certificate is a PKI and Privilege Management Infrastructure (PMI) standard that specifies, among other things, standard formats for public key certificates, certificate revocation lists, attribute certificates, and a certification path validation algorithm.
- A file containing concatenated X.509 certificates in Privacy Enhanced Mail (PEM) format with PEM headers.



Note Flash can also be used as the storage location for the bundles instead of NVRAM.

PKI Trustpool Updating

The PKI trustpool is treated as a single entity that needs to be updated when the following conditions occur:

- A certificate in the PKI trustpool is due to expire or has been reissued.
- The published CA certificate bundle contains additional trusted certificates that are needed by a given application.
- The configuration has been corrupted.



Note A built-in certificate in the PKI trustpool cannot be physically replaced. However, a built-in certificate is rendered inactive after an update if its X.509 subject-name attribute matches the certificate in the CA certificate bundle.

The PKI trustpool can be updated automatically or manually. The PKI trustpool may be used by certificate validation depending upon the application using it. See the "Manually Updating Certificates in the PKI Trustpool" and "Configuring Optional PKI Trustpool Policy Parameters" sections for more information.



Note During auto-update all the existing downloaded trustpool certificates must be deleted.

The PKI trustpool timer matches the CA certificate with the earliest expiration time. If the timer is running and a bundle location is not configured and not explicitly disabled, syslog warnings are issued to alert the administrator that the PKI trustpool policy option is not set.

Automatic PKI trustpool updates use the configured URL.

When the PKI trustpool expires, the policy is read, the bundle is loaded, and the PKI trustpool is replaced. If the automatic PKI trustpool update encounters problems when initiating, then the following schedule is used to initiate the update until the download is successful: 20 days, 15 days, 10 days, 5 days, 4 days, 3 days, 2 days, 1 day, and then once every hour.

CA Handling in Both PKI Trustpool and Trustpoint

There may be circumstances where a CA resides in both PKI trustpool and trustpoint; for example, a trustpoint uses a CA and a CA bundle is downloaded later with the same CA inside. In this scenario, the CA in the trustpoint and the policy of this trustpoint is considered before the CA in the PKI trustpool or PKI trustpool policy to ensure that any current behavior is not altered when the PKI Trustpool Management feature is implemented on the router.

PKI Trustpool Enhancements

In releases earlier than Cisco IOS XE Denali 16.3, the trustpool consists of built-in certificates deployed with every Cisco box and downloaded CA certificates from published bundles. The downloaded certificates are saved in NVRAM, by default. The certificates from the downloaded trustpool bundle would be extracted and stored in the running configuration which was inefficient and utilized too much space.

From Cisco IOS XE Denali 16.3, the PKI trustpool enhancements stores the bundles in the same downloaded bundle format as one file in the storage location (default is NVRAM) instead of individual certificates like in the previous releases. This helps in saving storage memory as the file is in compressed format. Also, the certificates are not displayed individually in the running configuration. On every reboot the bundles are read from the storage location and individual certificates are installed in the database.

This feature removes the current downloaded certificates from the running configuration. The **crypto pki certificate pool** will not have the DER format certificates because these certificates are incompatible with the old NVRAM file and the new images. During upgrade, the trustpool certificates in DER format are lost and the bundles must be reinstalled again in the storage. This is indicated by a syslog during reboot in case of old NVRAM files. The **show crypto pki trustpool** command indicates that the configuration has been removed. Before you upgrade, use the **show crypto pki trustpool** command to verify that the certificates are available.

The following steps must be followed before upgrading to Cisco IOS XE Denali 16.3 :

- Remove the downloaded trustpool certificates using the **crypto pki trustpool clean** command
- Use the **write memory** command

- Reboot the device
- Download the trustpool bundles using the `crypto pki trustpool import url` command

If you are using trustpool certificates to log into SSH, then you need to follow additional steps to transfer that specific certificate from bundle to a trustpoint. See *Example: Using PKI Trustpool for SSH Connection During Upgrade* for more information.

How to Configure PKI Trustpool Management

Manually Updating Certificates in the PKI Trustpool

The PKI Trustpool Management feature is enabled by default and uses the built-in CA certificate bundle in the PKI trustpool, which receives automatic updates from Cisco. Perform this task to manually update certificates in the PKI trustpool if they are not current, are corrupt, or if certain certificates need to be updated.

SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `crypto pki trustpool import clean [terminal | url url]`
4. `crypto pki trustpool import {terminal} {url url | ca-bundle} {vrf vrf-name | source interface interface-name}`
5. `exit`
6. `show crypto pki trustpool`

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: <pre>Device> enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: <pre>Device# configure terminal</pre>	Enters global configuration mode.
Step 3	crypto pki trustpool import clean [terminal url url] Example: <pre>Device(config)# crypto pki trustpool import clean</pre>	(Optional) Manually removes all downloaded PKI CA certificates. <ul style="list-style-type: none"> • The clean keyword specifies the removal of the downloaded PKI trustpool certificates before the new certificates are downloaded. • The terminal keyword removes the existing CA certificate bundle terminal setting.

	Command or Action	Purpose
		<ul style="list-style-type: none"> The url keyword and <i>url</i> argument removes the existing URL file system setting.
Step 4	<p>crypto pki trustpool import {terminal} {url <i>url</i> ca-bundle} {vrf <i>vrf-name</i> source interface <i>interface-name</i>}</p> <p>Example:</p> <pre>Device(config)# crypto pki trustpool import url http://www.cisco.com/security/pki/trs/ios.p7b</pre>	<p>Manually imports (downloads) the CA certificate bundle into the PKI trustpool to update or replace the existing CA certificate bundle.</p> <ul style="list-style-type: none"> The terminal keyword specifies the importation of a CA certificate bundle through the terminal (cut-and-paste) in PEM format. The url keyword with the <i>url</i> argument specifies the importation of a CA certificate bundle through a URL. This URL can be through a variety of URL file systems such as HTTP. See the <i>PKI Trustpool Updating</i> section for more information. In CA bundle, you can use the crypto pki trustpool import command to pass the traffic through global VRF. Also, the traffic will not divert through a VRF, when you configure the crypto pki trustpool policy command specifying the VRF and source interface.
Step 5	<p>exit</p> <p>Example:</p> <pre>Device(config)# exit</pre>	Exits global configuration mode.
Step 6	<p>show crypto pki trustpool</p> <p>Example:</p> <pre>Device(config)# show crypto pki trustpool</pre>	Displays the PKI trustpool certificates of the router in a verbose format.

Configuring Optional PKI Trustpool Policy Parameters

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **crypto pki trustpool policy**
4. **cabundle url** {*url* | none}
5. **chain-validation**
6. **cr1** {cache {delete-after {*minutes* | none} | query *url*}
7. **default** *command-name*
8. **match certificate** *certificate-map-name* [allow expired-certificate | override {cdp directory *ldap-location* | oosp {*number url url* | trustpool *name number url url*} | sia *number url*} | skip [revocation-check | authorization-check]]
9. **oosp** {disable-nonce | *url url*}

10. **revocation-check** *method1* [*method2* [*method3*]]
11. **source interface** *name number*
12. **storage** *location*
13. **vrf** *vrf-name*
14. **show**

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	crypto pki trustpool policy Example: Device(config)# crypto pki trustpool policy Device(ca-trustpool)#	Enters ca-trustpool configuration mode where commands can be accessed to configure CA PKI trustpool policy parameters. The trustpool policy only affects the crl retrieval process and has no effect on trustpool import process.
Step 4	cabundle url { <i>url</i> none } Example: Device(ca-trustpool)# cabundle url http://www.cisco.com/security/pki/crl/crca2048.crl	Specifies the URL from which the PKI trustpool certificate authority CA certificate bundle is downloaded . <ul style="list-style-type: none"> • The <i>url</i> argument is the URL of the CA certificate bundle. • The none keyword specifies that autoupdates of the PKI trustpool CA are not permitted.
Step 5	chain-validation Example: Device(ca-trustpool)# chain-validation	Enables chain validation from the peer's certificate to the root CA certificate in the PKI trustpool. The default has validation stopping at the peer certificate's issuer.
Step 6	crl { cache { delete-after { <i>minutes</i> none } query url } Example: Device(ca-trustpool)# crl query http://www.cisco.com/security/pki/crl/crca2048.crl	Specifies the certificate revocation list (CRL) query and CRL cache options for the PKI trustpool. <ul style="list-style-type: none"> • The cache keyword specifies CRL cache options. • The delete-after keyword removes the CRL from the cache after a timeout. • The <i>minutes</i> argument is the number of minutes from 1 to 43,200 to wait before deleting the CRL from the cache.

	Command or Action	Purpose
		<ul style="list-style-type: none"> The none keyword specifies that CRLs are not cached. The query keyword with the <i>url</i> argument specifies the URL published by the CA server to query the CRL.
<p>Step 7</p>	<p>default <i>command-name</i></p> <p>Example:</p> <pre>Device(ca-trustpool)# default crl query http://www.cisco.com/security/pki/crl/crca2048.crl</pre>	<p>Resets the value of a ca-trustpool configuration subcommand to its default .</p> <ul style="list-style-type: none"> The <i>command-name</i> argument is the ca-trustpool configuration mode command with its applicable keywords.
<p>Step 8</p>	<p>match certificate <i>certificate-map-name</i> [allow expired-certificate override {cdp directory ldap-location ocsp {<i>number url url</i> trustpool name number url url} sia number url} skip [revocation-check authorization-check]]</p> <p>Example:</p> <pre>match certificate mycert override ocsp 1 url http://ocspts.identrust.com</pre>	<p>Enables the use of certificate maps for the PKI trustpool.</p> <ul style="list-style-type: none"> The <i>certificate-map-name</i> argument matches the certificate map name. The optional allow expired-certificate keyword ignores expired certificates. <p>Note If this keyword is not configured, the router does not ignore expired certificates.</p> <ul style="list-style-type: none"> The override keyword overrides the online certificate status protocol (OCSP) or SubjectInfoAccess (SIA) attribute fields in a certificate that is in the PKI trustpool. The cdp keyword overrides the certificate distribution point (CDP) in a certificate. The directory keyword and <i>ldap-location</i> specifies the CDP in either the http: or ldap: URL, or LDAP directory to override in the certificate. The ocsp keyword and <i>number</i> argument and url keyword and <i>url</i> argument specifies the OCSP sequence number from 0 to 10000 and URL to override in the certificate. The trustpool keyword and <i>name</i> and <i>number</i> arguments with the url keyword and <i>url</i> argument override the PKI trustpool for verifying the OCSP certificate by specifying the PKI trustpool name, sequence number, and URL. The sia keyword and <i>number</i> and <i>url</i> arguments override the SIA URL in a certificate by specifying the SIA sequence number and URL.

	Command or Action	Purpose
		<ul style="list-style-type: none"> The optional skip revocation-check keyword combination allows the PKI trustpool to enforce certificate revocation lists (CRLs) except for specific certificates. <p>Note If this keyword combination is not configured, then the PKI trustpool enforces CRLs for all certificates.</p> <ul style="list-style-type: none"> The optional skip authorization-check keyword combination skips the authentication, authorization, and accounting (AAA) check of a certificate when public key infrastructure (PKI) integration with an AAA server is configured. <p>Note If this keyword combination is not configured, and PKI integration with an AAA server is configured, then the AAA checking of a certificate is done.</p>
Step 9	<p>ocsp {disable-nonce url <i>url</i>}</p> <p>Example:</p> <pre>Device(ca-trustpool)# ocspt url http://ocspts.identrust.com</pre>	<p>Specifies OCSP settings for the PKI trustpool.</p> <ul style="list-style-type: none"> The disable-nonce keyword disables the OCSP Nonce extension. The url keyword and <i>url</i> argument specify the OCSP server URL to override (if one exists) in the Authority Info Access (AIA) extension of the certificate. All certificates associated with a configured PKI trustpool are checked by the OCSP server at the specified HTTP URL. The URL can be a hostname, IPv4 address, or an IPv6 address.
Step 10	<p>revocation-check <i>method1</i> [<i>method2</i> [<i>method3</i>]]</p> <p>Example:</p> <pre>Device(ca-trustpool)# revocation-check ocspt crl none</pre>	<p>Disables revocation checking when the PKI trustpool policy is being used. The <i>method</i> argument is used by the router to check the revocation status of the certificate. Available keywords are as follows:</p> <ul style="list-style-type: none"> The crl keyword performs certificate checking by a certificate revocation list (CRL). This is the default behavior. The none keyword does not require a certificate checking. The ocsp keyword performs certificate checking by an online certificate status protocol (OCSP) server. <p>If a second and third method are specified, each method is used only if the previous method returns an error, such as a server being down.</p>

	Command or Action	Purpose
Step 11	<p>source interface <i>name number</i></p> <p>Example:</p> <pre>Device(ca-trustpool)# source interface tunnel 1</pre>	<p>Specifies the source interface to be used for CRL retrieval, OCSP status, or the downloading of a CA certificate bundle for the PKI trustpool .</p> <ul style="list-style-type: none"> The <i>name</i> and <i>number</i> arguments are for the interface type and number used as the source address for the PKI trustpool.
Step 12	<p>storage <i>location</i></p> <p>Example:</p> <pre>Device(ca-trustpool)# storage storage disk0:crca2048.crl</pre>	<p>Specifies a file system location where PKI trustpool certificates are stored on the router.</p> <ul style="list-style-type: none"> The <i>location</i> is the file system location where the PKI trustpool certificates are stored. The types of file system locations are disk0:, disk1:, nvrn:, unix:, or a named file system.
Step 13	<p>vrf <i>vrf-name</i></p> <p>Example:</p> <pre>Device(ca-trustpool)# vrf myvrf</pre>	<p>Specifies the VPN routing and forwarding (VRF) instance to be used for enrolment, CRL retrieval, and OCSP status.</p>
Step 14	<p>show</p> <p>Example:</p> <pre>Device(ca-trustpool)# show Chain validation will stop at the first CA certificate in the pool Trustpool CA certificates will expire 12:58:31 PST Apr 5 2012 Trustpool policy revocation order: crl Certificate matching is disabled Policy Overrides:</pre>	<p>Displays the PKI trustpool policy of the router.</p>

Configuration examples for PKI Trustpool Management

Example: Configuring PKI Trustpool Management

The following **show crypto pki trustpool** command output displays the certificates in PKI trustpool:



Note The command output in this example is abridged because it is verbose.

```
Device# show crypto pki trustpool

CA Certificate
  Status: Available
  Version: 3
```

Example: Configuring PKI Trustpool Management

```

Certificate Serial Number (hex): 00D01E47400000111C38A96440000002
Certificate Usage: Signature
Issuer:
  cn=DST Root CA X3
  o=Digital Signature Trust Co.
Subject:
  cn=Cisco SCA
  o=Cisco Systems
CRL Distribution Points:
  http://crl.identrust.com/DSTROOTCA3.crl
Validity Date:
  start date: 12:58:31 PST Apr 5 2007
  end   date: 12:58:31 PST Apr 5 2012

```

```

CA Certificate
Status: Available
Version: 3
Certificate Serial Number (hex): 6A6967B3000000000003
Certificate Usage: Signature
Issuer:
  cn=Cisco Root CA 2048
  o=Cisco Systems
Subject:
  cn=Cisco Manufacturing CA
  o=Cisco Systems
CRL Distribution Points:
  http://www.cisco.com/security/pki/crl/crca2048.crl
Validity Date:
  start date: 14:16:01 PST Jun 10 2005
  end   date: 12:25:42 PST May 14 2029

```

The following **show crypto pki trustpool verbose** command output displays the certificates in PKI trustpool:

```

Device# show crypto pki trustpool verbose

CA Certificate
Status: Available
Version: 3
Certificate Serial Number (hex): 01
Certificate Usage: Signature
Issuer:
  cn=Licensing Root - DEV
  o=Cisco
Subject:
  cn=Licensing Root - DEV
  o=Cisco
Validity Date:
  start date: 03:25:43 IST Apr 25 2013
  end   date: 03:25:43 IST Apr 25 2033
Subject Key Info:
  Public Key Algorithm: rsaEncryption
  RSA Public Key: (2048 bit)
Signature Algorithm: SHA256 with RSA Encryption
Fingerprint MD5: 432CBFA0 32D2983A 8A56A319 FD28C6F9
Fingerprint SHA1: 6341FCAF 19CE9FEE 961D92A5 D47390B5 2DD6D94D
X509v3 extensions:
  X509v3 Key Usage: 6000000
    Key Cert Sign
    CRL Signature
  X509v3 Subject Key ID: 43214521 B5FB217A 1A4D1BB7 0236E664 CBEC8B65

```

```
X509v3 Basic Constraints:
    CA: TRUE
Authority Info Access:
Associated Trustpoints: Trustpool
Trustpool: Built-In
```

Example: Using PKI Trustpool for SSH Connection During Upgrade

Before upgrading to Cisco IOS XE Denali 16.3, copy the certificate from trustpool to a new trustpoint.

```
Device # show run | sec pool
crypto pki trustpool policy
  revocation-check none
  source interface GigabitEthernet0/0/0
crypto pki certificate pool
certificate ca 01
308204FA 308202E2 A0030201 02020101 300D0609 2A864886 F70D0101 0C050030
0E310C30 0A060355 04031303 61626330 1E170D31 36303730 35303435 3935335A
170D3136 30373035 30353535 35335A30 0E310C30 0A060355 04031303 61626330
82022230 0D06092A 864886F7 0D010101 05000382 020F0030 82020A02 82020100
C78AA144 8EC1D18A 4EECC3E8 81450CC7 A85A4C57 AF59E584 5C1EA888 6EF70DA8
33327D93 E1F6CED7 32BB4FCF 693F60E0 37000225 40F6F9C5 0462C4AD 899E5BDD
ED779180 D6C75E1B FBE97D42 E2A7B35D DDC18C4D 4CCDE401 68F67A6D E40FD744
904EE49F 40820640 C6E0B072 510BC40E A0883F6C E8DF5128 EFF3B5F4 B31E5C16
217652FF AFC30EBF 593CB19C 56C0E793 2814D504 0E079E0C 8E9E856A BCADB19C
F2376994 A0A040C1 7BC1E88F CF80F218 9C48B4D9 F84ED5C0 79827BD1 32448478
8F1F82F2 C91A9479 692B6456 C53CF937 777D0C31 1B8A1F5E 24B33553 047C2448
855CF974 DFA21665 8AD8A0E5 81ED8068 81688997 FF05118C 93A59CA0 7FD594F6
B7B1898C 272E089A 3392A2C4 22A22625 2BC1E16F 95B2FC15 207CCA49 378AD3A6
0C574197 C5E94D8C E6736271 CE0BA9AB ACB380E3 A8084243 4E038DD1 8E86E206
E2269290 F1AFB29A D28CFB3A 5ABADE4A 21A59728 7174E7A3 2FF59C90 E6100C6E
E2E8CB4C 91BD574D 57B5E18A 78F9CE75 624C4A2E 1A6EFCC3 7D1BB20B 1CC79024
CD2FBC4D 46BE1B7A 6EFD8F05 6FD84E91 51215E9B E5E952A4 6E2D1388 10075706
7D6FAF9B 3F7F8994 F39B9B5D 0C7CD5BC 40738877 5D9985AC 5AB6363D 811BA440
41A1639F 352F4F01 1994300A A4B85B75 01486CA0 4C4B3175 82038B26 BEFE1D2A
4AC0D577 7784FACF A6877D68 5D73DD04 DC8D942B DE3FC9FE 4C1FF715 A2E7A5AB
02030100 01A36330 61300F06 03551D13 0101FF04 05300301 01FF300E 0603551D
0F0101FF 04040302 0186301F 0603551D 23041830 168014CA 195EDBF1 51753A92
71342CA8 36DDABA9 63A93130 1D060355 1D0E0416 0414CA19 5EDBF151 753A9271
342CA836 DDABA963 A931300D 06092A86 4886F70D 01010C05 00038202 0100553B
FB77A348 C4447C40 BEB2DDFD 63C82441 3CBDC198 B5D5B1AB DF17C4E2 98AEAF2F
CD570939 BCC116E0 33CFF471 E91EE308 8B29B5BD 11DFACF9 A3AC3135 8BE81B22
ED205587 5DE04654 A051CC14 CA8D2A6E 81F924DA 001BB1C4 7F85F177 4E75D8EA
797CCAEF 1502492D 17627CD1 E39E295B 44C55884 8E6DFF68 2129B222 18E3187D
AB97B4A7 6F838E75 A8908566 AD9E6687 35B150DE 0C8C1B37 6F17FDAC 7A7C53A4
434F5CF3 6EB71957 E65EC5D2 7685B05B A9D8C0D3 2DB8F97E E6B37E11 C9E26F4F
BFB97745 83E1A214 461B0E49 0FFDEF21 A7CA5364 44416002 03A01F0C 2BC098D3
B50A4071 AC4D2234 4E55C5D4 0FD9C308 63F2A8D4 24D34613 B73EAA1B B407D56F
90EEF5C7 AE61C0D8 13FB493D 0E1C8F9B 1D2D6DEA 458CDE18 8753FF14 F8C75213
35557FCC 50405056 D9790AF0 EAC21646 2D9AF88D 59C05434 45F21248 0BB72191
74D951DD 9D23997E 1134611E 837137E6 C40C694E 7AB4A05F E8470E87 E0F6D924
A69A98A8 5AA2B9B3 B7446883 94A7230D EE3C6EDA 4A348351 FC40C16D 6FDC91EC
CEFF580B F7826DD1 1D1D07DB 17CA3298 8C510826 D2712E04 EB669909 3D8106EB
5391A5BA 80B7E981 B41AAEB9 CE4A5236 20E30AE7 01D5FDB3 604C5505 0F8C96DC
8F5CF569 5D90C1FB F5679221 B7B922C0 5F11C379 9EBA283C 45A209F7 132B8DA2
EAF4751B 290A1CAC C3E7978B 760FB05A 185991FE 4884FA1A D3EEDD7C 63
3B
```

```
quit
```

Paste the certificate in config mode by creating a new trustpoint.

```
Device(config)#cry pki trust abc
Device(ca-trustpoint)#cry pki cert chain abc
Device(config-cert-chain)#certificate ca 01
```

Enter the certificate in hexadecimal representation

```
Device(config-pki-hexmode) # 308204FA 308202E2 A0030201 02020101 300D0609 2A864886 F70D0101
0C050030
Device(config-pki-hexmode) # 0E310C30 0A060355 04031303 61626330 1E170D31 36303730 35303435
3935335A
Device(config-pki-hexmode) # 170D3136 30373035 30353535 35335A30 0E310C30 0A060355 04031303
61626330
Device(config-pki-hexmode) # 82022230 0D06092A 864886F7 0D010101 05000382 020F0030 82020A02
82020100
Device(config-pki-hexmode) # C78AA144 8EC1D18A 4EECC3E8 81450CC7 A85A4C57 AF59E584 5C1EA888
6EF70DA8
Device(config-pki-hexmode) # 33327D93 E1F6CED7 32BB4FCF 693F60E0 37000225 40F6F9C5 0462C4AD
899E5BDD
Device(config-pki-hexmode) # ED779180 D6C75E1B FBE97D42 E2A7B35D DDC18C4D 4CCDE401 68F67A6D
E40FD744
Device(config-pki-hexmode) # 904EE49F 40820640 C6E0B072 510BC40E A0883F6C E8DF5128 EFF3B5F4
B31E5C16
Device(config-pki-hexmode) # 217652FF AFC30EBF 593CB19C 56C0E793 2814D504 0E079E0C 8E9E856A
BCADB19C
Device(config-pki-hexmode) # F2376994 A0A040C1 7BC1E88F CF80F218 9C48B4D9 F84ED5C0 79827BD1
32448478
Device(config-pki-hexmode) # 8F1F82F2 C91A9479 692B6456 C53CF937 777D0C31 1B8A1F5E 24B33553
047C2448
Device(config-pki-hexmode) # 855CF974 DFA21665 8AD8A0E5 81ED8068 81688997 FF05118C 93A59CA0
7FD594F6
Device(config-pki-hexmode) # B7B1898C 272E089A 3392A2C4 22A22625 2BC1E16F 95B2FC15 207CCA49
378AD3A6
Device(config-pki-hexmode) # 0C574197 C5E94D8C E6736271 CE0BA9AB ACB380E3 A8084243 4E038DD1
8E86E206
Device(config-pki-hexmode) # E2269290 F1AFB29A D28CFB3A 5ABADE4A 21A59728 7174E7A3 2FF59C90
E6100C6E
Device(config-pki-hexmode) # E2E8CB4C 91BD574D 57B5E18A 78F9CE75 624C4A2E 1A6EFCC3 7D1BB20B
1CC79024
Device(config-pki-hexmode) # CD2FBC4D 46BE1B7A 6EFD8F05 6FD84E91 51215E9B E5E952A4 6E2D1388
10075706
Device(config-pki-hexmode) # 7D6FAF9B 3F7F8994 F39B9B5D 0C7CD5BC 40738877 5D9985AC 5AB6363D
811BA440
Device(config-pki-hexmode) # 41A1639F 352F4F01 1994300A A4B85B75 01486CA0 4C4B3175 82038B26
BEFE1D2A
Device(config-pki-hexmode) # 4AC0D577 7784FACF A6877D68 5D73DD04 DC8D942B DE3FC9FE 4C1FF715
A2E7A5AB
Device(config-pki-hexmode) # 02030100 01A36330 61300F06 03551D13 0101FF04 05300301 01FF300E
0603551D
Device(config-pki-hexmode) # 0F0101FF 04040302 0186301F 0603551D 23041830 168014CA 195EDBF1
51753A92
Device(config-pki-hexmode) # 71342CA8 36DDABA9 63A93130 1D060355 1D0E0416 0414CA19 5EDBF151
753A9271
Device(config-pki-hexmode) # 342CA836 DDABA963 A931300D 06092A86 4886F70D 01010C05 00038202
0100553B
Device(config-pki-hexmode) # FB77A348 C4447C40 BEB2DDFD 63C82441 3CBDC198 B5D5B1AB DF17C4E2
```

```

98AEAF2F
Device(config-pki-hexmode) # CD570939 BCC116E0 33CFF471 E91EE308 8B29B5BD 11DFACF9 A3AC3135
8BE81B22
Device(config-pki-hexmode) # ED205587 5DE04654 A051CC14 CA8D2A6E 81F924DA 001BB1C4 7F85F177
4E75D8EA
Device(config-pki-hexmode) # 797CCAEEF 1502492D 17627CD1 E39E295B 44C55884 8E6DFF68 2129B222
18E3187D
Device(config-pki-hexmode) # AB97B4A7 6F838E75 A8908566 AD9E6687 35B150DE 0C8C1B37 6F17FDAC
7A7C53A4
Device(config-pki-hexmode) # 434F5CF3 6EB71957 E65EC5D2 7685B05B A9D8C0D3 2DB8F97E E6B37E11
C9E26F4F
Device(config-pki-hexmode) # BFB97745 83E1A214 461B0E49 0FFDEF21 A7CA5364 44416002 03A01F0C
2BC098D3
Device(config-pki-hexmode) # B50A4071 AC4D2234 4E55C5D4 0FD9C308 63F2A8D4 24D34613 B73EAA1B
B407D56F
Device(config-pki-hexmode) # 90EEF5C7 AE61C0D8 13FB493D 0E1C8F9B 1D2D6DEA 458CDE18 8753FF14
F8C75213
Device(config-pki-hexmode) # 35557FCC 50405056 D9790AF0 EAC21646 2D9AF88D 59C05434 45F21248
0BB72191
Device(config-pki-hexmode) # 74D951DD 9D23997E 1134611E 837137E6 C40C694E 7AB4A05F E8470E87
E0F6D924
Device(config-pki-hexmode) # A69A98A8 5AA2B9B3 B7446883 94A7230D EE3C6EDA 4A348351 FC40C16D
6FDC91EC
Device(config-pki-hexmode) # CEFF580B F7826DD1 1D1D07DB 17CA3298 8C510826 D2712E04 EB669909
3D8106EB
Device(config-pki-hexmode) # 5391A5BA 80B7E981 B41AAEB9 CE4A5236 20E30AE7 01D5FDB3 604C5505
0F8C96DC
Device(config-pki-hexmode) # 8F5CF569 5D90C1FB F5679221 B7B922C0 5F11C379 9EBA283C 45A209F7
132B8DA2
Device(config-pki-hexmode) # EAF4751B 290A1CAC C3E7978B 760FB05A 185991FE 4884FA1A D3EEDD7C
63
Device(config-pki-hexmode) # 3B
Device(config-pki-hexmode) # quit

```

Now you can upgrade to Cisco IOS XE Denali 16.3. The certificate from trustpool would disappear but would still stay in trustpoint. Install the certificate in trustpool after the upgrade.

Additional References for PKI Trustpool Management

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases

Related Topic	Document Title
Security commands	<ul style="list-style-type: none"> • Cisco IOS Security Command Reference: Commands A to C • Cisco IOS Security Command Reference: Commands D to L • Cisco IOS Security Command Reference: Commands M to R • Cisco IOS Security Command Reference: Commands S to Z

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for PKI Trustpool Management

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1: Feature Information for PKI Trustpool Management

Feature Name	Releases	Feature Information
PKI Trustpool Management		<p>The PKI Trustpool Management feature is used to authenticate sessions, such as HTTPS, that occur between devices by using commonly recognized trusted agents called certificate authorities (CAs).</p> <p>The following commands were introduced or modified: cabundle url, chain-validation (ca-trustpool), crypto pki trustpool import, crypto pki trustpool policy, crl, default (ca-trustpool), match certificate (ca-trustpool), ocsp, show (ca-trustpool), show crypto pki trustpool, source interface (ca-trustpool), storage, vrf (ca-trustpool), show crypto pki trustpool built-in, crypto pki trustpool import clean ca-bundle.</p>

