

## Chapter 49

# Public Key Infrastructure (PKI)

Introduction .....	49-2
Overview of PKI .....	49-2
Public Keys .....	49-2
Certificates .....	49-3
Elements of a Public Key Infrastructure .....	49-5
Certificate Validation .....	49-6
Certificate Revocation Lists (CRLs) .....	49-6
PKI on the Router .....	49-7
Certificate Retrieval and Storage .....	49-7
Certificate Validation .....	49-8
Certificate Revocation Lists .....	49-9
Requesting a Certificate .....	49-9
Global PKI Parameters .....	49-10
Configuration Examples .....	49-11
Manual Enrollment .....	49-12
Automatic Enrollment with CMP .....	49-14
Command Reference .....	49-16
add pki certificate .....	49-16
add pki crl .....	49-18
add pki ldaprepository .....	49-19
create pki certificate .....	49-20
create pki enrollmentrequest .....	49-21
create pki keyupdaterequest .....	49-22
delete pki certificate .....	49-23
delete pki crl .....	49-23
delete pki ldaprepository .....	49-24
destroy pki enrollmentrequest .....	49-24
destroy pki keyupdaterequest .....	49-25
disable pki debug .....	49-25
enable pki debug .....	49-26
purge pki .....	49-27
set pki .....	49-28
set pki certificate .....	49-29
set pki crl .....	49-30
set pki ldaprepository .....	49-31
set system distinguishedname .....	49-32
show pki .....	49-33
show pki certificate .....	49-40
show pki crl .....	49-43
show pki enrollmentrequest .....	49-46
show pki keyupdaterequest .....	49-48
show pki ldaprepository .....	49-50

## Introduction

---

This chapter describes how to configure the router for interaction with a Public Key Infrastructure (PKI). The PKI is part of the router's suite of security features, and consists of a set of tools for managing and using certificates.

The router acts as an End Entity (EE) in an X.509 certificate-based PKI. More specifically, the router can communicate with Certification Authorities (CAs) and Certificate Repositories to request, retrieve and verify X.509 certificates, and allow protocols running on the router, such as ISAKMP, access to these certificates.

In the unlikely event of the router's flash memory becoming corrupted, you may lose current feature licences, including those enabled by default. If this happens, contact your authorised distributor or reseller.

## Overview of PKI

---

The tools that make up the Public Key Infrastructure allow the router to securely exchange public keys, while being sure of the identity of the keyholder.

## Public Keys

Public key encryption involves the generation of two keys for each user: private and public. Material encrypted with a private key can be decrypted with the corresponding public key and vice versa. An individual's private key must be kept secret, but the public key may be widely known because it is impossible to calculate the private key from the public key. The advantage of public key encryption is that the private key need never be exchanged and so can be kept secure more easily than a shared secret key.

### Message encryption

One of the two main services provided by public key encryption is the exchange of encrypted messages. User 1 can send a secure message to user 2 by encrypting it with user 2's public key. Only user 2 is able to decrypt it because only user 2 has access to the corresponding private key.

### Digital signatures

The second main service provided by public key encryption is digital signing. Digital signatures both confirm the identity of the message's supposed sender and protect the message from tampering. Therefore they provide message authentication and non-repudiation. It is very difficult for the signer of a message to claim that the message was corrupted, or to deny that it was sent.

The process for creating a digital signature is:

1. A "hash" algorithm is used to generate a one-way hash from the message.
2. The hash is encrypted with the sender's private key.
3. The message, the encrypted hash, and information about the hash algorithm are transmitted to the receiver.
4. The receiver uses the sender's public key to decrypt the hash.
5. The receiver applies the same hash algorithm to the message to generate a hash.
6. The receiver compares the decrypted hash with the generated hash. If they are identical, the message was sent by the owner of that public key.

More information about public key encryption and message authentication can be found in [Chapter 42, Compression and Encryption Services](#).

The exchange of encrypted messages and digital signatures are secure when the public key used for encryption or decryption belongs to the message's expected recipient. If a public key is insecurely distributed, it is possible that a malicious agent could intercept it and replace it with the malicious agent's public key (the man-in-the-middle attack). To prevent this and other attacks, PKI provides a means for secure transfer of public keys by linking an identity and that identity's public key in a secure certificate.

**Important** While a certificate binds a public key to a subject to ensure the public key's security, it does not guarantee that the security of the associated private key has not been breached. A secure system is dependent upon private keys being kept secret, by protecting them from malicious physical and virtual access.

## Certificates

A certificate is an electronic identity document. To create a certificate for a subject, a trusted third party (known as the Certification Authority) verifies the subject's identity, binds a public key to that identity, and digitally signs the certificate. A person receiving a copy of the certificate can verify the Certification Authority's digital signature and be sure that the public key is owned by the identity in it.

The router can generate a self-signed certificate but this should be used with an SSL-enabled HTTP server only or where third party trust is not required.

### X.509 Certificates

X.509 specifies a format for certificates. Almost all certificates use the X.509 version 3 format, described in RFC 2459, *Internet X.509 Public Key Infrastructure Certificate and CRL Profile*. This is the format supported by the router.

An X.509 v3 certificate consists of:

- A serial number that distinguishes the certificate from others issued by the same issuer. This serial number identifies the certificate in a Certificate Revocation List if necessary.
- Details about the owner's identity such as name, company, and address.
- The owner's public key, and information about the algorithm with which it was produced.
- Details about the identity of the organisation that issued the certificate.
- The issuer's digital signature and the algorithm that produced it.
- The period when the certificate is valid.
- Optional information such as the type of application for which the certificate is intended.

The issuing organisation's digital signature is included in order to authenticate the certificate. If it is tampered with during transmission, it will be detected.

## Distinguished names (DN)

In an X.509 certificate, the identity of the certificate's subject is given in the form of a *distinguished name*. A distinguished name is a comma-separated list of parameters which together uniquely identify the subject of the certificate. A distinguished name also forms part of a Lightweight Directory Access Protocol (LDAP) URL, which is used to access an X.500-like directory.

A distinguished name can be set for the router by using the command:

```
set system distinguishedname=dist-name
```

The Certification Authority that issues the router a certificate may require that a particular distinguished name be used. Otherwise, a logical one should be chosen.

The syntax of a distinguished name is:

```
distinguished-name="[cn=common-name, ]
[ list of [dc=domain-name-component, ]
[ou=organisation-unit-name, ] [o=organisation-name, ]
[street=street-address, ] [st=state-or-province-name, ]
[l=locality-name, ] [c=country-name, ]"
```

where:

- *common-name*, *locality-name*, *organisation-name*, *organisation-unit-name*, *state-or-province-name*, and *street-address* are all strings consisting of any printable characters except quotation marks. The special characters {, =, +, <, >, #, ;, \, <CR> } must be escaped by typing a \ before the character, as defined in RFC 1779, *A String Representation of Distinguished Names*, unless they are used for their prescribed purpose. For example, to include a \ in the string, type \\ and to include a #, type \#.
- *domain-name-component* is a section of a fully-qualified domain name, in the format "dc=foo, dc=bar, dc=com" for the domain name foo.bar.com.
- *country-name* is a string consisting of any printable characters. Country names are generally given in the form of the two-letter ISO 3166 code for the country, for example, "us", "de", or "nz".

The following example is a distinguished name for Janet Bloggs at examplecompany.com:

```
distinguishedname="cn=Janet Bloggs, dc=examplecompany,
dc=com, ou=Example Department, o=Example Company,
street=Somewhere St, c=us"
```

For illustrative purposes, this example is very detailed. The domain name and the parameter that provides the person's physical location (organisation unit, organisation, street address and locality) are really two different methods of specifying the address; combining them is unlikely to be useful.

The order of the parameters is significant because a name cannot be recognised if the order is changed after definition. In general, the name should begin with the most specific element (the common name) and end with the most general (the country).

Spaces between the comma-separated items in the list are optional and are ignored by the router. However, quotation marks are required when the name contains spaces, either between items or within an item.

## Elements of a Public Key Infrastructure

A Public Key Infrastructure is a set of applications that manage the creation, retrieval, validation, and storage of certificates. A PKI consists of the following key elements:

- At least one Certification Authority (CA), which issues and revokes certificates.
- At least one publicly accessible repository, which stores certificates and Certificate Revocation Lists (CRL).
- At least one End Entity (EE), which retrieves certificates from the repository, validates them, and uses them.

**End Entities (EE)** End Entities own public keys and may use them for encryption and digital signing. An entity that uses its private key to digitally sign certificates is not considered to be an End Entity, but is a Certification Authority.

The router acts as an End Entity.

**Certification Authorities** A Certification Authority is an entity that issues, updates, revokes, and otherwise manages public keys and their certificates. A CA receives requests for certification, validates the requester's identity according to the CA's requirements, and issues the certificate, signed with one of the CA's keys. CAs may also perform the functions of End Entities in that they may use other CAs' certificates for message encryption and verification of digital signatures.

An organisation may own a Certification Authority and issue certificates for use within its own networks. Its certificates may also be accepted by another network after an exchange of certificates has validated it from the other network's viewpoint. Alternatively, an outside CA may be used. The router can interact with the CA by sending it requests for certification, regardless of whether that CA is part of the organisation.

The usefulness of certificates depends on trust. Users must be able to trust the issuing CA to verify identities reliably. The level of verification required in a given situation depends on the organisation's security needs.

**Repositories** Certificates are stored in repositories and can be accessed by:

- File Transfer Protocol (FTP)
- Trivial File Transfer Protocol (TFTP)
- HyperText Transfer Protocol (HTTP)
- Lightweight Directory Access Protocol (LDAP)

An LDAP repository can be accessed via LDAP. LDAP is a lightweight network-layer protocol for accessing X.500-like directories. It runs over TCP and uses a client/server model.

For more information on TFTP and LDAP, see [“Loading Files onto the Router” on page 5-4 of Chapter 5, Managing Configuration Files and Software Versions.](#)

## Certificate Validation

To validate a certificate, the End Entity verifies the signature in the certificate by using the public key of the CA who issued the certificate. If the End Entity does not hold the issuer's certificate (which contains the issuer's public key), it downloads the certificate from a repository and tries to validate it. This process of accessing CA certificates and attempting to validate them can be followed as far as necessary up a certificate chain.

### CA hierarchies and certificate chains

It may not be practical for every individual certificate in an organisation to be signed by one Certification Authority. A certification hierarchy can be formed in which one CA (for example, national headquarters) is declared the root CA. This CA issues certificates to the next level down in the hierarchy (for example, regional headquarters), who become subordinate CAs and issue certificates to the next level down, and so on. A hierarchy can have as many levels as necessary.

Certificate hierarchies allow validation of certificates through certificate chains and cross-certification. If a router X, which holds a certificate signed by CA X, wants to communicate securely with a router Y, which holds a certificate signed by CA Y, there are two ways that the routers can validate each other's certificates. Cross-certification occurs when router X validates router Y's CA (CA Y) by obtaining a certificate for router Y's CA that has been issued by its own CA (CA X). A certificate chain is formed when both CA X and CA Y hold a certificate signed by a root CA Z, which the routers have verified out of band. Router X can validate router Y's certificate (and vice versa) by following the chain up to CA Z.

### Root CA certificates

A root CA must sign its own certificate. The root CA is the most critical link in the certification chain because the validity of all certificates issued by a CA in the hierarchy depends on the validity of the root CA. Therefore, every device that uses a certificate from the root CA must verify it out of band.

Out-of-band verification involves both the owner of a certificate and the user who wants to verify it generating a one-way hash (a fingerprint) of the certificate. These two hashes must then be compared using at least one non-network-based communication method. Examples of suitable communication methods are post, telephone, fax, or transfer by hand from a storage device such as a smartcard or floppy disk. If the two hashes are the same, the certificate can be considered valid.

## Certificate Revocation Lists (CRLs)

Every CA must keep a publicly accessible list of its certificates that have been revoked. A certificate may become invalid because:

- some of the details in it change (for example, the address)
- the relationship between the Certification Authority and the subject changes (for example, an employee leaves a company)
- the associated private key is compromised

## PKI on the Router

---

The router supports the following standards:

- draft-ietf-pkix-roadmap-05, *PKIX Roadmap*
- RFC 1779, *A String Representation of Distinguished Names*
- RFC 2459, *PKIX Certificate and CRL Profile*
- RFC 2511, *PKIX Certificate Request Message Format*
- PKCS #10 v1.7, *Certification Request Syntax Standard*
- RFC 2559, *Operational Protocols: LDAPv2*
- RFC 2587, *LDAPv2 Schema*
- draft-ietf-pkix-cmp-transport-protocols-01, *Transport Protocols for CMP*
- RFC 2585, *Operational Protocols: FTP and HTTP* (HTTP only)
- RFC 2510, *PKIX Certificate Management Protocols* (a subset of messages and functionality)

## Certificate Retrieval and Storage

Certificates are stored by CAs in publicly accessible repositories for retrieval by end entities. Repositories used in PKI are commonly accessed with the following protocols:

- Hypertext Transfer Protocol (HTTP)
- File Transfer Protocol (FTP)
- Lightweight Directory Access Protocol (LDAP)

The router supports retrieval of certificates from LDAP and HTTP repositories and via TFTP (*Trivial File Transfer Protocol*).

Before the router can use a certificate, it must be retrieved and added to the router's Certificate Database, which is stored in RAM memory. The router tries to validate the certificate and if successful, the certificate's public key is available for use.

To add a certificate to the certificate database, use the [add pki certificate command on page 49-16](#). This command retrieves the certificate from one of the following locations:

- a file in the router's filesystem
- an LDAP repository, using the LDAP protocol
- an HTTP repository, using the HTTP protocol

To load a file containing a certificate into the router's flash file system using HTTP, LDAP or TFTP, use the **load** command as described in "[Loading Files onto the Router](#)" on page 5-4 of [Chapter 5, Managing Configuration Files and Software Versions](#). A certificate file has a .cer file extension. Storing certificates in flash memory may be particularly useful for administrators of small networks who may not want to operate a repository.

Certificates in the router's flash memory cannot be accessed by the ISAKMP module. The certificates must first be placed in the Certificate Database with the [add pki certificate](#). This command can be included in the start-up configuration script to add certificates to the database when the router is restarted.

Certificates are retrieved from an LDAP repository and added to the Certificate Database without a user entering a command in the following cases:

- as required by ISAKMP to authenticate a message.
- as required by the certificate validation process.

These processes require that the router be configured with information about one or more LDAP repositories (see [“Automatic retrieval from LDAP repositories” on page 49-9](#)).

To create a self-signed certificate for router management, use the [create pki certificate command on page 49-20](#). This command creates a certificate that is suitable only for secure router management via the GUI. A pop-up message appears in the browser window warning that the certificate is not issued by a trusted authority.

To delete one or all existing certificates from the Certificate Database, use the [delete pki certificate command on page 49-23](#).

To see details about one or all certificates in the Certificate Database, use the [show pki certificate command on page 49-40](#). The router assigns names to certificates that it automatically retrieves as part of the certificate validation or message authentication process. The subject of the certificate is also displayed for these certificates.

Once a certificate has been downloaded and added to the Certificate Database, its type and the degree to which it is trusted can be changed with the [set pki certificate command on page 49-29](#). A certificate should not be set to "trusted" unless it is a root CA certificate that has been verified out-of-band (see [“Root CA certificates” on page 49-6](#)).

## Certificate Validation

Before the public key contained in a certificate can be used, the certificate must be trusted. To gain trust, the router checks, among other things:

- that the time period that the certificate is valid includes the current time
- that the certificate has not been revoked (see [“Certificate Revocation Lists” on page 49-9](#))
- that the certificate was signed by a trusted CA.

In the simplest case, the router already has a valid certificate from its CA that contains the public key used to sign the certificate. In this case, the certificate is easily verified.

### Root CA certificates

Root CA certificates are verified out of band by comparing the certificate's *fingerprint* (the encrypted one-way hash with which the issuing CA signs the certificate) with the fingerprint which the CA has supplied by a non-network-based method. To view a certificate's fingerprint, use the [show pki certificate command on page 49-40](#).

To manually set a verified root certificate to "trusted", use the **trusted** parameter in the [set pki certificate command on page 49-29](#). This indicates that it is unnecessary for PKI to validate this certificate and stops the validation process up the certificate chain. All certificates **below** this one in the chain are validated.



### Automatic retrieval from LDAP repositories

If the router does not have all the certificates it needs to validate a certificate in a certificate chain, it automatically tries to retrieve missing ones from LDAP repositories that the router is configured to use. To add information about an LDAP repository, use the [add pki ldaprepository command on page 49-19](#).

To change the access details for an LDAP repository, use the [set pki ldaprepository command on page 49-31](#).

To delete information about one or all existing LDAP repositories, use the [delete pki ldaprepository command on page 49-24](#).

To see information about the configured LDAP repositories, use the [show pki ldaprepository command on page 49-50](#).

## Certificate Revocation Lists

CAs maintain publicly accessible Certificate Revocation Lists (CRLs), which are regularly downloaded by the router and checked as part of the process of validating a certificate.

### The CRL database

The CRL database contains CRLs that have been received by the router and information on how to update them.

CRLs are retrieved regularly by the PKI module from HTTP or LDAP repositories or from a local file. To add a CRL to the CRL database, use the [add pki crl command on page 49-18](#).

Users can manually download a CRL into the router's flash memory by using the [load command on page 5-31 of Chapter 5, Managing Configuration Files and Software Versions](#). A CRL file has a .crl file extension. CRLs change often and need to be retrieved regularly from the repository.

To change the access details for a CRL, use the [set pki crl command on page 49-30](#).

To delete one or all of the CRLs in the database, use the [delete pki crl command on page 49-23](#).

To see details of one or all of the CRLs in the database, use the [show pki crl command on page 49-43](#).

## Requesting a Certificate

A new key pair can be created using the [create enco key command on page 42-19 of Chapter 42, Compression and Encryption Services](#). The user can request a certificate from a CA for the new (or an existing) key pair. This request is called an enrollment request.

Enrollment requests can be sent to the CA by one of the following methods:

- manually
- using the Certificate Management Protocol (CMP)

To create a manual enrollment request, set **protocol=manual** in the [create pki enrollmentrequest command on page 49-21](#).

Manual enrollment requests may be in PKCS #10 format, defined in *PKCS #10 v1.7: Certification Request Syntax Standard*, or the PKIX format defined in RFC 2511, *PKIX Certificate Request Message Format*. A Certificate Signing Request file is created and stored in the router's file system, named `<name-of-enrollment-request>.csr`. This file can be manually retrieved from the router and sent to a CA for enrollment.

The Certificate Management Protocol is described in RFC 2510 *PKIX Certificate Management Protocols (CMP)*. CMP enrollment requests are possible with CAs that support CMP and must be of type PKIX. The enrollment request is transported directly to the CA over TCP.

To create a CMP enrollment request, set **protocol=cmp** in the **create pki enrollmentrequest** command on page 49-21 command:

To remove one or all current enrollment requests, use the **destroy pki enrollmentrequest** command on page 49-24.

To view details of one or all current enrollment requests, use the **show pki enrollmentrequest** command on page 49-46.

## Updating a key pair

The public key for a certificate can be updated without re-enrollment, if the current certificate has not been revoked. The update request must use the Certificate Management Protocol (CMP) rather than manual enrollment, and therefore must be in PKIX format.

To create a key update request, use the **create pki keyupdaterequest** command on page 49-22.

To remove one or all of the current key update requests, use the **destroy pki keyupdaterequest** command on page 49-25.

To view details of one or all current enrollment requests, use the **show pki keyupdaterequest** command on page 49-48.

## Global PKI Parameters

Global PKI parameters include:

- the number of certificates that can be stored on the router, after which adding a new certificate removes the oldest dynamically-added certificate
- the number of times the router tries to resend an unsuccessful CMP request and the period between retries
- the frequency with which the router updates CRLs
- an alternative name for the router's certificates' subject

Use the **set pki** command on page 49-28 to modify these parameters.

To return parameters to their factory defaults, use the **purge pki** command on page 49-27.

To see the current settings for parameters, use the **show pki** command on page 49-33.

To see counters for certificates, CRLs, enrollment requests, and key update requests, use **counters** option in the **show pki** command on page 49-33.

For debugging purposes, some or all of the PKI data can be displayed on the terminal as it is received. To enable debugging, use the [enable pki debug command on page 49-26](#).

To disable debugging, use the [disable pki debug command on page 49-25](#). See the [enable pki debug command on page 49-26](#) for an explanation of the debugging options.

## Configuration Examples

---

The examples in this section show how to configure PKI on a router.

### ■ Manual Enrollment

If your CA does not support CMP for certificate enrollment, you must manually create a Certificate Signing Request (CSR) for the router's public/private key-pair and use an out-of-band method to send it to the CA. The CA typically requires the CSR be attached to an email, pasted into a web page, or couriered.

### ■ Automatic Enrollment with CMP

If your CA supports CMP, you can configure the router to automatically send an enrollment request to the CA, and to retrieve certificates and CRLs from the CA's LDAP repository on the fly.

## Manual Enrollment

This example shows how to:

- Load the CA's certificate on to the router and manually verify it.
- Create a public/private key-pair for the router.
- Generate a CSR and submit it to the CA.
- Load the newly generated router's certificate onto the router.
- Load the CA's Certificate Revocation List (CRL) onto the router.

### To obtain a certificate for the router

#### 1. Obtain preliminary details from your CA.

Determine the following:

- how to retrieve and verify the CA's certificate.
- the router's distinguished name, if the CA requires a particular name.
- the CSR type (PKCS10 or PKIX).
- the CSR format (DER, PEM or BASE64).
- how to send the CSR to the CA.
- how to retrieve the router's certificate once it has been generated by the CA.
- how to retrieve the CA's CRL (if it is available).

#### 2. Load the CA's certificate on to the router and add it to the certificate database.

To load the CA's certificate named `ca_certificate.cer` from the TFTP server at 192.168.0.100, use the command:

```
load file=ca_certificate.cer server=192.168.0.100
```

Note that the default METHOD is TFTP.

To add the certificate to the Certificate Database, use the command:

```
add pki certificate=ca_certificate  
location=ca_certificate.cer type=ca
```

#### 3. Verify the CA's certificate and set it to "trusted".

The most common way of verifying the CA's certificate is to verbally compare the certificate's fingerprint using an out-of-band method with the CA administrator (for example, over the phone).

To read the certificate's fingerprint, use the command:

```
show pki certificate=ca_certificate
```

To set the verified certificate to trusted, use the command:

```
set pki certificate=ca_certificate trusted=true
```

#### 4. Set the router's distinguished name.

To set the routers distinguished name to "cn=router1,o=my\_company,c=us", use the command:

```
set sys distinguishedname="cn=router1,o=my_company,c=us"
```

#### 5. Create the router's encryption key-pair.

To create a 1024-bit RSA key-pair for the router, use the command:

```
create enco key=1 type=rsa length=1024
```

**6. Create a Certificate Signing Request (CSR).**

To create a PEM-encoded Certificate Signing Request of type PKCS#10, use the command:

```
create pki enrollmentrequest=my_request keypair=1
protocol=manual type=pkcs10 format=pem
```

**7. Upload the CSR and send to your CA.**

To upload the CSR file to the TFTP server at 192.168.0.100, use the command:

```
upload file=my_request.csr server=192.168.0.100
```

Send `my_request.csr` to your CA using the method required by the CA, as determined in Step 1.

**8. Load the router's certificate on to the router and add it to the certificate database.**

To load the certificate into flash memory on the router from the TFTP server at 192.168.0.100, use the command:

```
load file=my_certificate.cer server=192.168.0.100
```

To add the certificate to the Certificate Database, use the command:

```
add pki certificate=my_certificate
location=my_certificate.cer type=self
```

**To maintain the router's CRL database****I. Load the CA's CRL on to the router and add it to the CRL Database.**

To load the CA's CRL from the TFTP server at 192.168.0.100, use the command:

```
load file=ca_crl.crl dest=flash server=192.168.0.100
```

To add the CRL to the CRL Database, use the command:

```
add pki crl=ca_crl location=ca_crl.crl
```

Every time the CA updates its CRL, you must manually retrieve and load the new CRL.

## Automatic Enrollment with CMP

This example shows how to:

- load the CA's certificate onto the router and manually verify it.
- create a public/private key-pair for the router.
- enrol with the CA using CMP.
- load the router's newly-generated certificate on to the router.
- set up the router to periodically download the CA's Certificate Revocation List (CRL).
- set up the router to automatically retrieve certificates as required from an LDAP repository.

### To obtain a certificate for the router

#### 1. Obtain preliminary details from your CA.

Determine the following:

- IP address or domain name for the CA's LDAP repository.
- Distinguished Name of the CA.
- router's distinguished name, if the CA requires a particular name.
- IP address or domain name for the CA's CMP server.
- secret value and reference number from the CA administrator.

#### 2. Add the CA's certificate to the router's certificate database.

To load the certificate of a CA with the distinguished name "o=myCA,c=us" from the LDAP repository at 192.168.0.100, use the command:

```
load method=ldap server=192.168.0.100
baseobject="o=myca,c=us" dstfile=ca_certificate.cer
attribute=cacertificate
```

To add the certificate to the Certificate Database, use the command:

```
add pki certificate=ca_certificate
location=ca_certificate.cer type=ca
```

#### 3. Verify the CA's certificate and set it to "trusted".

The most common way of verifying the CA's certificate is to verbally compare the certificate's fingerprint using an out-of-band method with the CA administrator (for example, over the phone).

To read the certificate's fingerprint, use the command:

```
show pki certificate=ca_certificate
```

To set the verified certificate to trusted, use the command:

```
set pki certificate=ca_certificate trusted=true
```

#### 4. Set the router's distinguished name.

To set the router's distinguished name to "cn=router1,o=myCA,c=us", use the command:

```
set sys distinguishedname="cn=router1,o=myca,c=us"
```

#### 5. Create the router's encryption key-pair.

To create a 1024-bit RSA key-pair for the router, use the command:

```
create enco key=1 type=rsa length=1024
```

## 6. Enrol with the CA using CMP.

To enrol with the CA using CMP, use the command:

```
create pki enrollmentrequest=my_ca location=192.168.0.101
protocol=cmp keyid=1 secr=secretvalue ref=12345678
```

where:

- 192.168.0.101 is the IP Address of the CA's CMP server, as determined in Step 1.
- *secretvalue* is the shared secret value obtained out-of-band from the CA operator, as determined in Step 1.
- 12345678 is the reference number that identifies a new user to the CA, and is obtained with the shared secret from the CA operator, as determined in Step 1.

The new certificate is published to the CA's LDAP repository. It must be loaded into the router's Certificate Database before it can be used.

## 7. Load the router's certificate on to the router and add it to the certificate database.

To load the router's certificate from the LDAP repository at 192.168.0.100, use the command:

```
load method=ldap server=192.168.0.100
baseobject="cn=router1,o=myca,c=us"
dstfile=my_certificate.cer
```

To add the certificate to the certificate database, use the command:

```
add pki certificate=my_certificate
location=my_certificate.cer type=self
```

## To maintain the Router's Certificate and CRL Database

### 1. Set up the router to periodically download the CA's Certificate Revocation List (CRL).

To add the CA's CRL to the CRL Database, use the command:

```
add pki crl=ca_crl
location="ldap://192.168.0.100/o=myca,c=us"
```

### 2. Set up the router to automatically retrieve certificates as required from an LDAP repository.

To add the LDAP repository at 192.168.0.100 to the router, use the command:

```
add pki ldaprepository=ca_rep
location="ldap://192.168.0.100/"
```

## Command Reference

---

This section describes the commands available to configure and manage PKI functionality. All the commands in this section except the **show** commands require Security Officer status.

The shortest valid command is denoted by capital letters in the Syntax section. See [“Conventions” on page lxv of About this Software Reference](#) in the front of this manual for details of the conventions used to describe command syntax. See [Appendix A, Messages](#) for a complete list of messages and their meanings.

### add pki certificate

---

**Syntax** ADD PKI CERTificate=*name* LOCation={*url*|*localfile*}  
 [PASSword=*password*] [PROXYAddress={*hostname*|*ipadd*}]  
 [PROXYPort=*port*] [TRUsted={TRUE|FALSE|YES|NO|ON|OFF}]  
 [TYpe={CA|SELF|ENTITY|EE}] [USERname=*username*]

where:

- *name* is a string 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.
- *url* is either an LDAP URL or an HTTP URL. The URL can be up to 128 characters long, excluding the protocol prefix (ldap:// or http://). LDAP URLs are described in [“Loading from a Lightweight Directory Access Protocol \(LDAP\) Server” on page 5-7 of Chapter 5, Managing Configuration Files and Software Versions](#).
- *localfile* is a filename with the file extension `.cer`.
- *password* is a string 1 to 64 characters long. Valid characters are any printable characters. If the password contains spaces, it must be in double quotes. Wildcards are not allowed.
- *hostname* is a string 1 to 40 characters long. Valid characters are any printable characters.
- *ipadd* is an IP address in dotted decimal notation.
- *port* is an integer between 1 and 65535.
- *username* is a string 1 to 64 characters long. Valid characters are any printable characters. If the username contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command adds a certificate to the router’s Certificate Database from either a file in the router’s file system or a remote repository. It requires a user with Security Officer privilege when the router is in security mode.

The **location** parameter specifies from where the certificate is retrieved. If a URL is specified, the certificate is retrieved from a remote repository using the appropriate method for the URL (LDAP or HTTP). If a local file is specified, the certificate is retrieved from the router’s file system. The local file must be a valid filename with a `.cer` file extension.

The **password** parameter specifies the password for the remote repository.



The **proxyaddress** parameter specifies the address of the optional HTTP proxy to use. This parameter is valid when **location** is an HTTP URL.

The **proxyport** parameter specifies the port to use on the optional HTTP proxy.

The **trusted** parameter specifies whether the certificate is automatically trusted. If **on**, the certificate is trusted unless it is badly formatted, out-of-date, or revoked. If **no**, the certificate is not automatically trusted—only if another trusted certificate is found whose public key has signed this certificate. The default is **no**.

Self-signed root CA certificates are typically set to be automatically trusted, and only after the user has checked the certificate's fingerprint and other details by using the **show pki certificate** command.

The **type** parameter specifies what type of certificate is being added. If **ca** is specified, the router tags this certificate as a CA certificate. If **self**, the router tags the certificate as its own. If **entity** or **ee**, the router tags the certificate to indicate that it belongs to another end entity. The default is **entity**.

The **username** parameter specifies the username for the remote repository.

**Examples** To load a certificate called "bobscertificate" for an entity with the distinguished name "cn=router\_city1, o=company1, c=us", from a remote LDAP repository, use the command:

```
add pki cer=bobscertificate
    loc="ldap://ca.trustworthy.com/cn=router_city1,
    o=company1, c=us"
```

**Related Commands** [delete pki certificate](#)  
[set pki certificate](#)  
[show pki certificate](#)

## add pki crl

---

**Syntax** `ADD PKI CRL=name LOCation={url|localfile}  
[PASSword=password] [PROXYAddress={hostname|ipadd}]  
[PROXYPort=1..65535] [USERname=username]`

where:

- *name* is a string 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.
- *url* is either an LDAP URL or an HTTP URL. The URL can be up to 128 characters long, excluding the protocol prefix (ldap:// or http://). LDAP URLs are described in [“Loading from a Lightweight Directory Access Protocol \(LDAP\) Server” on page 5-7 of Chapter 5, Managing Configuration Files and Software Versions.](#)
- *localfile* is a filename with the file extension `.crl`.
- *password* is a string 1 to 64 characters long. Valid characters are any printable characters. If the password contains spaces, it must be in double quotes. Wildcards are not allowed.
- *hostname* is a string 1 to 40 characters long.
- *ipadd* is an IP address in dotted decimal notation.
- *username* is a string 1 to 64 characters long. Valid characters are any printable characters. If the username contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command adds a Certificate Revocation List request. A CRL is retrieved periodically from the specified location and added to the CRL Database. The frequency of download can be set with the [set pki command on page 49-28](#), and defaults to 24 hours. This command requires a user with Security Officer privilege when the router is in security mode.

The **location** parameter specifies from where the certificate is retrieved. If a URL is specified, the certificate is retrieved from a remote repository using the appropriate method for the URL (LDAP or HTTP). If a local file is specified, the certificate is retrieved from the router's file system. The local file must be a valid filename with a `.crl` file extension.

The **password** parameter specifies the password for the remote repository.

The **proxyaddress** parameter specifies the address of the optional HTTP proxy server to use. Either the IP address or the fully qualified domain name of the proxy server may be specified. If a domain name is specified, the router performs a DNS lookup to resolve the name.

The **proxyport** parameter specifies the port to use on the optional HTTP proxy. This parameter is valid if you specify a **proxyaddress**. The default is 80.

The **username** parameter specifies the username for the remote repository.

**Examples** To add a CRL from a remote LDAP repository, use the command:

```
add pki crl=trustworthyscrl
loc="ldap://ca.trustworthy.com/cn=trustworthycrl,
o=trustworthy, c=us"
```

**Related Commands** [delete pki crl](#)  
[show pki crl](#)

# add pki ldaprepository

---

**Syntax** `ADD PKI LDaprepository=name LOCation=ldap-url  
[PASSword=password] [USERname=username]`

where:

- *name* is a string 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.
- *ldap-url* is a valid LDAP URL as defined in “[Loading from a Lightweight Directory Access Protocol \(LDAP\) Server](#)” on page 5-7 of Chapter 5, [Managing Configuration Files and Software Versions](#), except that the URL must not contain a distinguished name. The URL can be up to 128 characters long, excluding the protocol prefix (ldap://).
- *password* is a string 1 to 64 characters long. Valid characters are any printable characters. If the password contains spaces, it must be in double quotes. Wildcards are not allowed.
- *username* is a string 1 to 64 characters long. Valid characters are any printable characters. If the username contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command adds information about a remote LDAP repository, and requires a user with Security Officer privilege when the router is in security mode. Once the information is added, the repository can then be used by the certificate validation process of the PKI operational protocols to dynamically retrieve certificates.

The **location** parameter specifies the address of the LDAP repository.

The **password** parameter specifies the password for the remote repository.

The **username** parameter specifies the username for the remote repository.

**Examples** To add an LDAP repository, use the command:

```
add pki ld=trustworthy_repository  
loc=ldap://repository.trustworthy.com
```

**Related Commands** [delete pki ldaprepository](#)  
[set pki ldaprepository](#)  
[show pki ldaprepository](#)

## create pki certificate

---

**Syntax** CREate PKI CERTificate=*name* KEYpair=0..65535  
SERialnumber=0..4294967295 [FORMat=DER|PEM|BASE64]  
[SUBject=*dist-name*]

where:

- *name* is a string 1 to 8 characters long. Valid characters are uppercase and lowercase letters, digits, the underscore, hyphen, any printable characters, and alphanumeric characters. If *name* contains spaces, it must be in double quotes. Wildcard characters are not allowed.
- *dist-name* is an X.500 distinguished name as described in “[X.509 Certificates](#)” on page 49-3.

**Description** This command creates a self-signed certificate using an ENCO private RSA key and the router’s distinguished name. The router’s distinguished name, set with the [set system distinguishedname command on page 49-32](#), is inserted in the issuer field of the certificate. This certificate is suitable for an SSL enabled HTTP server or where third party trust is not required.

This command requires a user with Security Officer privilege when the router is in security mode. To ensure router security, use an external CA to generate certificates for VPNs or when the certificate will be used for more than router management.

The **keypair** parameter specifies the ENCO key ID of the private RSA key used to sign the certificate.

The **serialnumber** parameter specifies the number to be inserted into the serial number field of the certificate.

The **subject** parameter specifies the distinguished name to be inserted in the subject field of the certificate. If this parameter is not specified, the system distinguished name is used.

The **format** parameter specifies the type of encoding the certificate uses. Both **pem** and **base64** are ASCII encoded and let the certificate be displayed once it has been generated. The **der** option encodes binary and the certificate cannot be displayed. The default is **der**.

**Examples** To create a self-signed certificate, use the command:

```
cre pki cer=mycert key=1 ser=1234
```

**Related Commands** [add pki certificate](#)  
[show pki certificate](#)

## create pki enrollmentrequest

**Syntax** `CREate PKI ENRollmentrequest=name KEYpair=key-id  
[FORMat={DER|PEM|BASE64}] [LOCation={domainname|ipadd}]  
[PROToCol={CMP|MANual}] [REFerencenumber=refnum]  
[SECRetvalue=secretvalue] [TYpe={PKCS10|PKIX}]`

where:

- *name* is a string 1 to 8 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.
- *key-id* is a decimal number from 0 to 65535.
- *domainname* is a string from 1 to 128 characters long.
- *ipadd* is an IP address in dotted decimal notation.
- *refnum* is a string 1-24 characters long.
- *secretvalue* is a string 1-24 characters long.

**Description** This command creates a certificate enrollment request, and requires a user with Security Officer privilege when the router is in security mode. This operation is required when the user first creates a new key pair and wants it signed by a CA. The enrollment request can be transmitted to the CA automatically using CMP, or manually uploaded with the [upload command on page 5-62 of Chapter 5, Managing Configuration Files and Software Versions](#).

The **name** parameter specifies a name to distinguish the enrollment request from any other current requests.

The **keypair** parameter specifies the ENCO key identification number for the new certificate.

The **format** parameter specifies the type of encoding format for the request. The **der** option specifies that the enrollment request should be written straight to the binary file. The **pem** option specifies that the enrollment request should be encoded using the "Privacy Enhanced Mail" format. The **base64** option specifies that the enrollment request should be BASE64 encoded before it is written to the file. The default is **der**. This parameter is valid for manual enrollment only.

The **location** parameter specifies the address of the CA. This parameter is valid for the CMP protocol only.

The **protocol** parameter specifies the PKI management protocol to use for the enrollment request. If **cmp**, the enrollment request is automatically sent using the PKI Certificate Management Protocol. If **manual**, the enrollment request is written to a file in the router's file system. The file is named *<name-of-enrollment-request>.csr*. This file can be retrieved from the router later and sent to the CA to process. The default is **cmp**.

The **referencenumber** parameter allows the user to enter a reference number if one has been provided by the CA. This parameter is valid for the CMP protocol only.

The **secretvalue** parameter specifies the shared secret for Proof of Possession (of private key) transactions that the CA may require. This parameter is valid for the CMP protocol only.

The **type** parameter specifies the type of request. If **pkix** is specified, the request is encoded to the format in RFC 2511, *PKIX Certificate Request Message Format*. If **pkcs10** is specified, the request is formatted according to PKCS #10. Note that only **pkix** can be used for CMP. The default is **pkix**.

**Examples** To create an enrollment request, use the command:

```
cre pki enr=mycert key=1 prot=cmp loc=10.1.1.12
```

**Related Commands** [destroy pki enrollmentrequest](#)  
[show pki enrollmentrequest](#)

## create pki keyupdaterequest

**Syntax** CREate PKI KEYUpdaterequest=*name* CERTificate=*name*  
 KEYpair=0..65535 [LOCation={*domainname*|*ipadd*}]

where:

- *name* is a string 1 to 8 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.
- *domainname* is a string from 1 to 128 characters long.
- *ipadd* is an IP address in dotted decimal notation.

**Description** This command creates a certificate key update request. This operation is required when a user wants to update the key pair for the router's own certificate. The user must have previously enrolled and obtained a certificate from the CA. This function is available when the CA supports CMP and when the current certificate is still valid.

This command requires a user with Security Officer privilege when the router is in security mode.

The **certificate** parameter specifies the certificate for which the keys are to be updated.

The **keypair** parameter specifies the ENCO key identification number of the new key pair.

The **location** parameter specifies the address of the CA.

**Examples** To create a key update request, use the command:

```
cre pki keyu=mycert cer=mycert key=2 loc=10.1.1.12
```

**Related Commands** [destroy pki keyupdaterequest](#)  
[show pki keyupdaterequest](#)

## delete pki certificate

---

**Syntax** DELEte PKI CERtificate={*name*|ALL}

where *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command deletes one or all of the certificates stored in the router's certificate database, and requires a user with Security Officer privilege when the router is in security mode.

The **certificate** parameter specifies the name of the certificate to be deleted. If **all** is specified, every certificate in the router's certificate database is deleted.

**Examples** To delete a certificate, use the command:

```
del pki cer=bobs_old_certificate
```

**Related Commands** [add pki certificate](#)  
[set pki certificate](#)  
[show pki certificate](#)

## delete pki crl

---

**Syntax** DELEte PKI CRL={*name*|ALL}

where *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command deletes one or all of the CRLs stored in the router's CRL database, and requires a user with Security Officer privilege when the router is in security mode.

The **crl** parameter specifies the name of the CRL to be deleted. If **all** is specified, every CRL in the router's CRL database is deleted.

**Examples** To delete all CRLs in the CRL database, use the command:

```
del pki crl=all
```

**Related Commands** [add pki crl](#)  
[set pki crl](#)  
[show pki crl](#)

## delete pki ldaprepository

---

**Syntax** DELEte PKI LDaprepository={*name*|ALL}

where *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command deletes the information about one or all of the LDAP repositories configured for use by the router. It requires a user with Security Officer privilege when the router is in security mode.

The **ldaprepository** parameter specifies the name of the LDAP repository information to be deleted. If **all** is specified, every repository is deleted.

**Examples** To delete all LDAP repositories, use the command:

```
del pki ld=all
```

**Related Commands** [add pki ldaprepository](#)  
[set pki ldaprepository](#)  
[show pki ldaprepository](#)

## destroy pki enrollmentrequest

---

**Syntax** DESTroy PKI ENRollmentrequest={*name*|ALL}

where *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command destroys one or all of the current enrollment requests, and requires a user with Security Officer privilege when the router is in security mode.

The **enrollmentrequest** parameter specifies the name of the enrollment request to be destroyed. If **all** is specified, every request is destroyed.

**Examples** To destroy all current enrollment requests, use the command:

```
dest pki enr=all
```

**Related Commands** [create pki enrollmentrequest](#)  
[show pki enrollmentrequest](#)



## destroy pki keyupdaterequest

---

**Syntax** DESTroy PKI KEYUpdaterequest={*name*|ALL}

where *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command destroys one or all of the current key update requests, and requires a user with Security Officer privilege when the router is in security mode.

The **keyupdaterequest** parameter specifies the name of the enrollment request to be destroyed. If **all** is specified, every request is destroyed.

**Examples** To destroy all current key update requests, use the command:

```
dest pki keyu=all
```

**Related Commands** [create pki keyupdaterequest](#)  
[show pki keyupdaterequest](#)

## disable pki debug

---

**Syntax** DISable PKI DEBug={ALL|CMDTRACE|CRTDBTRACE|CRTRUTRACE|  
CRTVGSTATE|CRTVGTRACE|CRTVUSTATE|CRTVUTRACE|MPPACKET|  
MPPKT|MPSTATE|MPTRACE|OPHTTPTRACE|OPLDAPTRACE|OPPACKET|  
OPPKT|PACKET|PKT|STATE|TRACE} [, ...]

**Description** This command disables PKI debugging. It requires a user with Security Officer privilege when the router is in security mode. Specify options as single items or in a comma-separated list.

**Examples** To turn off all PKI module debugging, use the command:

```
dis pki deb=all
```

**Related Commands** [enable pki debug](#)

## enable pki debug

**Syntax** `ENABle PKI DEBug={ALL | CERTTRACE | CMDTRACE | CRTDBTRACE | CRTRUTRACE | CRTVGSTATE | CRTVGTRACE | CRTVUSTATE | CRTVUTRACE | MPPACKET | MPPKT | MPSTATE | MPTRACE | OPHTTPTRACE | OPLDAPTRACE | OPPACKET | OPPKT | PACKET | PKT | STATE | TRACE} [, ...]`

**Description** This command enables PKI debugging, and requires a user with Security Officer privilege when the router is in security mode.

The **debug** parameter enables debugging options in the following table, specified as single items or a comma-separated list.

Option	Description
ALL	All debug options.
CERTTRACE	Certificate unit trace debug.
CMDTRACE	Command handler trace debug.
CRTDBTRACE	Certificate database trace debug.
CRTRUTRACE	Certificate retrieval unit trace debug.
CRTVGSTATE	Certification validation state debug, for the candidate issuer certificate retrieval process.
CRTVGTRACE	Certification validation trace debug, for the candidate issuer certificate retrieval process.
CRTVUSTATE	Certificate validation unit state debug.
CRTVUTRACE	Certificate validation unit trace debug.
MPPACKET or MPPKT	Management protocol packet debug.
MPSTATE	Management protocol state debug.
MPTRACE	Management protocol trace debug.
OPHTTPTRACE	HTTP operation protocol trace debug.
OPLDAPTRACE	LDAP operation protocol trace debug.
OPPACKET or OPPKT	Operational protocol packet debug.
PACKET or PKT	All PKI packet debug options.
STATE	All PKI state debug options.
TRACE	All PKI trace debug options.

**Examples** To turn on all PKI debugging features, use the command:

```
ena pki deb=all
```

**Related Commands** [disable pki debug](#)

## purge pki

---

**Syntax** PURge PKI

**Description** This command resets the PKI module to the default configuration. Certificates, LDAP repositories, CRLs, enrollment requests, and key update requests are destroyed. Debugging is turned off and parameters modified by the **set pki** command are returned to defaults.

This command requires a user with Security Officer privilege when the router is in security mode.

**Examples** To reset the PKI module, use the command:

```
pur pki
```

**Related Commands**

- [show pki](#)
- [show pki certificate](#)
- [show pki crl](#)
- [show pki enrollmentrequest](#)
- [show pki keyupdaterequest](#)

## set pki

---

**Syntax** SET PKI [CERTstorelimit=*max-certificates*]  
[CMPRETRYMax=0..10] [CMPRETRYPeriod=10..600]  
[CRLUpdateperiod=1..168] [SUBjectaltname={ *ipadd* | *name* }]

where:

- *max-certificates* is a decimal number from 12 to 256.
- *name* is a string 1 to 64 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command sets global PKI parameters required for PKI operations. It requires a user with Security Officer privilege when the router is in security mode.

The **certstorelimit** parameter specifies the maximum number of certificates that can be stored in the router's certificate database. The default is 24. When the maximum number is reached, the router removes the oldest dynamically-added certificates first.

The **cmpretrymax** parameter specifies the number of times a CMP message is resent to a CA. This parameter is intended to resend the message when the CA is transiently unavailable. The default is 1 retry.

The **cmpretryperiod** parameter specifies the length of time between resending CMP messages to a CA when the CA is busy. The default is 30 seconds.

The **crlupdateperiod** parameter specifies the length of time between reloading CRLs in the CRL database. The default is 24 hours.

The **subjectaltname** parameter specifies the name to be added into certificate requests in the subject alternative name extension. The alternative name can be an IP address or a descriptive name such as foo.bar.com.

**Example** To specify that the IP address 192.168.1.2 is to be added into certificate requests as the subject alternative name extension, use the command:

```
set pki su=192.168.1.2
```

**Related Commands** [show pki](#)

## set pki certificate

---

**Syntax** SET PKI CERTificate=*name* [TRUsted={TRUE|FALSE|YES|NO|ON|OFF}] [TYpe={CA|SELF|ENDentity|EE}]

where *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command sets the level of trust for a certificate loaded into the router's certificate database. It requires a user with Security Officer privilege when the router is in security mode.

The **certificate** parameter specifies the name of the certificate.

The **trusted** parameter specifies whether the certificate is automatically trusted. If **yes**, the certificate is always trusted unless it is badly formatted, out-of-date, or revoked. If **no**, the certificate is not automatically trusted—only if another trusted certificate is found whose public key has signed this certificate. The default is **no**.

Self-signed root CA certificates are typically set to be automatically trusted, and only after the user has checked the certificate's fingerprint and other details by using the **show pki certificate** command.

The **type** parameter specifies what type of certificate is being added. If **ca**, the router tags this certificate as a CA certificate. If **self**, the router tags the certificate as its own. If **endentity** or **ee**, the router tags the certificate to indicate that it belongs to another end entity. The default is **endentity**.

**Examples** To set a certificate to "trusted" after manually validating it, use the command.

```
set pki cer=bobscertificate tru=true
```

**Related Commands** [add pki certificate](#)  
[delete pki certificate](#)  
[show pki certificate](#)

## set pki crl

---

**Syntax** SET PKI CRL=*name* [LOCation={*url*|*localfile*}]  
[PASSword=*password*] [USERname=*username*]

where:

- *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.
- *url* is either an LDAP URL or an HTTP URL. The URL can be up to 128 characters long, excluding the protocol prefix (ldap:// or http://). LDAP URLs are described in [“Loading from a Lightweight Directory Access Protocol \(LDAP\) Server” on page 5-7 of Chapter 5, Managing Configuration Files and Software Versions.](#)
- *localfile* is a filename with the file extension .crl.
- *password* is a string from 1 to 64 characters long. Valid characters are any printable characters. If the password contains spaces, it must be in double quotes. Wildcards are not allowed.
- *username* is a string from 1 to 64 characters long. Valid characters are any printable characters. If the username contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command sets the parameters for a certificate revocation list request. It requires a user with Security Officer privilege when the router is in security mode.

The **location** parameter specifies where the CRL is loaded from. If a URL is specified, the certificate is loaded from a remote repository using the appropriate method for the URL (LDAP or HTTP). If a local file is specified, the certificate is loaded from the router's flash file system.

The **username** parameter specifies the username for the remote repository.

The **password** parameter specifies the password for the remote repository.

**Examples** To set a CRL's location, use the command:

```
set pki crl=trustworthyscrl  
loc=http://ca.trustworthy.com/mycrl.crl
```

**Related Commands** [add pki crl](#)  
[delete pki crl](#)  
[show pki crl](#)

## set pki ldaprepository

---

**Syntax** SET PKI LDaprepository=*name* [LOCation=*ldap-url*]  
[PASSword=*password*] [USERname=*username*]

where:

- *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.
- *ldap-url* is a valid LDAP URL as defined in “[Loading from a Lightweight Directory Access Protocol \(LDAP\) Server](#)” on page 5-7 of [Chapter 5, Managing Configuration Files and Software Versions](#), except that the URL must not contain a distinguished name. The URL can be up to 128 characters long, excluding the protocol prefix (ldap://).
- *password* is a string from 1 to 64 characters long. Valid characters are any printable characters. If the password contains spaces, it must be in double quotes. Wildcards are not allowed.
- *username* is a string from 1 to 64 characters long. Valid characters are any printable characters. If the username contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command modifies information about a remote LDAP repository. The certificate validation process of the PKI operational protocols uses the repository to dynamically retrieve certificates. This command requires a user with Security Officer privilege when the router is in security mode.

The **location** parameter specifies the address of the LDAP repository.

The **password** parameter specifies the password for the remote repository.

The **username** parameter specifies the username for the remote repository.

**Examples** To set parameters for a current LDAP repository, use the command:

```
set pki ld=trustworthy_repository loc=ldap://  
repository.trustworthy.com
```

**Related Commands** [add pki ldaprepository](#)  
[delete pki ldaprepository](#)  
[show pki ldaprepository](#)

## set system distinguishedname

---

**Syntax** SET SYStem DIStinguishedname={*dist-name*|NONE}

where *dist-name* is an X.500 distinguished name as described in [“X.509 Certificates” on page 49-3](#)

**Description** This command sets the router’s distinguished name for PKI and ISAKMP to use, and requires a user with Security Officer privilege when the router is in security mode.

The **distinguishedname** parameter specifies the name. If **none** is specified, the router’s distinguished name is an empty string. The **none** option can be used when the router is to be identified in a PKI certificate by an alternative name such as its IP address. For compatibility with other implementations of PKI, we recommend this not be done.

**Examples** To set the router’s distinguished name, use the command:

```
set sys dis="cn=router1, o=company1, c=us"
```

**Related Commands** [show system](#) in Chapter 4, Configuring and Monitoring the System



## show pki

**Syntax** SHow PKI [COUnters]

**Description** This command displays information about the PKI module ([Figure 49-1](#), [Table 49-1](#)).

If the **counters** parameter is specified, counters for the PKI module are displayed ([Figure 49-2 on page 49-34](#), [Table 49-2 on page 49-35](#)). All of these counters apply since the router was last restarted.

Figure 49-1: Example output from the **show pki** command

```
PKI Module general information:
subjectAltName .....
CRL update period ..... 24 hours
CMP retry period ..... 5 seconds
CMP maximum retries ..... 1
Max. # of certificates .. 24
Debug device ..... 16
Debug types enabled: none
```

Table 49-1: Parameters in output of the **show pki** command

Parameter	Meaning
subjectAltName	Alternative subject name for this router's certificates.
CRL update period	Period in hours between automatic updates of any Certificate Revocation Lists used by the router.
CMP retry period	Period in seconds between the initial transmission of a CMP message and the first retransmission of the message when no response is received.
CMP maximum retries	Maximum number of times a CMP is retransmitted when no response is received.
Max. # of certificates	Maximum number of certificates that may be stored in the router's certificate database.
Debug device	Device number where PKI debug output is sent.
Debug types enabled	Types of PKI debugging that are enabled. For a list of available types and their meanings, see the <a href="#">enable pki debug command on page 49-26</a> .

Figure 49-2: Example output from the **show pki counters** command

```

PKI CERTIFICATE UNIT COUNTERS:
GENERAL COUNTERS:
  checkExtractParseFail          0  checkExtractFieldGetFail      0
  createFingerprintFail         0

VALIDATION UNIT COUNTERS:
  eventRequestNotFound          0
  startRequest                  13  startRequestEquivReqFnd       0
  stopRequestFail               0  stopRequestGood               0
  gncicResultNoCIC             7
  actionIllegal                 0
  startInitChecksTooDeep        0  startInitChecksBadTime        0
  startInitChecksIssNotCA       0  startInitChcksBadKeyUsge      0
  startInitChcksSSignNotCA      0  startInitChcksSSgnUntrst      0
  startInitChecksRevoked        0
  startValCICCertNotFound       0  startValCICAlreadyTrustd      6
  startValCICAlrdyVldating      5  startValCICStartVURqFail      0
  startVerifyCertNotFound       0  startVerifyCertParseFail      0
  startVerifyCrtFldGetFail      0
  startVerifyCICParseFail       0  startVerifyCICFldGetFail      0
  startVerifyFailImm            0  startVerifyStarted            7
  verifyCbackReqNotFound        0  verifyCallbackVerifyGood      6
  verifyCallbackVerifyFail      1
  createRequest                 13  destroyRequest                13
  dbAdd                         13  dbRemoveFail                  0
  dbFindFail                   0  dbFindByRequestorFail         13
  dbFindByCertFail              2

VALIDATION UNIT GET NEXT CANDIDATE
  eventRequestNotFound          0  getNextCICNotFound            0
  remoteRetrievalReqNotFnd      0  actionIllegal                 0
  startGetRemoteFail            7

ISSUER CERTIFICATE COUNTERS:
  retrievedRequestNotExist      0
  getFileOpenFail               0
  getFileCloseFail              0

RETRIEVAL UNIT COUNTERS:
  startOPStartFail              7  retrievedRequestNotExist      0
  getFileNotExist               0  getFileOpenFail               0
  getFileReadFail               0  getFileCloseFail              0

PKI CRL UNIT COUNTERS:
GENERAL COUNTERS:
  retrievedNotFound             0  retrievedParseFail            0
  retrievedGetFieldsFail        0  retrievedRUSStartFail         0
  timeoutRUSStartFail           0
  addAlreadyExists              0  addRUSStartFail               0
  addGood                       0
  setNotFound                   0  setRUSStartFail               0
  setGood                       0  setNothingSet                 0
  deleteNotFound                0  deleteGood                    0
  purgeGood                     0  showNotFound                   0
  showListParseFail             0

RETRIEVAL UNIT COUNTERS:
  startOPStartFail              0  retrievedRequestNotExist      0
  getFileNotExist               0  getFileOpenFail               0
  getFileReadFail               0  getFileCloseFail              0

```

Figure 49-2: Example output from the **show pki counters** command (Continued)

PKI MANAGEMENT UNIT COUNTERS:			
CMP COUNTERS:			
startedEnrollment	0	startedKeyUpdate	1
receivedPKIMessage	1	receivedPKIFIN	1
receivedTCPError	0	receivedMsgVerifyOK	1
receivedMsgVerifyFail	0	illegalEvent	0
requestFailed	0	requestCompleted	1
receivedMessageDiscarded	0	retryEvent	0
timeoutEvent	0	requestQueueError	0
MANUAL ENROLLMENT COUNTERS:			
started	0	fileOpenFailed	0
failed	0	completed	0
fileOpenOK	0	fileClosed	0
fileWriteFailed	0	CSRCreationError	0

Table 49-2: Parameters in output of the **show pki counters** command

Parameter	Meaning
<b>PKI Certificate Unit Counters – for events in the PKI certificate unit</b>	
<b>General Counters</b>	Counters about general events in the PKI certificate unit.
checkExtractParseFail	Number of times a bad certificate format prevented the certificate from being parsed successfully.
checkExtractFieldGetFail	Number of times a bad certificate format prevented a field from being read successfully.
createFingerprintFail	Number of times a certificate fingerprint was not created successfully.
<b>Validation Unit Counters – for events in the PKI certificate validation unit</b>	
eventRequestNotFound	Number of times an event was received for a certificate validation request that had been deleted.
startRequest	Number of times an certificate validation request was started successfully.
startRequestEquivReqFnd	Number of times an certificate validation request was not started because a request for the same certificate already existed.
stopRequestFail	Number of times a request to stop a certificate validation request failed because the request had been deleted.
stopRequestGood	Number of times an certificate validation request was stopped successfully.
gncicResultNoCIC	Number of times a "no candidate issuer certificate found" event was received.
actionIllegal	Number of times an illegal action was produced by the certificate validation state machine.
startInitChecksTooDeep	Number of times a certificate validation request failed because the validation chain was too long.
startInitChecksBadTime	Number of times a certificate validation request failed because the certificate was not valid at the current time.
startInitChecksIssNotCA	Number of times a certificate validation request failed because the certificate was being used to sign another certificate and was not a CA certificate.

Table 49-2: Parameters in output of the **show pki counters** command (Continued)

Parameter	Meaning
startInitChcksBadKeyUsge	Number of times a certificate validation request failed because the certificate was being used to sign another certificate and had a critical key usage extension that did not allow key signing.
startInitChcksSSignNotCA	Number of times a certificate validation request failed because the certificate was self-signed and not a CA certificate.
startInitChcksSSgnUntrst	Number of times a certificate validation request failed because the certificate was self-signed and not manually trusted.
startInitChecksRevoked	Number of times a certificate validation request failed because the certificate was revoked.
startValCICCertNotFound	Number of times a certificate validation request failed because no issuer certificate was found.
startValCICAlreadyTrustd	Number of times a trusted issuer certificate was found for a certificate validation request.
startValCICAlrdyVldating	Number of times a certificate validation request failed because the issuer certificate was in the process of being validated.
startValCICStartVURqFail	Number of times a certificate validation request failed because the issuer certificate validation failed.
startVerifyCertNotFound	Number of times a certificate validation request failed because the certificate signature could not verified because the certificate had been deleted.
startVerifyCertParseFail	Number of times a certificate validation request failed because the certificate signature could not verified because a bad certificate format prevented the certificate from being parsed successfully.
startVerifyCrtFldGetFail	Number of times a certificate validation request failed because the certificate signature could not verified because a bad certificate format prevented a field from being read successfully.
startVerifyCICParseFail	Number of times a certificate validation request failed because the certificate signature could not verified because a bad issuer certificate format prevented the issuer certificate from being parsed successfully.
startVerifyCICFldGetFail	Number of times a certificate validation request failed because the certificate signature could not verified because a bad issuer certificate format prevented a field from being read successfully.
startVerifyFaillmm	The number of times a certificate validation request failed because the certificate signature verification failed immediately.
startVerifyStarted	Number of times a certificate validation request certificate signature verification was started successfully.
verifyCbackReqNotFound	Number of times a certificate signature verification finished and the certificate validation request had been deleted.
verifyCallbackVerifyGood	The number of times a certificate validation request certificate signature was verified successfully.

Table 49-2: Parameters in output of the **show pki counters** command (Continued)

Parameter	Meaning
verifyCallbackVerifyFail	Number of times a certificate validation request certificate signature was different to the calculated signature.
createRequest	Number of times a certificate validation request was created.
destroyRequest	Number of times a certificate validation request was destroyed.
dbAdd	Number of times a certificate validation request was added to the certificate validation request database.
dbRemoveFail	Number of times a specified certificate validation request could not be found and removed from the certificate validation request database.
dbFindFail	Number of times a specified certificate validation request could not be found in the certificate validation request database.
dbFindByRequestorFail	Number of times a certificate validation request with a specified requester could not be found in the certificate validation request database.
dbFindByCertFail	Number of times a certificate validation request with a specified certificate could not be found in the certificate validation request database.
<b>Validation Unit Get Next Candidate Issuer Certificate Counters for events in the PKI certificate "get next candidate issuer certificate" unit</b>	
eventRequestNotFound	Number of times an event was received for a get next candidate issuer certificate request that had been deleted.
getNextCICNotFound	Number of times the get next candidate issuer certificate unit failed to find another candidate issuer certificate.
remoteRetrievalReqNotFound	Number of times a certificate was retrieved for a get next candidate issuer certificate request that had been deleted.
actionIllegal	Number of times an illegal action was produced by the get next candidate issuer certificate state machine.
startGetRemoteFail	Number of times the retrieval of a remote certificate for a get next candidate issuer certificate request failed.
<b>Retrieval Unit Counters – for events in the PKI certificate retrieval unit</b>	
startOPStartFail	Number of times a certificate retrieval using a PKI Operational Protocol failed to start.
retrievedRequestNotExist	Number of times a certificate retrieval finished but the retrieval request had been deleted.
getFileNotExist	Number of times the retrieval of a certificate from a router file failed because the file did not exist.
getFileOpenFail	Number of times the retrieval of a certificate from a router file failed because the file could not be opened.
getFileReadFail	Number of times the retrieval of a certificate from a router file failed because the file could not be read.
getFileCloseFail	Number of times the retrieval of a certificate from a router file failed because the file could not be closed.
<b>PKI CRL Unit Counters – for events in the PKI CRL unit</b>	
<b>General Counters – for general events in the PKI CRL unit</b>	

Table 49-2: Parameters in output of the **show pki counters** command (Continued)

Parameter	Meaning
retrievedNotFound	Number of times a CRL was retrieved for a CRL request that had been deleted.
retrievedParseFail	Number of times a CRL with an invalid format was retrieved that prevented the CRL from being parsed successfully.
retrievedGetFieldsFail	Number of times a CRL with an invalid format was retrieved that prevented a field from being read successfully.
retrievedRUSStartFail	Number of times a CRL retrieval failed to start when the CRL request had been changed.
timeoutRUSStartFail	Number of times a CRL retrieval failed to start when doing a periodic update.
addAlreadyExists	Number of times a CRL could not be added to the CRL database because a CRL with the same name already existed.
addRUSStartFail	Number of times a CRL retrieval failed to start when initially added.
addGood	Number of times a CRL was successfully added to the CRL database.
setNotFound	Number of times a request to change information in a CRL failed because the CRL was not found in the CRL database.
setRUSStartFail	Number of times a CRL retrieval failed to start after information about it was changed.
setGood	Number of times information about a CRL was successfully changed to the CRL database.
setNothingSet	Number of times a request to change some information in a CRL failed because the requested settings were no different.
deleteNotFound	Number of times a request to delete a CRL failed because the CRL was not found in the CRL database.
deleteGood	Number of times a CRL was successfully deleted from the CRL database.
purgeGood	Number of times the CRL database was successfully purged of all entries.
showNotFound	Number of times a request to show information about a CRL failed because it was not found in the CRL database.
showListParseFail	Number of times a request to show information about a CRL in the CRL database failed because the CRL had an invalid format that prevented the CRL from being parsed successfully.
<b>Retrieval Unit Counters – for events in the PKI CRL retrieval unit</b>	
startOPStartFail	Number of times a CRL retrieval using a PKI Operational Protocol failed to start.
retrievedRequestNotExist	Number of times a CRL retrieval finished but the retrieval request had been deleted.
getFileNotExist	Number of times the retrieval of a CRL from a router file failed because the file did not exist.
getFileOpenFail	Number of times the retrieval of a CRL from a router file failed because the file could not be opened.

Table 49-2: Parameters in output of the **show pki counters** command (Continued)

Parameter	Meaning
getFileReadFail	Number of times the retrieval of a CRL from a router file failed because the file could not be read.
getFileCloseFail	Number of times the retrieval of a CRL from a router file failed because the file could not be closed.
<b>PKI Management Unit Counters – for events in the PKI management unit</b>	
<b>CMP Counters – for events in the PKI CMP enrollment unit.</b>	
startedEnrollment	Number of Enrollment Requests that have been started.
startedKeyUpdate	Number of Key Update Requests that have been started.
receivedPKIMessage	Number of PKI CMP Messages that have been received.
receivedPKIFIN	Number of PKI FIN messages that have been received from CMP Transport.
receivedTCPError	Number of TCP errors that have been indicated by CMP TCP Transport.
receivedMsgVerifyOK	Number of received messages that have valid content and protection.
receivedMsgVerifyFail	Number of received messages that have invalid content or protection.
illegalEvent	Number of internal illegal events.
requestFailed	Number of Enrollment or Key update requests that have failed.
requestCompleted	Number of Enrollment or Key update requests that have been completed.
receivedMessageDiscarded	Number of unsolicited messages or out of sequence messages discarded.
retryEvent	Number of timeout and retry events.
timeoutEvent	Number of timeout and fail events.
requestQueueError	Number of CMP request queue errors.
<b>Manual Enrollment Counters – for events in the PKI manual enrollment unit</b>	
started	Number of manual enrollments started.
fileOpenFailed	Number of times an attempt to open a file has failed.
failed	Number of manual enrollment requests that have failed.
completed	Number of manual enrollment requests that have been completed.
fileOpenOK	Number of files that have been opened successfully.
fileClosed	Number of files that have been closed successfully.
fileWriteFailed	Number of times a file write attempt has failed.
CSRCreationError	Number of times an error has occurred generating a Certificate Signing Request.

**Examples** To show general information of the PKI module, use the command:

```
sh pki
```

To show counters for the PKI module, use the command:

```
sh pki cou
```

**Related Commands** [set pki](#)

## show pki certificate

**Syntax** `SHoW PKI CeRTificate[=name]`

where *name* is a string 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command displays information about a certificate or all certificates in the router's certificate database (Figure 49-3, Table 49-3).

If a name is specified, details for the certificate are displayed (Figure 49-4 on page 49-41, Table 49-4 on page 49-41).

Figure 49-3: Example output from the **show pki certificate** command

Certificate Database:				
Name	State	MTrust	Type	Source
d0 (dc=yogi, dc=com)	TRUSTED	TRUE	CA	VLD_UNIT
bart	TRUSTED	FALSE	EE	COMMAND

Table 49-3: Parameters in output of the **show pki certificate** command

Parameter	Meaning
Name	Name given to the certificate by the user or by the router's dynamic retrieval facility. In the latter case the subject of the certificate is displayed for the user's information.
State	Whether the certificate is trusted, untrusted, or validating.
MTrust	Whether the certificate has been manually trusted by a user command.
Type	Whether the type of certificate is SELF, CA, or EE (end entity).
Source	Source of the certificate: COMMAND VLD_UNIT (dynamic retrieval by certificate validation unit) UM_ISAKMP (user module, ISAKMP) MGMT_PROT (management protocol, CMP)



Figure 49-4: Example output from the **show pki certificate=name** command

```

Certificate:
  name ..... router1
  state ..... TRUSTED
  manually trusted .... FALSE
  type ..... EE
  source ..... COMMAND

  version ..... V3
  serial number ..... 3bf1 c141 [1005699393]
  signature alg ..... SHA1 with RSA
  public key alg ..... RSA
  not valid before .... 03:55:03 - 14-Nov-2001 (GMT)
  not valid after .... 04:25:03 - 14-Nov-2002 (GMT)
  subject ..... cn=router1, dc=foo, dc=bar, dc=com
  issuer ..... dc=foo, dc=bar, dc=com

  MD5 fingerprint ..... e81e bb17 deb3 664d 91e3 5c58 c890 aae1
  SHA1 fingerprint .... d662 ba63 ecb9 be83 0962 9ca1 5888 1bee d96b 67d6
  key fingerprint ..... 49d4 4919 106f ea71 21c7 7bef ab69 48c1 0ca8 99d2

  key usage ..... Digital Signature
  subject key ID ..... e70d3c808b6d747f2a415ccf7efc8e16a94c9f8d
  authority key ID .... dcc16049a4e158dcda046cecb90b91c9a94c6800

  validation path ..... <- foobar[ manually trusted, self-signed ]

Source Location:
  type ..... LDAP
  IP address ..... 192.168.100.200
  distinguished name  cn=router1, dc=foo, dc=bar, dc=com

```

Table 49-4: Parameters in output of the **show pki certificate=name** command

Parameter	Meaning
<b>Certificate</b>	Information about the certificate.
name	Name given to the certificate by the user or by the router's dynamic retrieval facility. In the latter case the subject of the certificate is displayed for the user's information.
state	Whether the certificate is trusted, untrusted, or validating. When the state is untrusted, a reason is given.
manually trusted	Whether the certificate has been manually trusted by a user command.
type	Whether the type of certificate is SELF, CA, or EE (end entity).
source	Source of the certificate: COMMAND VLD_UNIT (dynamic retrieval by certificate validation unit) UM_ISAKMP (user module, ISAKMP)
version	Version of X.509 with which the certificate complies.
serial number	Serial number of the certificate.
sha1 fingerprint	SHA1 fingerprint of the certificate.
signature alg	Algorithm used to sign the certificate.
public key alg	Algorithm of the public key certified by the certificate.
not valid before	Date before which this certificate is not valid.

Table 49-4: Parameters in output of the **show pki certificate=name** command (Continued)

Parameter	Meaning
not valid after	Date after which this certificate is not valid.
subject	Distinguished name of the subject of the certificate.
issuer	Distinguished name of the issuer of the certificate.
MD5 fingerprint	MD5 fingerprint of the certificate.
SHA1 fingerprint	SHA1 fingerprint of the certificate.
key fingerprint	Key fingerprint of the certificate.
key usage	Usages for which the public key certified by the certificate is valid.
subject key ID	ID that distinguishes this key from other keys owned by the same user.
authority key ID	ID that determines the CA keys used to sign this certificate.
subject alt name	Alternative names of the subject of the certificate.
validation path	List of the certificates in the validation path of the certificate.
Source Location	Information about the source location of the certificate.
file	Name of a file in the router file system.
type	The type of address of the location of the certificate; one of "LDAP", "HTTP", "ISAKMP" or "SSL". "ISAKMP" or "SSL" indicates the certificate was received from an ISAKMP or SSL peer, respectively. In those cases, the source information refers to the ISAKMP or SSL peer, which may not be the location at which the certificate is stored.
IP address	IP address (IPv4 or IPv6) of the location of the certificate.
domain name	Domain name of the location of the certificate.
distinguished name	Distinguished name of the location of the certificate.
port	Port of the location of the certificate.
HTTP file name	HTTP file name of the location of the certificate.
username	Username used to access the location of the certificate.
password	Password used to access the location of the certificate.

**Examples** To show the contents of a certificate named 'router1', use the command:

```
sh pki cer=router1
```

**Related Commands** [add pki certificate](#)  
[delete pki certificate](#)  
[set pki certificate](#)

## show pki crl

**Syntax** `SHOW PKI CRL [=name]`

where *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command displays information about a CRL or all CRLs in the router's CRL database (Figure 49-5).

If a name is specified, details for the named CRL are displayed (Figure 49-6 on page 49-44).

This command may produce a large amount of output that can be interrupted when paging is turned on (see the [set asyn command on page 9-40 of Chapter 9, Interfaces](#)).

Figure 49-5: Example output from the **show pki crl** command

PKI CRL list:		
Name	State	Minutes-to-next-update
-----		
cal	UPTODATE	1439
-----		

Table 49-5: Parameters in output of the **show pki crl** command

Parameter	Meaning
<b>PKI CRL list shows a summary of the CRLs about which the router has information</b>	
Name	Name assigned to this CRL.
State	State of the CRL:
GETTINGFIRST	router is attempting to retrieve the CRL for the first time
GETTING	router is attempting to retrieve the CRL for an update
NOTFOUNDFIRST	router failed to retrieve the CRL for the first time
NOTFOUND	router failed to retrieve the CRL for an update
UPTODATE	CRL is up to date and being used
NOTVALIDATED	the most recent copy of the CRL retrieved could not be validated
OUTOFDATE	the most recent copy of the CRL retrieved was invalid at the current date
UNRECFORMAT	the most recent copy of the CRL retrieved was corrupt
Minutes-to-next-update	Number of minutes until the CRL is updated.

Figure 49-6: Example output from the **show pki crl=name** command

```

PKI CRL: cal
State ..... UPTODATE
Minutes to next update ... 1434
Number of updates ..... 1

Type ..... CRL
Version ..... V1
Issuer ..... cn=Test CA 1, ou=Web test, o=SSH Communications
                Security, c=FI
Signature algorithm ..... SHA1 with RSA
Number of entries ..... 21
This update ..... 04:54:01 - 14-Mar-2001 (GMT)
Next update ..... 06:00:00 - 14-Mar-2001 (GMT)

Source Location:
file ..... cal.crl

Certificate List:
Certificate Serial Number      Revocation Date      Revocation Reason
-----
380f 893a [940542266]         13:01:51 - 19-Oct-1999 unused
3817 4a1f [941050399]         18:53:19 - 27-Oct-1999 unused
3818 9c41 [941136961]         18:56:01 - 28-Oct-1999 unused
3869 5da3 [946429347]         01:02:28 - 29-Dec-1999 unused
389f 59b0 [949967280]         23:48:00 - 07-Feb-2000 unused
38a0 5ca4 [950033572]         18:12:53 - 08-Feb-2000 unused
38b8 cdc8 [951635400]         07:10:01 - 27-Feb-2000 unused
38ba 124d [951718477]         06:14:37 - 28-Feb-2000 unused
38ff 3486 [956249222]         16:47:02 - 20-Apr-2000 unused
3922 d125 [958583077]         17:04:37 - 17-May-2000 unused
3934 2329 [959718185]         20:23:06 - 30-May-2000 unused
3950 2941 [961554753]         02:32:33 - 21-Jun-2000 unused
3950 656f [961570159]         06:49:19 - 21-Jun-2000 unused
-----

```

Table 49-6: Parameters in output of the **show pki crl=name** command

Parameter	Meaning
PKI CRL	Name of the CRL.
State	State of the CRL:
GETTINGFIRST	router is attempting to retrieve the CRL for the first time
GETTING	router is attempting to retrieve the CRL for an update
NOTFOUNDFIRST	router failed to retrieve the CRL for the first time
NOTFOUND	router failed to retrieve the CRL for an update
UPTODATE	the CRL is up to date and being used
NOTVALIDATED	the most recent copy of the CRL retrieved could not be validated
OUTOFDATE	the most recent copy of the CRL retrieved was invalid at the current date
UNRECFORMAT	the most recent copy of the CRL retrieved was corrupt

Table 49-6: Parameters in output of the **show pki crl=name** command (Continued)

Parameter	Meaning
Minutes to next update	Number of minutes until the CRL is updated.
Number of updates	Number of times the router has retrieved this CRL.
Type	Type of CRL. Currently always CRL (basic CRL).
Version	x.509 CRL version with which the CRL complies.
Issuer	Distinguished name of the CA issued the CRL.
Signature algorithm	Algorithm used by the issuing CA to sign the CRL.
Number of entries	Number of revoked certificates described by the CRL.
This update	Date when this update of the CRL was issued.
Next update	Date when the next update of the CRL will be issued.
Source Location	Location from which the CRL is retrieved.
Certificate List	List of certificates revoked by this CRL.
Certificate Serial Number	Serial number of a revoked certificate.
Revocation Date	Date the certificate was revoked.
Revocation Reason	Reason for the revocation.

**Examples** To display the list of CRLs loaded into the router's CRL database, use the command:

```
sh pki crl
```

To display details about a particular CRL in the CRL database, use the command:

```
sh pki crl=mycrl
```

**Related Commands**

- [add pki crl](#)
- [delete pki crl](#)
- [set pki crl](#)

## show pki enrollmentrequest

**Syntax** Show PKI ENRollmentrequest [=name]

where *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command displays information about current enrollment requests (Figure 49-7). Note that enrollment requests are processed rapidly and it may not be possible to capture the output.

If a name is specified, details for the named request are displayed (Figure 49-8).

Figure 49-7: Example output from the **show pki enrollmentrequest** command

Enrollment Requests			
Name	KeyId	Protocol	State
-----	-----	-----	-----
bob	1	CMP	WAIT_FOR_IP
-----	-----	-----	-----

Table 49-7: Parameters in output of the **show pki enrollmentrequest** command

Parameter	Meaning
<b>Enrollment Requests</b>	Information about current enrollment requests.
Name	Name of the enrollment request.
KeyId	ENCO key identification number for the new certificate.
Protocol	Whether the PKI management protocol used for the enrollment request is CMP or MANUAL.
State	State of the request, which can be used for debugging purposes; one of WAIT_FOR_IP (the router is waiting for an Initialisation Response Message from the CA), WAIT_FOR_CERT_CHECK (the router is validating the new certificate) or WAIT_FOR_CONFOK (the router is waiting for an Confirmation OK Indication from the CA)

Figure 49-8: Example output from the **show pki enrollmentrequest=name** command

Enrollment Request:	
Name .....	bob
KeyID .....	1
Protocol .....	CMP
State .....	WAIT_FOR_IP
Secret Value .....	ASDFGHJKLZ
Reference Number ....	80303003
Location:	
IP address .....	192.168.1.100

Table 49-8: Parameters in output of the **show pki enrollmentrequest=name** command

Parameter	Meaning
Enrollment Request	Information about the named enrollment request.
Name	Name of the enrollment request.
KeyID	ENCO key identification number for the new certificate.
Protocol	Whether the PKI management protocol used for the enrollment request is CMP or Manual.
State	State of the request, which can be used for debugging purposes; one of WAIT_FOR_IP (the router is waiting for an Initialisation Response Message from the CA), WAIT_FOR_CERT_CHECK (the router is validating the new certificate) or WAIT_FOR_CONFOK (the router is waiting for an Confirmation OK Indication from the CA)
Secret Value	Shared secret for Proof of Possession (of private key) transactions. A shared secret is required by some CAs.
Reference Number	Reference number for this request from the End Entity. A reference number is provided by some CAs.
Location	Address of the CA; either an IP address or a domain name. These parameters are relevant for CMP requests.
IP address	IP address of the CA.
domain name	Fully-qualified domain name of the CA of the type foo.bar.com.

**Examples** To show a summary of all current enrollment requests, use the command:

```
sh pki enr
```

To display details about a particular enrollment request, use the command:

```
sh pki enr=myreq
```

**Related Commands** [create pki enrollmentrequest](#)  
[destroy pki enrollmentrequest](#)

## show pki keyupdaterequest

**Syntax** Show PKI KEYUpdaterequest [=name]

where *name* is a string from 1 to 24 characters long. Valid characters are any printable characters. If the name contains spaces, it must be in double quotes. Wildcards are not allowed.

**Description** This command displays information about current key update requests. If a name is specified, details for the name are displayed.

Figure 49-9: Example output from the **show pki keyupdaterequest** command

Key Update Requests			
Name	KeyID	Certificate	State
upbob	2	bob	WAIT_FOR_KUP

Table 49-9: Parameters in output of the **show pki keyupdaterequest** command

Parameter	Meaning
<b>Key Update Requests</b>	Information about all current key update requests.
Name	Name of the key update request.
KeyID	ENCO key identification number for the new certificate.
Certificate	Name of the certificate for which the keys are to be updated.
State	State of the request, which can be used for debugging purposes; one of "WAIT_FOR_IP" (the router is waiting for an Initialisation Response Message from the CA), "WAIT_FOR_KUP" (the router is waiting for an Key Update Response Message from the CA), "WAIT_FOR_CERT_CHECK" (the router is validating the new certificate) or "WAIT_FOR_CONFOK" (the router is waiting for an Confirmation OK Indication from the CA).

Figure 49-10: Example output from the **show pki keyupdaterequest=name** command

Key Update Request:	
Name .....	upbob
KeyID .....	2
Certificate Name ....	bob
Location:	
IP address .....	192.168.1.100



Table 49-10: Parameters in output of the **show pki keyupdaterequest=name** command

Parameter	Meaning
<b>Key Update Request</b>	Information about the named current key update request.
Name	Name of the key update request.
KeyID	ENCO key identification number for the new certificate.
Certificate Name	Name of the certificate for which the keys are to be updated.
<b>Location</b>	Address of the CA; either an IP address or a domain name.
IP address	IP address of the CA.
domain name	Fully-qualified domain name of the CA of the type foo.bar.com.

**Examples** To show a summary of all current key update requests, use the command:

```
sh pki keyu
```

To display details about a particular key update request, use the command:

```
sh pki keyu=myreq
```

**Related Commands** [create pki keyupdaterequest](#)  
[destroy pki keyupdaterequest](#)

## show pki ldaprepository

**Syntax** SHOW PKI LDAPrepository

**Description** This command displays information about the LDAP repositories configured on the router (Figure 49-11, Table 49-11).

Figure 49-11: Example output from the **show pki ldaprepository** command

LDAP Repository Information:		
Index	Name	Address
0	foobar	192.168.100.200

Table 49-11: Parameters in output of the **show pki ldaprepository** command

Parameter	Meaning
Index	Local index of the LDAP repository.
Name	Name given to the LDAP repository by the user.
Address	IP address or domain name of the LDAP repository.

**Examples** To show summary of all LDAP repositories, use the command:

```
sh pki ld
```

**Related Commands** [add pki ldaprepository](#)  
[delete pki ldaprepository](#)  
[set pki ldaprepository](#)