Red Hat Certificate System Red Hat Certificate System 9 Administration Guide

Updated for Certificate System 9

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Abstract

This manual covers all aspects of installing, configuring, and managing Certificate System subsystems. It also covers management tasks such as adding users; requesting, renewing, and revoking certificates; publishing CRLs; and managing smart cards. This guide is intended for Certificate System administrators.

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Chapter 1. Overview of Red Hat Certificate System Subsystems

Every common PKI operation — issuing, renewing and revoking certificates; archiving and recovering keys; publishing CRLs and verifying certificate status — are carried out by interoperating subsystems within Red Hat Certificate System. The functions of each individual subsystem and the way that they work together to establish a robust and local PKI is described in this chapter.

1.1. Uses for Certificates

The purpose of certificates is to establish trust. Their usage varies depending on the kind of trust they are used to ensure. Some kinds of certificates are used to verify the identity of the presenter; others are used to verify that an object or item has not been tampered with.

For information on how certificates are used, the types of certificates, or how certificates establish identities and relationships, see *Red Hat Certificate System Planning, Installation, and Deployment Guide*.

1.2. A Review of Certificate System Subsystems

Red Hat Certificate System provides five different subsystems, each focusing on different aspects of a PKI deployment. These subsystems work together to create a public key infrastructure (PKI). Depending on what subsystems are installed, a PKI can function as a token management system (TMS) or a non token management system. For descriptions of the subsystems and TMS and non-TMS environments, see *Red Hat Certificate System Planning, Installation, and Deployment Guide*.

Enterprise Security Client

The Enterprise Security Client is not a subsystem since it does not perform any operations with certificates, keys, or tokens. The Enterprise Security Client is a user interface which allows people to manage certificates on smart cards very easily. The Enterprise Security Client sends all token operations, such as certificate requests, to the token processing system (TPS), which then sends them to the certificate authority (CA).

1.3. A Look at Managing Certificates (Non-TMS)

A conventional PKI environment provides the basic framework to manage certificates stored in software databases. This is a *non-TMS* environment, since it does not manage certificates on smart cards. At a minimum, a non-TMS requires only a CA, but a non-TMS environment can use OCSP responders and KRA instances as well.

For information on this topic, see the following sections in *Red Hat Certificate System Planning, Installation, and Deployment Guide*:

- Managing Certificates
- Using a Single Certificate Manager
- Planning for Lost Keys: Key Archival and Recovery

- Balancing Certificate Request Processing
- Balancing Client OCSP Requests

1.4. A Look at the Token Management System (TMS)

Certificate System creates, manages, renews, and revokes certificates, and it also archives and recovers keys. For organizations which use smart cards, the Certificate System has a token management system — a collection of subsystems with established relationships — to generate keys and requests and receive certificates to be used for smart cards.

For information on this topic, see the following sections in *Red Hat Certificate System Planning, Installation, and Deployment Guide*:

- Working with Smart Cards (TMS)
- Using Smart Cards

1.5. Red Hat Certificate System services

There are three different interfaces for managing certificates and subsystems, depending on the user type: administrators, agents, and end users. For an overview of the different functions that are performed through each interface, see Red Hat Certificate System Planning, Installation, and Deployment Guide.

Part I. Setting up Certificate Services

Chapter 2. Making Rules for Issuing Certificates (Certificate Profiles)

The Certificate System provides a customizable framework to apply policies for incoming certificate requests and to control the input request types and output certificate types; these are called *certificate profiles*. Certificate profiles set the required information for certificate enrollment forms in the Certificate Manager end-entities page. This chapter describes how to configure certificate profiles.

2.1. About Certificate Profiles

A certificate profile defines everything associated with issuing a particular type of certificate, including the authentication method, the authorization method, the default certificate content, constraints for the values of the content, and the contents of the input and output for the certificate profile. Enrollment and renewal requests are submitted to a certificate profile and are then subject to the defaults and constraints set in that certificate profile. These constraints are in place whether the request is submitted through the input form associated with the certificate profile or through other means. The certificate that is issued from a certificate profile request contains the content required by the defaults with the information required by the default parameters. The constraints provide rules for what content is allowed in the certificate.

The Certificate System contains a set of default profiles. While the default profiles are created to satisfy most deployments, every deployment can add their own new certificate profiles or modify the existing profiles. All the profiles that are served by the Certificate System are listed and their corresponding profile configuration files defined in the **`CS.cfg`** file.

- *Authentication.* In every certification profile can be specified an authentication method. The authentication method specified must be one of the registered authentication instances from **`CS.cfg`**.
- *Authorization.* In every certification profile can be specified an authorization method. The authorization method specified must be one of the registered authorization instances from **`CS.cfg`**.
- *Profile inputs.* Profile inputs are parameters and values that are submitted to the CA when a certificate is requested. Profile inputs include public keys for the certificate request and the certificate subject name requested by the end entity for the certificate.
- *Profile outputs.* Profile outputs are parameters and values that specify the format in which to provide the certificate to the end entity. Profile outputs include base-64 encoded files, CMMF responses, and PKCS #7 output, which also contains the CA chain.
- *Certificate content.* Each certificate defines content information, such as the name of the entity to which it is assigned (the subject name), its signing algorithm, and its validity period. What is included in a certificate is defined in the X.509 standard. With version 3 of the X509 standard, certificates can also contain extensions. For more information about certificate extensions, see Section B.3, “Standard X.509 v3 Certificate Extension Reference”.

  All of the information about a certificate profile is defined in the **`set`** entry of the profile policy in the profile's configuration file. When multiple certificates are expected to be requested at the same time, multiple set entries can be defined in the profile policy to satisfy needs of each certificate. Each policy set consists of a number of policy rules and each policy rule describes a field in the certificate content. A policy rule can include the following parts:

- *Profile defaults.* These are predefined parameters and allowed values for information contained within the certificate. Profile defaults include the validity period of the certificate, and what certificate extensions appear for each type of certificate issued.
- *Profile constraints.* Constraints set rules or policies for issuing certificates. Amongst other, profile constraints include rules to require the certificate subject name to have at least one CN component, to set the validity of a certificate to a maximum of 360 days, to define the allowed grace period for renewal, or to require that the **subjectaltname** extension is always set to **true**.

2.1.1. The Enrollment Profile

The enrollment profile itself is defined in a special **.cfg** file in the ***/instance_path/*ca/profiles/ca/** directory for the CA, for example, **/var/lib/pki/pki-ca/ca/profiles/ca/**. The parameters for this file defining the inputs, outputs, and policy sets are listed in more detail in Section 2.2.3, “Creating and Editing Certificate Profiles through the Command Line”.

A profile usually contains inputs, policy sets, and outputs, as illustrated in the **caUserCert** profile in Example 2.1, “Example caUserCert Profile”.

Example 2.1. Example caUserCert Profile

The first part of a certificate profile is the description. This shows the name, long description, whether it is enabled, and who enabled it.

```
desc=This certificate profile is for enrolling user certificates.
visible=true
enable=true
enableBy=admin
name=Manual User Dual-Use Certificate Enrollment
```

Note

The missing **auth.instance_id=** entry in this profile means that with this profile, authentication is not needed to submit the enrollment request. However, manual approval by an authorized CA agent will be required to get an issuance.

Next, the profile lists all of the required inputs for the profile:

```
input.list=i1,i2,i3
input.i1.class_id=keyGenInputImpl
input.i2.class_id=subjectNameInputImpl
input.i3.class_id=submitterInfoInputImpl
```

For the **caUserCert** profile, this defines the keys to generate, the fields to use in the subject name, and the fields to use for the person submitting the certificate.

- *Key generation* specifies that the key pair generation during the request submission be CRMF-based and has a drop-down menu to select the key bit size.
- *Subject name* is used when distinguished name (DN) parameters need to be collected from the user; the text fields in the input form can be used to create the subject name in the certificate.
  - UID
  - Email
  - Common name
  - Organizational unit
  - Organization
  - Country
- *Requester*. This input has the following form fields:
  - Requester name
  - Requester email
  - Requester phone

Next, the profile must define the output, meaning the format of the final certificate. There are several pre-defined outputs. More than one of these can be used, but none of the values of the output can be modified.

```
output.list=o1
output.o1.class_id=certOutputImpl
```

For **caUserCert**, the output displays the certificate in pretty print format. This output needs to be specified for any automated enrollment. Once a user successfully authenticates and is authorized using the automated enrollment method, the certificate is automatically generated, and this output page is returned to the user. In an agent-approved enrollment, the user can obtain the certificate, once it is issued, by providing the request ID in the CA end entities page.

The last — largest — block of configuration is the policy set for the profile. Policy sets list all of the settings that are applied to the final certificate, like its validity period, its renewal settings, and the actions the certificate can be used for. The **policyset.list** parameter identifies the block name of the policies that apply to one certificate; the **policyset.userCertSet.list** lists the individual policies to apply.

For example, the sixth policy populates the Key Usage Extension automatically in the certificate, according to the configuration in the policy. It sets the defaults and requires the certificate to use those defaults by setting the constraints:

```
policyset.list=userCertSet
policyset.userCertSet.list=1,10,2,3,4,5,6,7,8,9
...
policyset.userCertSet.6.constraint.class_id=keyUsageExtConstraintImpl
policyset.userCertSet.6.constraint.name=Key Usage Extension Constraint
policyset.userCertSet.6.constraint.params.keyUsageCritical=true
policyset.userCertSet.6.constraint.params.keyUsageDigitalSignature=tru
e
```

```
policyset.userCertSet.6.constraint.params.keyUsageNonRepudiation=true
policyset.userCertSet.6.constraint.params.keyUsageDataEncipherment=fal
se
policyset.userCertSet.6.constraint.params.keyUsageKeyEncipherment=true
policyset.userCertSet.6.constraint.params.keyUsageKeyAgreement=false
policyset.userCertSet.6.constraint.params.keyUsageKeyCertSign=false
policyset.userCertSet.6.constraint.params.keyUsageCrlSign=false
policyset.userCertSet.6.constraint.params.keyUsageEncipherOnly=false
policyset.userCertSet.6.constraint.params.keyUsageDecipherOnly=false
policyset.userCertSet.6.default.class_id=keyUsageExtDefaultImpl
policyset.userCertSet.6.default.name=Key Usage Default
policyset.userCertSet.6.default.params.keyUsageCritical=true
policyset.userCertSet.6.default.params.keyUsageDigitalSignature=true
policyset.userCertSet.6.default.params.keyUsageNonRepudiation=true
policyset.userCertSet.6.default.params.keyUsageDataEncipherment=false
policyset.userCertSet.6.default.params.keyUsageKeyEncipherment=true
policyset.userCertSet.6.default.params.keyUsageKeyAgreement=false
policyset.userCertSet.6.default.params.keyUsageKeyCertSign=false
policyset.userCertSet.6.default.params.keyUsageCrlSign=false
policyset.userCertSet.6.default.params.keyUsageEncipherOnly=false
policyset.userCertSet.6.default.params.keyUsageDecipherOnly=false
...
```

2.1.2. Certificate Extensions: Defaults and Constraints

An extension configures additional information to include in a certificate or rules about how the certificate can be used. These extensions can either be specified in the certificate request or taken from the profile default definition and then enforced by the constraints.

A certificate extension is added or identified in a profile by adding the *default* which corresponds to the extension and sets default values, if the certificate extension is not set in the request. For example, the Basic Constraints Extension identifies whether a certificate is a CA signing certificate, the maximum number of subordinate CAs that can be configured under the CA, and whether the extension is critical (required):

```
policyset.caCertSet.5.default.name=Basic Constraints Extension Default
policyset.caCertSet.5.default.params.basicConstraintsCritical=true
policyset.caCertSet.5.default.params.basicConstraintsIsCA=true
policyset.caCertSet.5.default.params.basicConstraintsPathLen=-1
```

The extension can also set required values for the certificate request called *constraints*. If the contents of a request do not match the set constraints, then the request is rejected. The constraints generally correspond to the extension default, though not always. For example:

```
policyset.caCertSet.5.constraint.class_id=basicConstraintsExtConstraintI
mpl
policyset.caCertSet.5.constraint.name=Basic Constraint Extension
Constraint
policyset.caCertSet.5.constraint.params.basicConstraintsCritical=true
policyset.caCertSet.5.constraint.params.basicConstraintsIsCA=true
policyset.caCertSet.5.constraint.params.basicConstraintsMinPathLen=-1
policyset.caCertSet.5.constraint.params.basicConstraintsMaxPathLen=-1
```

> **Note**
>
> To allow user supplied extensions to be embedded in the certificate requests and ignore the system-defined default in the profile, the profile needs to contain the User Supplied Extension Default, which is described in Section B.1.32, “User Supplied Extension Default”.

2.1.3. Inputs and Outputs

Inputs set information that must be submitted to receive a certificate. This can be requester information, a specific format of certificate request, or organizational information.

The outputs configured in the profile define the format of the certificate that is issued.

In Certificate System, profiles are accessed by users through *enrollment forms* that are accessed through the end-entities pages. (Even clients, such as TPS, submit enrollment requests through these forms.) The inputs, then, correspond to fields in the enrollment forms. The outputs correspond to the information contained on the certificate retrieval pages.

2.2. Setting up Certificate Profiles

2.2.1. Creating Certificate Profiles through the CA Console

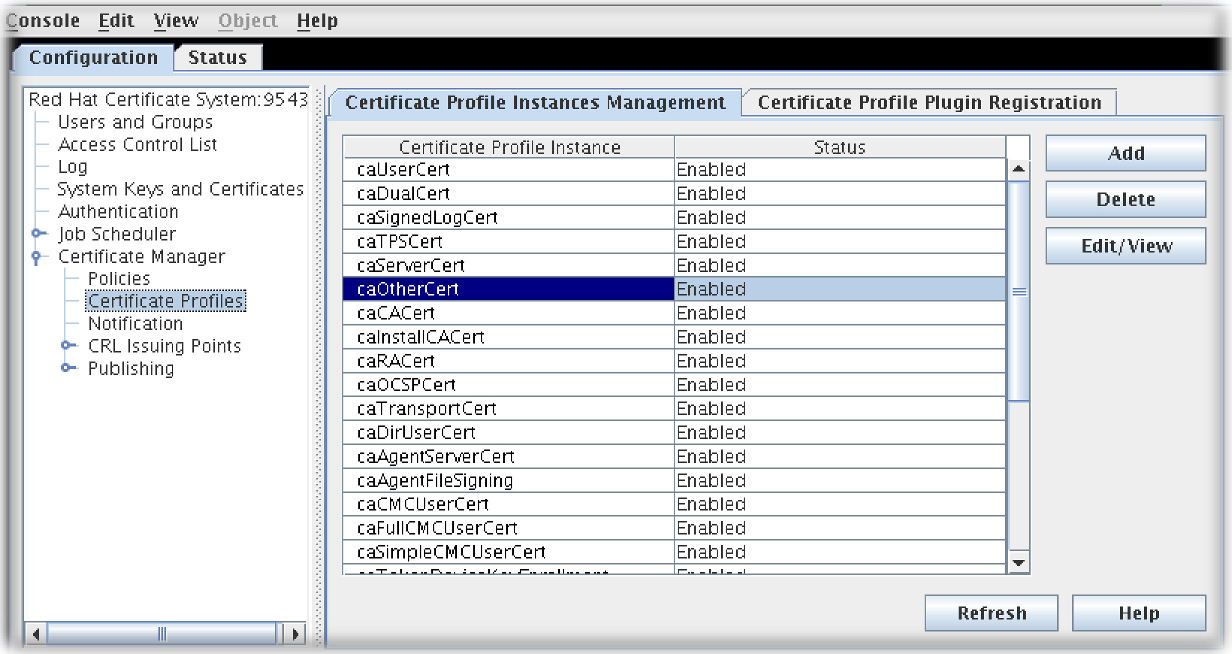
For security reasons, the Certificate Systems enforces separation of roles whereby an existing certificate profile can only be edited by an administrator after it was allowed by an agent. To add a new certificate profile or modify an existing certificate profile, perform the following steps as the administrator:

1. Log in to the Certificate System CA subsystem console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

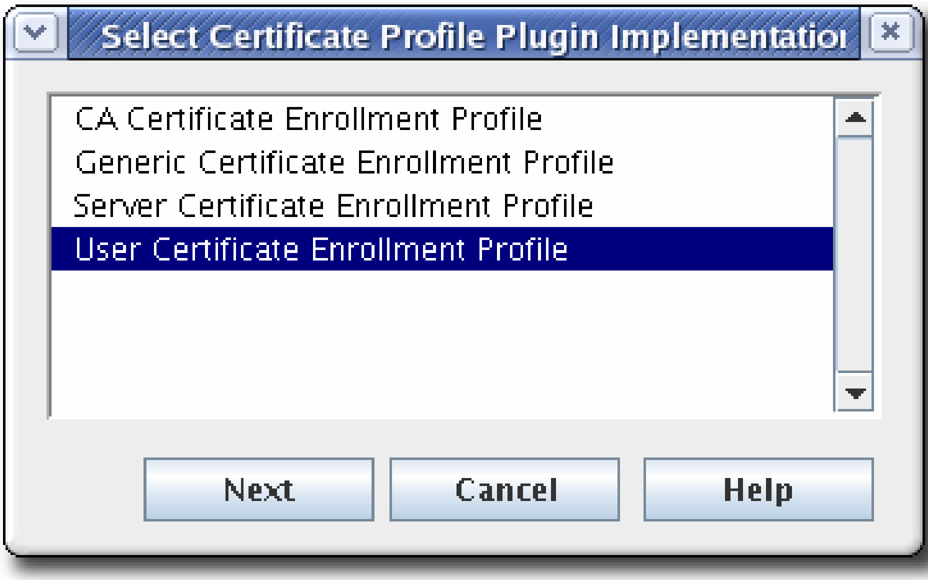
2. In the **`Configuration`** tab, select **`Certificate Manager`**, and then select **`Certificate Profiles`**.

   The **`Certificate Profile Instances Management`** tab, which lists configured certificate profiles, opens.

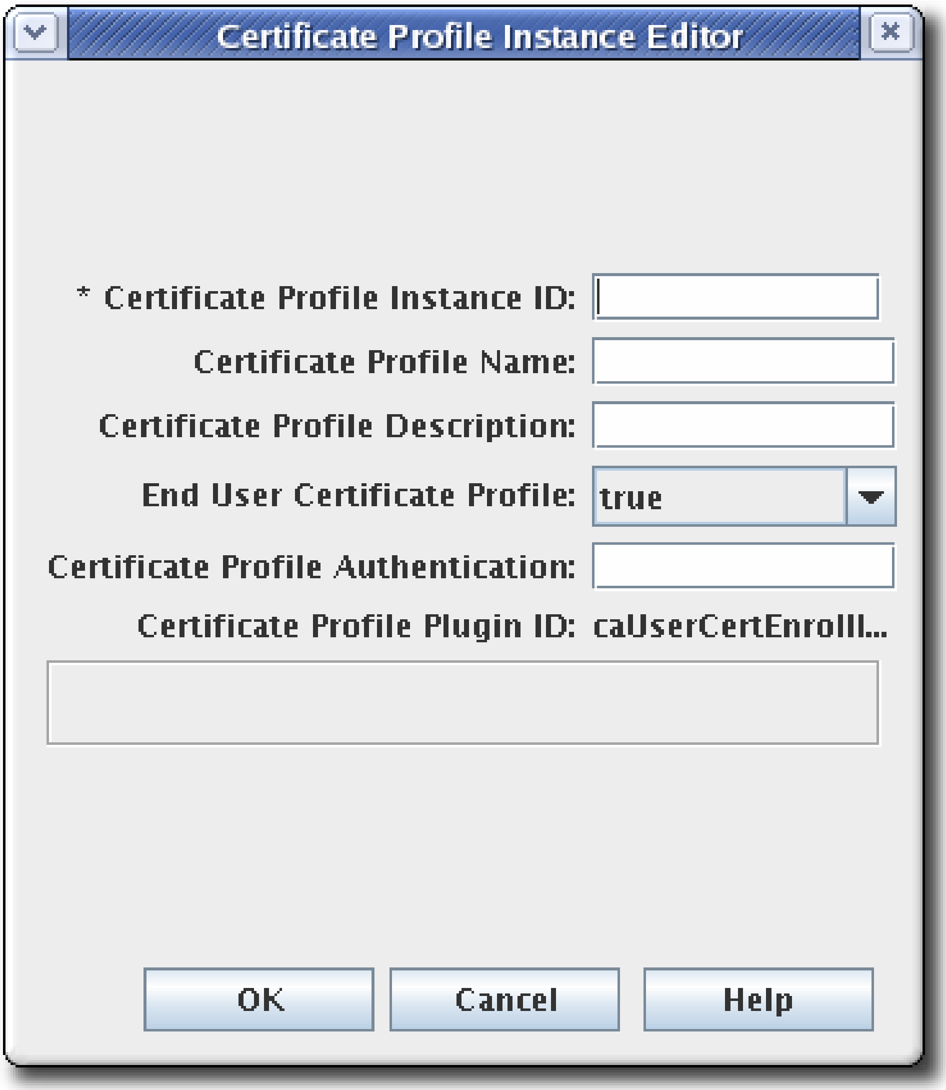


3. To create a new certificate profile, click **Add**.

   In the **Select Certificate Profile Plugin Implementation** window, select the type of certificate for which the profile is being created.



4. Fill in the profile information in the **Certificate Profile Instance Editor**.



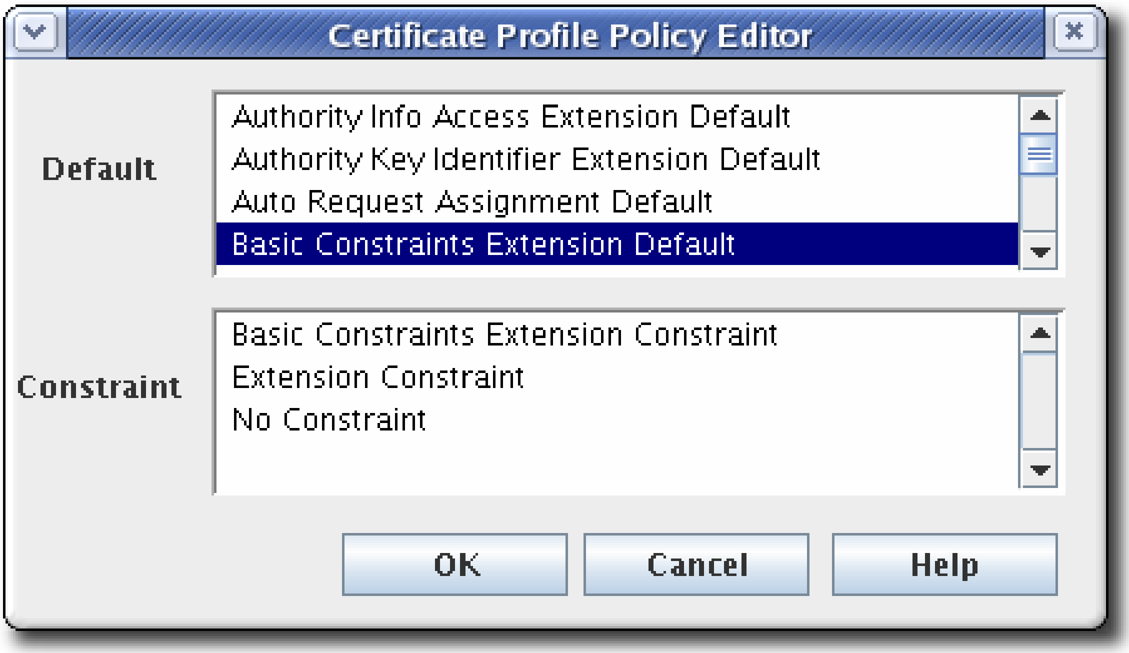
- **Certificate Profile Instance ID**. This is the ID used by the system to identify the profile.
- **Certificate Profile Name**. This is the user-friendly name for the profile.
- **Certificate Profile Description**.
- **End User Certificate Profile**. This sets whether the request must be made through the input form for the profile. This is usually set to **true**. Setting this to **false** allows a signed request to be processed through the Certificate Manager's certificate profile framework, rather than through the input page for the certificate profile.
- **Certificate Profile Authentication**. This sets the authentication method. An automated authentication is set by providing the instance ID for the authentication instance. If this field is blank, the authentication method is agent-approved enrollment; the request is submitted to the request queue of the agent services interface.

5. Click **OK**. The plug-in editor closes, and the new profile is listed in the profiles tab.

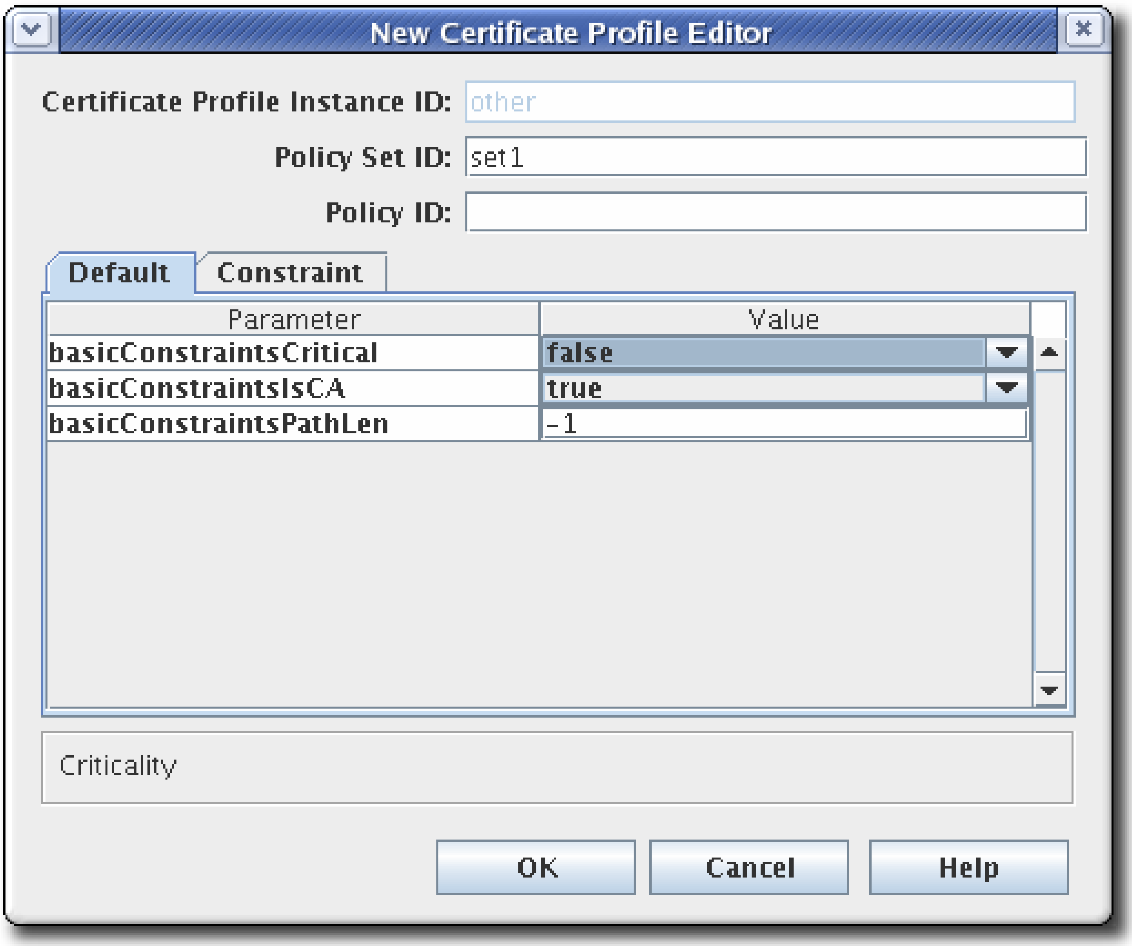
6. Configure the policies, inputs, and outputs for the new profile. Select the new profile from the list, and click **Edit/View**.

7. Set up policies in the **Policies** tab of the **Certificate Profile Rule Editor** window. The **Policies** tab lists policies that are already set by default for the profile type.

   a. To add a policy, click **Add**.

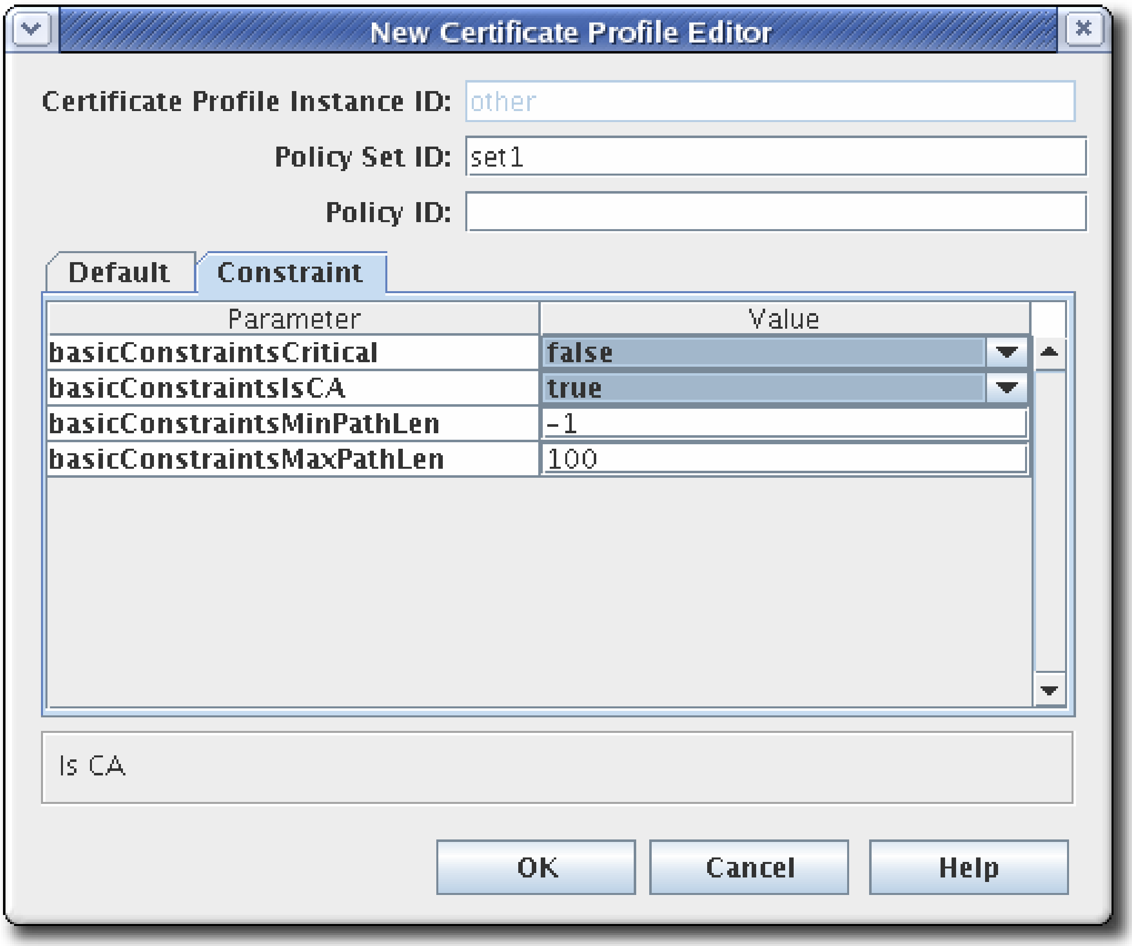


   b. Choose the default from the **Default** field, choose the constraints associated with that policy in the **Constraints** field, and click **OK**.



   c. Fill in the policy set ID. When issuing dual key pairs, separate policy sets define the policies associated with each certificate. Then fill in the certificate profile policy ID, a name or identifier for the certificate profile policy.

d. Configure any parameters in the **Defaults** and **Constraints** tabs.



Defaults defines attributes that populate the certificate request, which in turn determines the content of the certificate. These can be extensions, validity periods, or other fields contained in the certificates. **Constraints** defines valid values for the defaults.

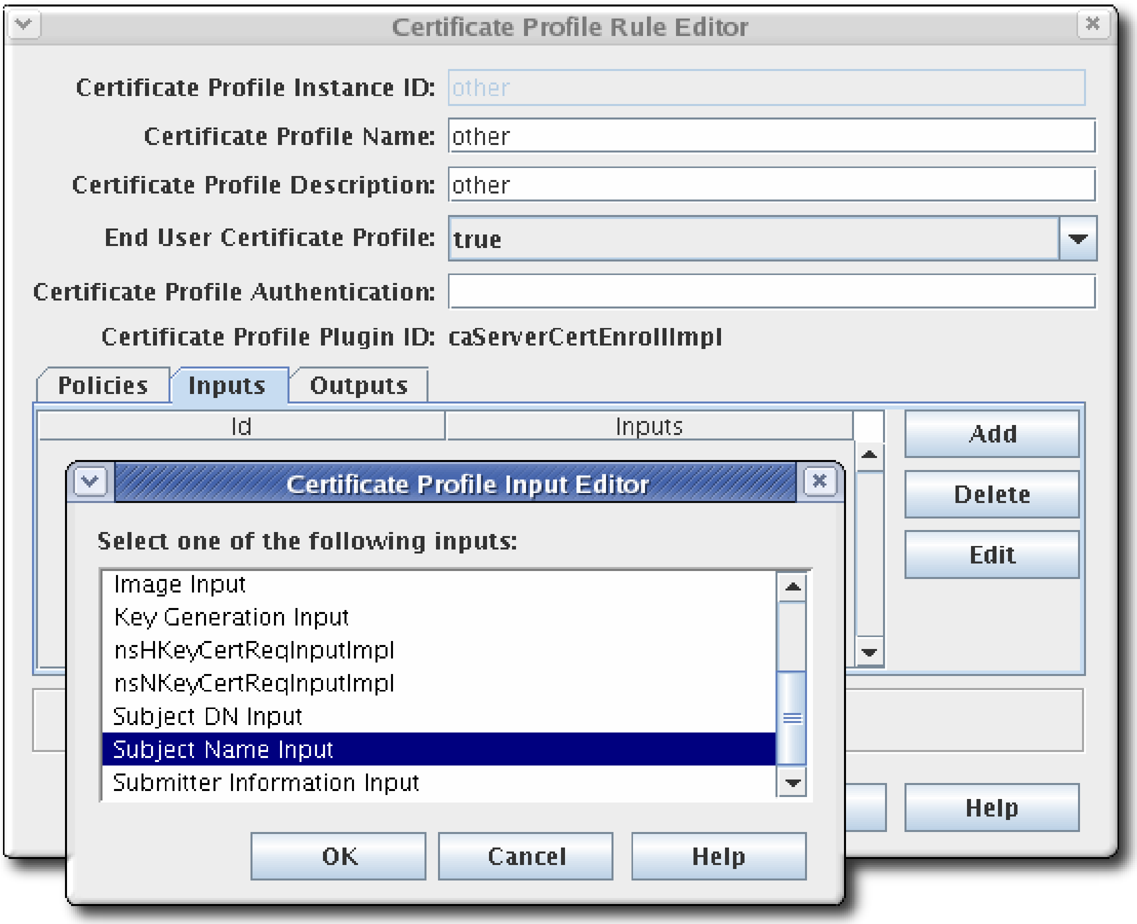
See Section B.1, “Defaults Reference” and Section B.2, “Constraints Reference” for complete details for each default or constraint.

To modify an existing policy, select a policy, and click **Edit**. Then edit the default and constraints for that policy.

To delete a policy, select the policy, and click **Delete**.

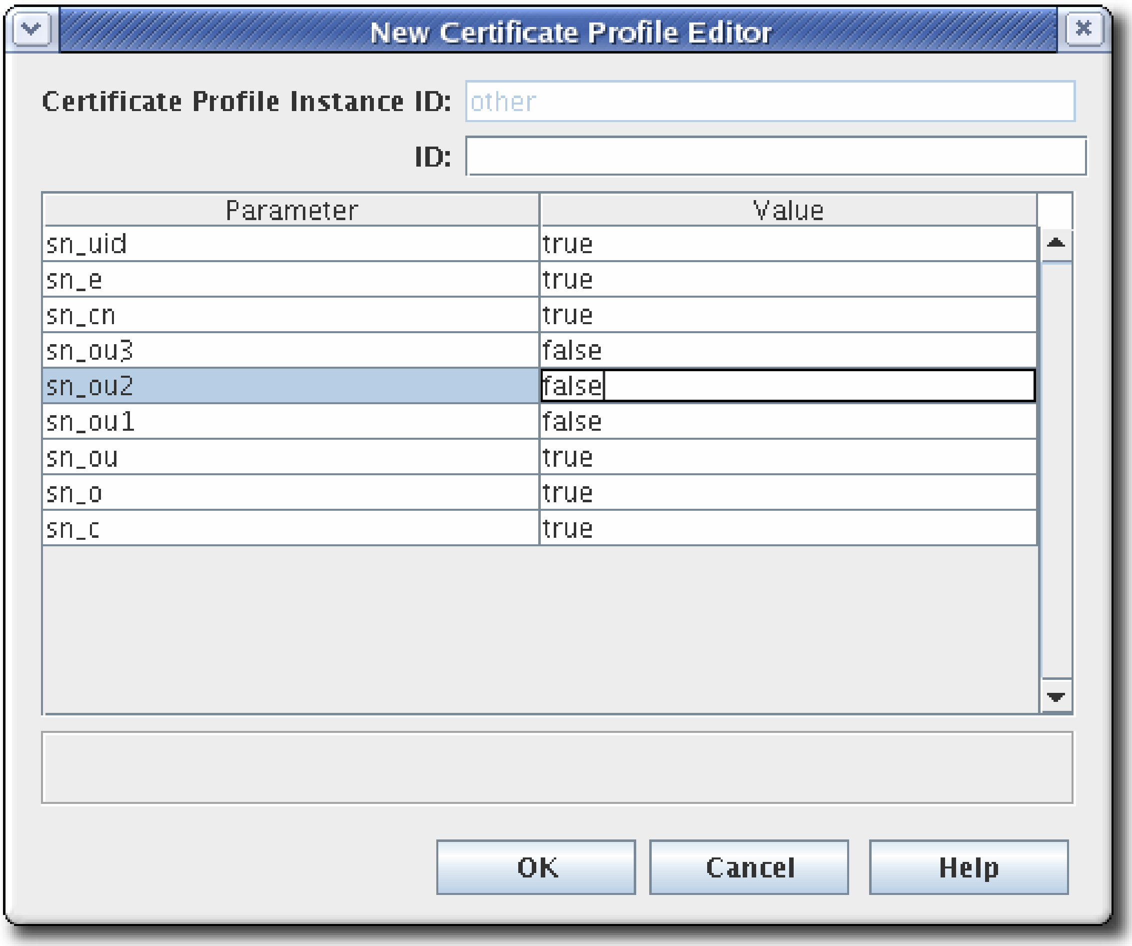
8. Set inputs in the **Inputs** tab of the **Certificate Profile Rule Editor** window. There can be more than one input type for a profile.

   a. To add an input, click **Add**.



b. Choose the input from the list, and click **OK**. See Section A.1, "Input Reference" for complete details of the default inputs.

c. The **`New Certificate Profile Editor`** window opens. Set the input ID, and click **OK**.

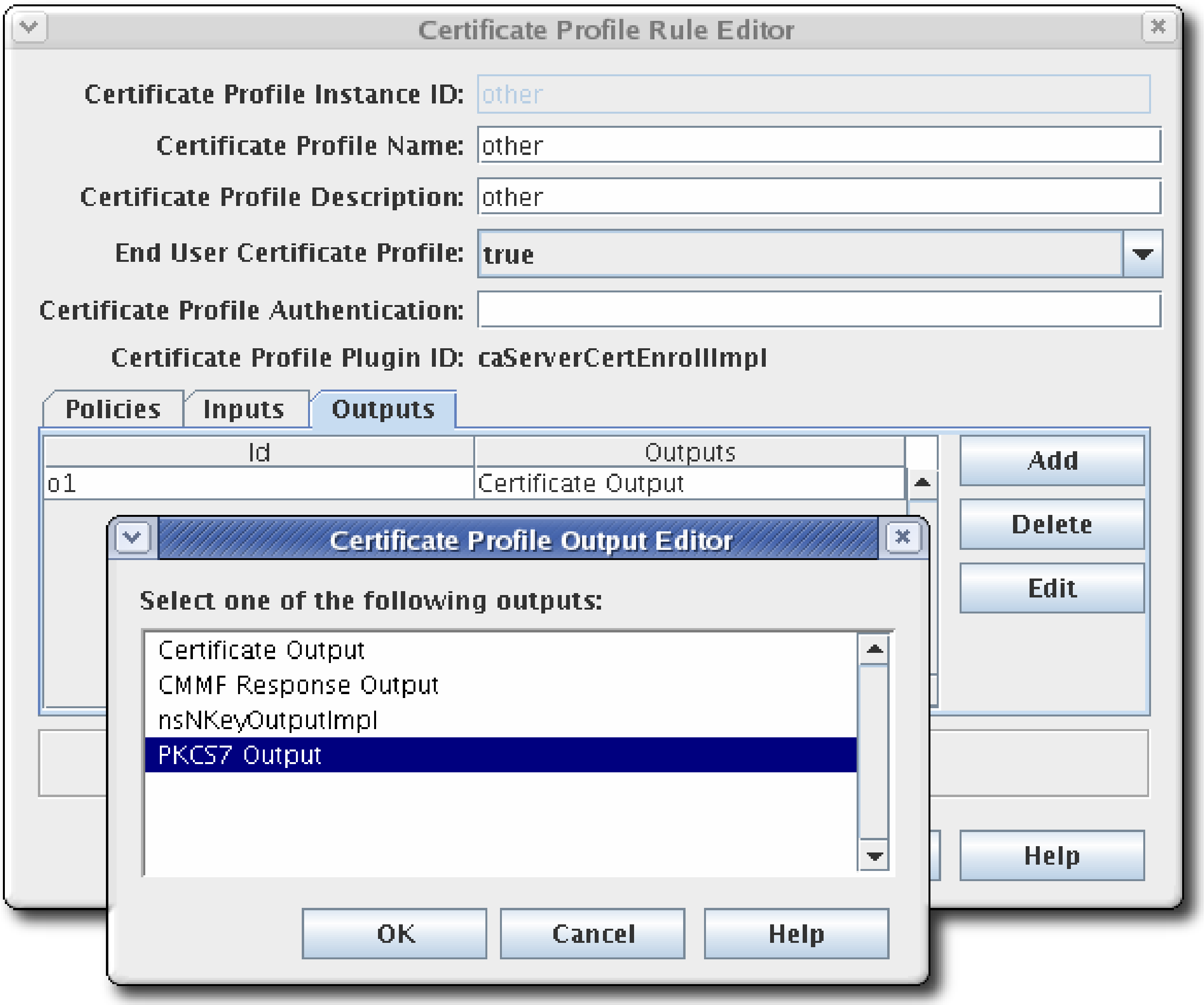


Inputs can be added and deleted. It is possible to select edit for an input, but since inputs have no parameters or other settings, there is nothing to configure.

To delete an input, select the input, and click **Delete**.

9. Set up outputs in the **Outputs** tab of the **Certificate Profile Rule Editor** window.

   Outputs must be set for any certificate profile that uses an automated authentication method; no output needs to be set for any certificate profile that uses agent-approved authentication. The Certificate Output type is set by default for all profiles and is added automatically to custom profiles.



Outputs can be added and deleted. It is possible to select edit for an output, but since outputs have no parameters or other settings, there is nothing to configure.

a. To add an output, click **Add**.

b. Choose the output from the list, and click **OK**.

c. Give a name or identifier for the output, and click **OK**.

   This output will be listed in the output tab. You can edit it to provide values to the parameters in this output.

To delete an output, select the output from list, and click **Delete**.

10. Restart the CA to apply the new profile.

```
systemctl restart pki-tomcatd@instance-name.service
```

11. After creating the profile as an administrator, a CA agent has to approve the profile in the agent services pages to enable the profile.

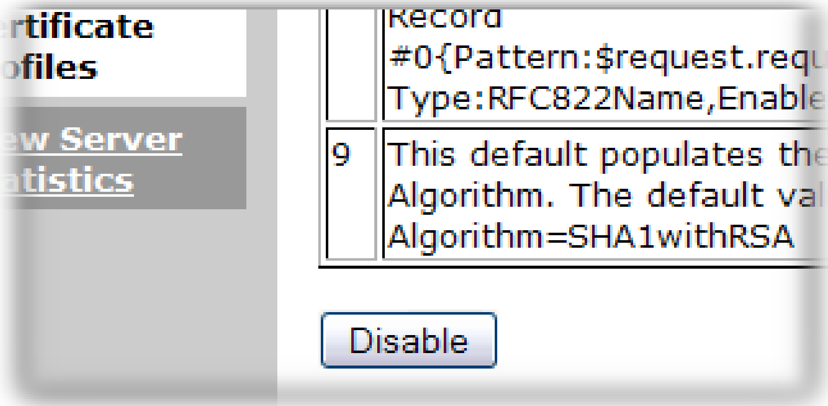
    a. Open the CA's services page.

    ```
    https://server.example.com:8443/ca/services
    ```

b. Click the **Manage Certificate Profiles** link. This page lists all of the certificate profiles that have been set up by an administrator, both active and inactive.

c. Click the name of the certificate profile to approve.

d. At the bottom of the page, click the **Enable** button.



> **Note**
>
> If this profile will be used with a TPS, then the TPS must be configured to recognized the profile type. This is in Section 2.4, "Managing Smart Card CA Profiles".

Authorization methods for the profiles can only be added to the profile using the command line, as described in Section 2.2.3, "Creating and Editing Certificate Profiles through the Command Line".

2.2.2. Editing Certificate Profiles in the Console

To modify an existing certificate profile:

1. Log into the agent services pages and disable the profile.

   Once a certificate profile is enabled by an agent, that certificate profile is marked enabled in the **Certificate Profile Instance Management** tab, and the certificate profile cannot be edited in any way through the console.

2. Log in to the Certificate System CA subsystem console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

3. In the **Configuration** tab, select **Certificate Manager**, and then select **Certificate Profiles**.

4. Select the certificate profile, and click **Edit/View**.

5. The **Certificate Profile Rule Editor** window appears. Many any changes to the defaults, constraints, inputs, or outputs.

> **Note**
>
> The profile instance ID cannot be modified.

If necessary, enlarge the window by pulling out one of the corners of the window.

6. Restart the CA to apply the changes.

7. In the agent services page, re-enable the profile.

> **Note**
>
> Delete any certificate profiles that will not be approved by an agent. Any certificate profile that appears in the **Certificate Profile Instance Management** tab also appears in the agent services interface. If a profile has already been enabled, it must be disabled by the agent before it can be deleted from the profile list.

2.2.3. Creating and Editing Certificate Profiles through the Command Line

The certificate profiles can be modified directly through the command line by modifying the profiles' configuration files. Default files exist for the default profiles at installation; when new profiles are created, new configuration files are also created. The configuration files are stored in the CA profile directory, *instance_directory*/**ca/profiles/ca/**, such as **/var/lib/pki/pki-ca/ca/profiles/ca/**. The file is named *profile_name*.**cfg**. All of the parameters for profile rules set or modified through the Console, such as defaults, inputs, outputs, and constraints, are written to the profile configuration file.

The enrollment profiles for subsystem certificates are located in the **/var/lib/pki/instance_name/ca/conf** directory with the name ***.profile**.

> **Note**
>
> Restart the server after editing the profile configuration file for the changes to take effect.

- Section 2.2.3.1, "Profile Configuration Parameters"
- Section 2.2.3.2, "Modifying Certificate Extensions through the Command Line"
- Section 2.2.3.3, "Adding Inputs through the Command Line"

2.2.3.1. Profile Configuration Parameters

The configuration files are stored in the CA profile directory, such as **/var/lib/pki/pki-ca/ca/profiles/ca/**. The file is named *profile_name*.**cfg**. All of the parameters for a profile rule - defaults, inputs, outputs, and constraints - are configured within a single policy set. A policy set for a profile has the name **policyset.***policyName.policyNumber*. For example:

```
policyset.cmcUserCertSet.6.constraint.class_id=noConstraintImpl
policyset.cmcUserCertSet.6.constraint.name=No Constraint
policyset.cmcUserCertSet.6.default.class_id=userExtensionDefaultImpl
policyset.cmcUserCertSet.6.default.name=User Supplied Key Default
policyset.cmcUserCertSet.6.default.params.userExtOID=2.5.29.15
```

The common profile configuration parameters are described in Table 2.1, “Profile Configuration File Parameters”.

There is only one policy set processed for the profile, except for dual key pairs when two policy sets are processed. The server evaluates each policy set for each request it receives. When a single certificate is issued, one set is evaluated, and any other sets in the profile are ignored. When dual key pairs are issued, the first policy set is evaluated with the first certificate request, and the second set is evaluated with the second certificate request. There is no need for more than one policy set when issuing single certificates or more than two sets when issuing dual key pairs.

Table 2.1. Profile Configuration File Parameters

Parameter	Description
desc	Gives a free text description of the certificate profile, which is shown on the end-entities page. For example, *desc=This certificate profile is for enrolling server certificates with agent authentication.*
enable	Sets whether the profile is enabled, and therefore accessible through the end-entities page. For example, *enable=true*.
auth.instance_id	Sets which authentication manager plug-in to use to authenticate the certificate request submitted through the profile. For automatic enrollment, the CA issues a certificate immediately if the authentication is successful. If authentication fails or there is no authentication plug-in specified, the request is queued to be manually approved by an agent. For example, *auth.instance_id=AgentCertAuth*.

Parameter	Description
authz.acl	Specifies the authorization constraint. Most commonly, this us used to set the group evaluation ACL. For example, this caCMCUserCert parameter requires that the signer of the CMC request belong to the Certificate Manager Agents group: *authz.acl=group="Certificate Manager Agents"* In directory-based user certificate renewal, this option is used to ensure that the original requester and the currently-authenticated user are the same. An entity must authenticate (bind or, essentially, log into the system) before authorization can be evaluated.
name	Gives the name of the profile. For example, *name=Agent-Authenticated Server Certificate Enrollment*. This name is displayed in the end users enrollment or renewal page.
input.list	Lists the allowed inputs for the profile by name. For example, *input.list=i1,i2*.
input.*input_id*.class_id	Gives the java class name for the input by input ID (the name of the input listed in *input.list*). For example, *input.i1.class_id=certReqInputImpl*.
output.list	Lists the possible output formats for the profile by name. For example, *output.list=o1*.
output.*output_id*.class_id	Gives the java class name for the output format named in *output.list*. For example, *output.o1.class_id=certOutputImpl*.
policyset.list	Lists the configured profile rules. For dual certificates, one set of rules applies to the signing key and the other to the encryption key. Single certificates use only one set of profile rules. For example, *policyset.list=serverCertSet*.
policyset.*policyset_id*.list	Lists the policies within the policy set configured for the profile by policy ID number in the order in which they should be evaluated. For example, *policyset.serverCertSet.list=1,2,3,4,5,6,7,8*.
policyset.*policyset_id*.*policy_number*.constraint.class_id	Gives the java class name of the constraint plug-in set for the default configured in the profile rule. For example, *policyset.serverCertSet.1.constraint.class_id=subjectNameConstraintImpl*.

Parameter	Description
policyset.*policyset_id.policy_number*.constraint.name	Gives the user-defined name of the constraint. For example, *policyset.serverCertSet.1.constraint.name=Subject Name Constraint*.
policyset.*policyset_id.policy_number*.constraint.params.*attribute*	Specifies a value for an allowed attribute for the constraint. The possible attributes vary depending on the type of constraint. For example, *policyset.serverCertSet.1.constraint.params.pattern=CN=.**.
policyset.*policyset_id.policy_number*.default.class_id	Gives the java class name for the default set in the profile rule. For example, *policyset.serverCertSet.1.default.class_id=userSubjectNameDefaultImpl*
policyset.*policyset_id.policy_number*.default.name	Gives the user-defined name of the default. For example, *policyset.serverCertSet.1.default.name=Subject Name Default*
policyset.*policyset_id.policy_number*.default.params.*attribute*	Specifies a value for an allowed attribute for the default. The possible attributes vary depending on the type of default. For example, *policyset.serverCertSet.1.default.params.name=CN=(Name)$request.requestor_name$*.

2.2.3.2. Modifying Certificate Extensions through the Command Line

Changing constraints changes the restrictions on the type of information which can be supplied. Changing the defaults and constraints can also add, delete, or modify the extensions which are accepted or required from a certificate request.

For example, the default caFullCMCUserCert profile is set to create a Key Usage extension from information in the request.

```
policyset.cmcUserCertSet.6.constraint.class_id=keyUsageExtConstraintImpl
policyset.cmcUserCertSet.6.constraint.name=Key Usage Extension Constraint
policyset.cmcUserCertSet.6.constraint.params.keyUsageCritical=true
policyset.cmcUserCertSet.6.constraint.params.keyUsageCrlSign=false
policyset.cmcUserCertSet.6.constraint.params.keyUsageDataEncipherment=false
policyset.cmcUserCertSet.6.constraint.params.keyUsageDecipherOnly=false

policyset.cmcUserCertSet.6.constraint.params.keyUsageDigitalSignature=true
policyset.cmcUserCertSet.6.constraint.params.keyUsageEncipherOnly=false

policyset.cmcUserCertSet.6.constraint.params.keyUsageKeyAgreement=false

policyset.cmcUserCertSet.6.constraint.params.keyUsageKeyCertSign=false

policyset.cmcUserCertSet.6.constraint.params.keyUsageKeyEncipherment=true
```

```
 policyset.cmcUserCertSet.6.constraint.params.keyUsageNonRepudiation=tru
e
 policyset.cmcUserCertSet.6.default.class_id=keyUsageExtDefaultImpl
 policyset.cmcUserCertSet.6.default.name=Key Usage Default
 policyset.cmcUserCertSet.6.default.params.keyUsageCritical=true
 policyset.cmcUserCertSet.6.default.params.keyUsageCrlSign=false
 policyset.cmcUserCertSet.6.default.params.keyUsageDataEncipherment=fals
e
 policyset.cmcUserCertSet.6.default.params.keyUsageDecipherOnly=false
 policyset.cmcUserCertSet.6.default.params.keyUsageDigitalSignature=true
 policyset.cmcUserCertSet.6.default.params.keyUsageEncipherOnly=false
 policyset.cmcUserCertSet.6.default.params.keyUsageKeyAgreement=false
 policyset.cmcUserCertSet.6.default.params.keyUsageKeyCertSign=false
 policyset.cmcUserCertSet.6.default.params.keyUsageKeyEncipherment=true
 policyset.cmcUserCertSet.6.default.params.keyUsageNonRepudiation=true
```

This constraint can be removed so that the server accepts the key usage set in the request. In this example, the key extension constraint is removed and replaced by no constraint, and the default is updated to allow user-supplied key extensions:

```
 policyset.cmcUserCertSet.6.constraint.class_id=noConstraintImpl
 policyset.cmcUserCertSet.6.constraint.name=No Constraint to keep it
simple
 policyset.cmcUserCertSet.6.default.class_id=userExtensionDefaultImpl
 policyset.cmcUserCertSet.6.default.name=User Supplied Key Default
 policyset.cmcUserCertSet.6.default.params.userExtOID=2.5.29.15
```

This sets the server to accept the extension OID **2.5.29.15** in the certificate request.

Other constraints and defaults can be changed similarly. Make sure that any required constraints and included with the appropriate default, that defaults are changed when a different constraint is required, and that only allowed constraints are used with the default. For more information, see Section B.1, "Defaults Reference" and Section B.2, "Constraints Reference".

2.2.3.3. Adding Inputs through the Command Line

The certificate profile configuration file in the CA's **profiles/ca** directory contains the input information for the that particular certificate profile form. Inputs are the fields in the end-entities page enrollment forms. There is a parameter, **input.list**, which lists the inputs included in that profile. Other parameters define the inputs; these are identified by the format **input.***ID*. For example, this adds a generic input to a profile:

```
input.list=i1,i2,i3,i4
...
input.i4.class_id=genericInputImpl
input.i4.params.gi_display_name0=Name0
input.i4.params.gi_display_name1=Name1
input.i4.params.gi_display_name2=Name2
input.i4.params.gi_display_name3=Name3
input.i4.params.gi_param_enable0=true
input.i4.params.gi_param_enable1=true
input.i4.params.gi_param_enable2=true
input.i4.params.gi_param_enable3=true
input.i4.params.gi_param_name0=gname0
```

```
input.i4.params.gi_param_name1=gname1
input.i4.params.gi_param_name2=gname2
input.i4.params.gi_param_name3=gname3
input.i4.params.gi_num=4
```

For more information on what inputs, or form fields, are available, see Section A.1, “Input Reference”.

2.2.4. Defining Key Defaults in Profiles

When creating certificate profiles, *the Key Default must be added before the Subject Key Identifier Default*. Certificate System processes the key constraints in the Key Default before creating or applying the Subject Key Identifier Default, so if the key has not been processed yet, setting the key in the subject name fails.

For example, an object-signing profile may define both defaults:

```
policyset.set1.p3.constraint.class_id=noConstraintImpl
policyset.set1.p3.constraint.name=No Constraint
policyset.set1.p3.default.class_id=subjectKeyIdentifierExtDefaultImpl
policyset.set1.p3.default.name=Subject Key Identifier Default
...
policyset.set1.p11.constraint.class_id=keyConstraintImpl
policyset.set1.p11.constraint.name=Key Constraint
policyset.set1.p11.constraint.params.keyType=RSA
policyset.set1.p11.constraint.params.keyParameters=1024,2048,3072,4096
policyset.set1.p11.default.class_id=userKeyDefaultImpl
policyset.set1.p11.default.name=Key Default
```

In the **policyset** list, then, the Key Default (**p11**) must be listed before the Subject Key Identifier Default (**p3**).

```
policyset.set1.list=p1,p2,p11,p3,p4,p5,p6,p7,p8,p9,p10
```

2.2.5. Configuring Cross-Pair Profiles

Cross-pair certificates are distinct CA signing certificates that establish a trust partner relationship whereby entities from these two distinct PKIs will trust each other. Both partner CAs store the other CA signing certificate in its database, so all of the certificates issued within the other PKI are trusted and recognized.

Two extensions supported by the Certificate System can be used to establish such a trust partner relationship (cross-certification):

- The Certificate Policies Extension (**CertificatePoliciesExtension**) specifies the terms that the certificate fall under, which is often unique for each PKI.
- The Policy Mapping Extension (**PolicyMappingExtension**) seals the trust between two PKI’s by mapping the certificate profiles of the two environments.

Issuing cross-pair certificates requires the Certificate Policies Extension, explained in Section B.3.4, “certificatePoliciesExt”.

To ensure that the issued certificate contains the CertificatePoliciesExtension, the enrollment profile needs to include an appropriate policy rule, for example:

```
policyset.userCertSet.p7.constraint.class_id=noConstraintImpl
policyset.userCertSet.p7.constraint.name=No Constraint
policyset.userCertSet.p7.default.class_id=certificatePoliciesExtDefaultI
mpl
policyset.userCertSet.p7.default.name=Certificate Policies Extension
Default
policyset.userCertSet.p7.default.params.Critical=false
policyset.userCertSet.p7.default.params.PoliciesExt.num=1
policyset.userCertSet.p7.default.params.PoliciesExt.certPolicy0.enable=t
rue
policyset.userCertSet.p7.default.params.PoliciesExt.certPolicy0.policyId
=1.1.1.1
policyset.userCertSet.p7.default.params.PoliciesExt.certPolicy0.PolicyQu
alifiers0.CPSURI.enable=false
policyset.userCertSet.p7.default.params.PoliciesExt.certPolicy0.PolicyQu
alifiers0.CPSURI.value=
policyset.userCertSet.p7.default.params.PoliciesExt.certPolicy0.PolicyQu
alifiers0.usernotice.enable=false
policyset.userCertSet.p7.default.params.PoliciesExt.certPolicy0.PolicyQu
alifiers0.usernotice.explicitText.value=
policyset.userCertSet.p7.default.params.PoliciesExt.certPolicy0.PolicyQu
alifiers0.usernotice.noticeReference.noticeNumbers=
policyset.userCertSet.p7.default.params.PoliciesExt.certPolicy0.PolicyQu
alifiers0.usernotice.noticeReference.organization=
```

Certificates issued with the enrollment profile in this example would contain the following information:

```
Identifier: Certificate Policies: - 2.5.29.32
Critical: no
Certificate Policies:
Policy Identifier: 1.1.1.1
```

2.2.6. List of Certificate Profiles

The following pre-defined certificate profiles are ready to use when the Certificate System CA is installed. These certificate profiles have been designed for the most common types of certificates, and they provide common defaults, constraints, authentication methods, inputs, and outputs.

By default, the profile configuration files are in the **/var/lib/*instance_name*/profiles/ca** directory. Note, that the table below is not complete as the default token enrollment profiles are listed in Table 2.4, “Default Token Certificate Profiles”.

Table 2.2. Certificate Profiles

Profile ID	Profile Name	Description
caAdminCert	Security Domain Administrator Certificate Enrollment	Enrolls Security Domain Administrator's certificates with LDAP authentication against the internal LDAP database.

Profile ID	Profile Name	Description
caAgentFileSigning	Agent-Authenticated File Signing	This certificate profile is for file signing with agent authentication.
caAgentServerCert	Agent-Authenticated Server Certificate Enrollment	Enrolls server certificates with agent authentication.
caCACert	Manual Certificate Manager Signing Certificate Enrollment	Enrolls Certificate Authority certificates.
caCMCUserCert	Signed CMC-Authenticated User Certificate Enrollment	Enrolls user certificates by using the CMC certificate request with CMC Signature authentication.
caDirUserCert	Directory-Authenticated User Dual-Use Certificate Enrollment	Enrolls user certificates with directory-based authentication.
caDirUserRenewal	Directory-Authenticated User Certificate Self-Renew profile	Renews user certificates through directory-based authentication. The user certificate is issued as soon as the requester successfully authenticates to the LDAP directory.

Profile ID	Profile Name	Description
		Note Renewal profiles can only be used in conjunction with the profile that issued the original certificate. There are two settings that are beneficial: - It is important the original enrollment profile name does not change. - The Renew Grace Period Constraint should be set in the original enrollment profile. This defines the amount of time before and after the certificate's expiration date when the user is allowed to renew the certificate. There are only a few examples of these in the default profiles, and they are mostly not enabled by default.
caDualCert	Manual User Signing & Encryption Certificates Enrollment	Enrolls dual user certificates. It works only with Netscape 7.0 or later.
caFullCMCUserCert	Signed CMC-Authenticated User Certificate Enrollment	Enrolls user certificates by using the CMC certificate request with CMC Signature authentication.
caInstallCACert	Manual Security Domain Certificate Authority Signing Certificate Enrollment	Enrolls Security Domain Certificate Authority certificates.

Profile ID	Profile Name	Description
caInternalAuthAuditSigningCert	Audit Signing Certificate Enrollment	Enrolls a signing certificate to use for signing audit logs; used automatically during any supported subsystem configuration.
caInternalAuthKRAstorageCert	Security Domain KRA Storage Certificate Enrollment	Enrolls KRA storage certificates for KRAs within a security domain; used automatically during a KRA configuration.
caInternalAuthOCSPCert	Security Domain OCSP Manager Signing Certificate Enrollment	Enrolls Security Domain OCSP Manager certificates.
caInternalAuthServerCert	Security Domain Server Certificate Enrollment	Enrolls Security Domain server certificates.
caInternalAuthSubsystemCert	Security Domain Subsystem Certificate Enrollment	Enrolls Security Domain subsystem certificates.
caInternalAuthTransportCert	Security Domain Key Recovery Authority Transport Certificate Enrollment	Enrolls Security Domain Key Recovery Authority transport certificates.
caManualRenewal	Renew certificate to be manually approved by agents	Renews a certificate that must be manually approved by agents.

Profile ID	Profile Name	Description
		Note Renewal profiles can only be used in conjunction with the profile that issued the original certificate. There are two settings that are beneficial: • It is important the original enrollment profile name does not change. • The Renew Grace Period Constraint should be set in the original enrollment profile. This defines the amount of time before and after the certificate's expiration date when the user is allowed to renew the certificate. There are only a few examples of these in the default profiles, and they are mostly not enabled by default.
caOCSPCert	Manual OCSP Manager Signing Certificate Enrollment	Enrolls OCSP Manager certificates.
caOtherCert	Other Certificate Enrollment	Enrolls other certificates.
caRouterCert	One Time Pin Router Certificate Enrollment	Enrolls router certificates using an automatically generated, one-time PIN that the router can use to retrieve its certificate.
caServerCert	Manual Server Certificate Enrollment	Enrolls server certificates.
caSignedLogCert	Manual Log Signing Certificate Enrollment	Enrolls audit log signing certificates.
caSimpleCMCUserCert	Simple CMC Enrollment	Enrolls user certificates by using the CMC certificate request with CMC Signature authentication.
caSSLClientSelfRenewal	Self-renew user SSL client certificates	Renews SSL client certificates using certificate-based authentication. The certificate is issued as soon as the request is authenticated and authorized by presenting the original certificate.

Profile ID	Profile Name	Description
		Note Renewal profiles can only be used in conjunction with the profile that issued the original certificate. There are two settings that are beneficial: • It is important the original enrollment profile name does not change. • The Renew Grace Period Constraint should be set in the original enrollment profile. This defines the amount of time before and after the certificate's expiration date when the user is allowed to renew the certificate. There are only a few examples of these in the default profiles, and they are mostly not enabled by default.
caTempTokenDeviceKeyEnrollment	Temporary Device Certificate Enrollment	Enrolls temporary keys to be used by servers or other network devices on a token; used by the TPS for smart card enrollment operations. These are temporary keys, valid for about a week, and intended to replace a temporarily lost token.

Profile ID	Profile Name	Description
caTempTokenUserEncryptionKeyEnrollment	Temporary Token User Encryption Certificate Enrollment	Enrolls an encryption key on a token; used by the TPS for smart card enrollment operations. These are temporary keys, valid for about a week, and intended to replace a temporarily lost token.
caTempTokenUserSigningKeyEnrollment	Temporary Token User Signing Certificate Enrollment	Enrolls a signing key on a token; used by the TPS for smart card enrollment operations. These are temporary keys, valid for about a week, and intended to replace a temporarily lost token.
caTokenDeviceKeyEnrollment	Token Device Key Enrollment	Enrolls keys to be used by servers or other network devices on a token; used by the TPS for smart card enrollment operations.
caTokenMSLoginEnrollment	Token User MS Login Certificate Enrollment	Enrolls key to be used by a person for logging into a Windows domain or PC; used by the TPS for smart card enrollment operations.
caTokenUserEncryptionKeyEnrollment	Token User Encryption Certificate Enrollment	Enrolls an encryption key on a token; used by the TPS for smart card enrollment operations.
caTokenUserEncryptionKeyRenewal	smart card token encryption cert renewal profile	Renews an encryption key that was enrolled on a token using the caTokenUserEncryptionKeyEnrollment profile; used by a TPS subsystem.
caTokenUserSigningKeyEnrollment	Token User Signing Certificate Enrollment	Enrolls a signing key on a token; used by the TPS for smart card enrollment operations.
caTokenUserSigningKeyRenewal	smart card token signing cert renewal profile	Renews a signing that was enrolled on a token using the caTokenUserSigningKeyEnrollment profile; used by a TPS subsystem.
caTPSCert	Manual TPS Server Certificate Enrollment	Enrolls TPS server certificates.
caTransportCert	Manual Key Recovery Authority Transport Certificate Enrollment	Enrolls Key Recovery Authority transport certificates.
caUserCert	Manual User Dual-Use Certificate Enrollment	Enrolls user certificates.

Profile ID	Profile Name	Description
caUUIDdevicecert	Manual device Dual-Use Certificate Enrollment to contain UUID in SAN	Enrolls certificates for devices which must contain a unique user ID number (UUID) as a component in the certificate's subject alternate name extension.
DomainController	Domain Controller	Enrolls certificates to be used by a Windows domain controller.

2.3. Configuring Renewal Profiles

Renewing a certificate regenerates the certificate using the same public key as the original certificate. Renewing a certificate can be preferable to simply generating new keys and installing new certificates; for example, if a new CA signing certificate is created, all of the certificates which that CA issued and signed must be reissued. If the CA signing certificate is renewed, than all of the issued certificates are still valid. A renewed certificate is identical to the original, only with an updated validity period and expiration date.

This section discusses renewing user certificates and creating renewal profiles. For information on renewing Certificate System subsystem certificates, see Chapter 16, *Managing Subsystem Certificates*.

2.3.1. About Renewal

A renewed certificate is identical to the original certificate, which makes renewing certificates a much simpler and cleaner option for handling the expiration of many kinds of certificates, especially CA signing certificates.

2.3.1.1. The Renewal Process

There are two methods of renewing a certificate. *Regenerating* the certificate takes the original key, profile, and request of the certificate and recreates a new certificate with a new validity period and expiration date using the identical key. *Re-keying* a certificate submits a certificate request through the original profile with the same information, so that a new key pair is generated.

By default, Certificate System supports regenerating user certificates with the same keys. In this kind of renewal, the CA re-creates the existing user certificate based on its previous configuration, such as its public key and defaults, constraints, and other settings.

When the user submits a renewal request, they provide some kind of information to identify which certificate to renew. This can be the serial number or the certificate itself.

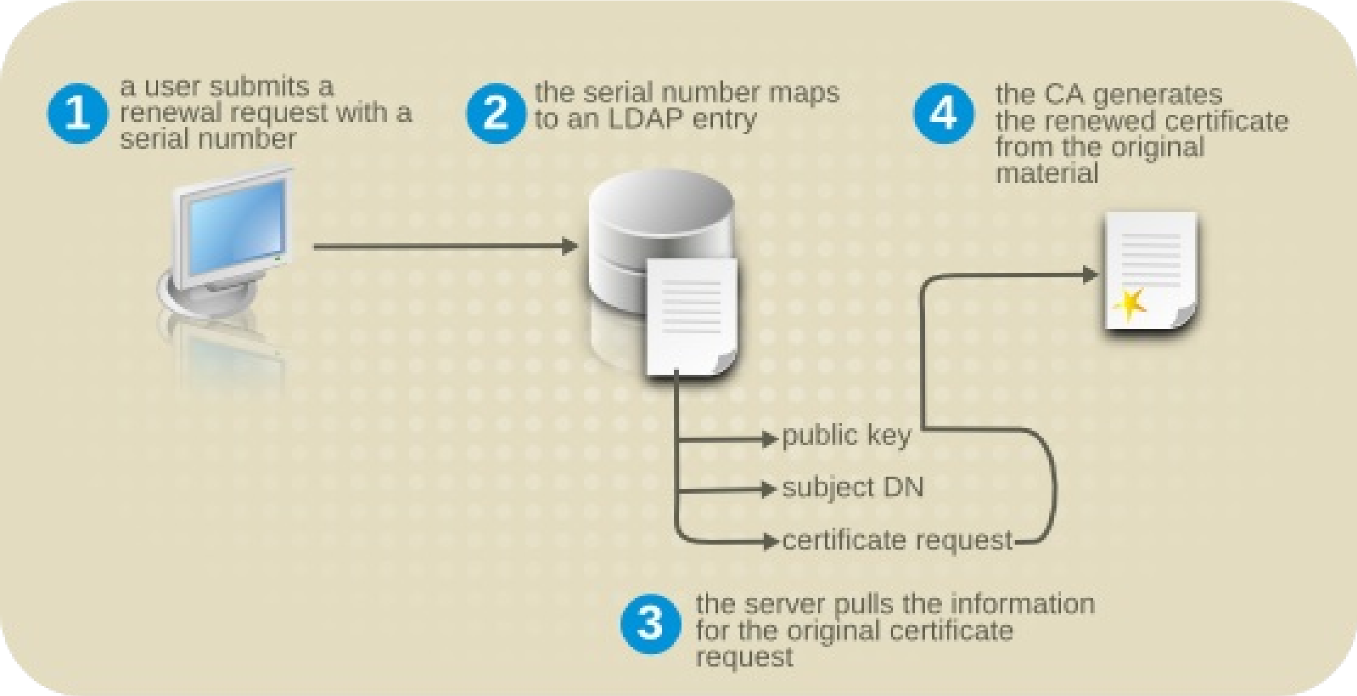


Figure 2.1. Renewal Flow

The server identifies the certificate and then maps the renewal request to the initial certificate request entry in the CA database. If more than one certificate matches the renewal request, then the most recent certificate entry is used. (The renewal request must be submitted to the same CA which issued the original certificate. This is the only way to map the serial number to the appropriate certificate.)

The certificate entry contains, along with the original certificate, the original profile used to submit the request, its public key, and its extensions. Since the defaults, constraints, and other settings must be the same in the new certificate as in the old, it is important that the renewal process accesses the original enrollment profile, with the original information.

Example 2.2. Certificate Request Entry

```
 dn: cn=54,ou=certificateRepository, ou=ca, dc=server.example.com-pki-
ca
objectClass: top
objectClass: certificateRecord
serialno: 0254
metaInfo: inLdapPublishDir:true
metaInfo: profileId:caUserCert
metaInfo: requestId:58
notBefore: 20090624082117Z
notAfter: 20091221072117Z
duration: 1115552000000
subjectName: UID=jsmith,E=jsmith@example.com,CN=John
Smith,OU=engineering,OU=content,OU=services,OU=people,C=US
publicKeyData::
MFwwDQYJKoZIhvcNAQEBBQADSwAwSAJBAOhd4g9Fluurl3mtUzEKmilsGolBKr/sEvGpPZ
ecPpcFxfkxwfvfjl6ycEUcxXJXEhdSQ+ZPdCUwakSBhn15Uz8CAwEAAQ==
extension: 1.3.6.1.5.5.7.1.1
extension: 2.5.29.37
extension: 2.5.29.35
```

```
extension: 2.5.29.17
extension: 2.5.29.15
userCertificate;binary::
MIIDXzCCAkegAwIBAgIBNjANBgkqhkiG9w0BAQUFADBAMR4wHAYD
 VQQKExVSZWRidWRjb21wdXRlciBEb21haW4xHjAcBgNVBAMTFUNlcnRpZmljYXRlIEF1d
Ghvcml0
 eTAeFw0wOTA2MjQxMzIxMTdaFw0wOTEyMjExMzIxMTdaMIGrMQswCQYDVQQGEwJVUzEPM
A0GA1UE
 CxMGcGVvcGxlMREwDwYDVQQLEwhzZXJ2aWNlczEQMA4GA1UECxMHY29udGVudDEUMBIGA
1UECxML
 ZW5naW5lZXJpbmcxFDASBgNVBAMTC0Rlb24gTGFja2V5MSEwHwYJKoZIhvcNAQkBFhJkb
GFja2V5
 QHJlZGhhdC5jb20xFzAVBgoJkiaJk/IsZAEBEwdkbGFja2V5MFwwDQYJKoZIhvcNAQEBB
QADSwAw
 SAJBAOhd4g9Fluurl3mtUzEKmilsGolBKr/sEvGpPZecPpcFxfkxwfvfjl6ycEUcxXJXE
hdSQ+ZP
 dCUwakSBhn15Uz8CAwEAAaOBvzCBvDAfBgNVHSMEGDAWgBS7F3+uS3y2ZNesUZLcB/ZTw
o9LIjBL
 BggrBgEFBQcBAQQ/MD0wOwYIKwYBBQUHMAGGL2h0dHA6Ly93aWxidXIucmVkYnVkY29tc
HV0ZXIu
 bG9jYWw6OTE4MC9jYS9vY3NwMA4GA1UdDwEB/wQEAwIF4DAdBgNVHSUEFjAUBggrBgEFB
QcDAgYI
 KwYBBQUHAwQwHQYDVR0RBBYwFIESZGxhY2tleUByZWRoYXQuY29tMA0GCSqGSIb3DQEBB
QUAA4IB
 AQB1Jig+3mucNrvhl009ZWshzKSZN7d1rGP+SsYCNTk9KzEhU/lCkQnOLbrAMDE7gBKLk
Dvpm+4y
 ud5qzHC6+tCR+L0H6JCm1Gufv5VE4yIN+dLPcO4Wr8ZCIgt2Rr3aR3FqE0tqUXh2RDmq+
EvfxBza
 FOTQpwz2EW1ppIXjKNZpi9+3enjMg0rc/CsT+c1rKeXJzo5mD6n+VmET8ZilvSgyq6jt9
KgqeVfM
 Cfl+ypQ2u9EW6a0sYflw+vPOkcXqRUnKfKjn1lq8CALrGDG71pAlHzXQNMB0YWlKKywhd
MfbHPN8
 FdFHC6Ro5Ny01DDRBF+y3Iqc3flLFJt1Ya3c8hEc
version: 2
algorithmId: 1.2.840.113549.1.1.1
signingAlgorithmId: 1.2.840.113549.1.1.5
dateOfCreate: 20090624082244Z
dateOfModify: 20090624082244Z
certStatus: VALID
autoRenew: ENABLED
issuedBy: admin
cn: 54
```


The original certificate request entry also contains the original validity period of the certificate. The certificate profile can contain the *grace period* for renewing the certificate, the time before and after the expiration date when renewal is allowed. If a certificate is outside of that period, either way, the renewal request is automatically rejected.

While renewal reissues an *expired* certificate, it does *not* reissue a *revoked* certificate. Only an otherwise valid certificate can be renewed.

The server then retrieves the public key from the entry, along with the original certificate request. Using the key and the original certificate request, the CA issues a new certificate, with a new validity period.

Note

The renewal process only renews one certificate at a time.

User certificates are frequently issued in pairs, such as encryption and signing certificates, and the initial enrollment issues both certificates at the same time. However, the renewal process takes a single serial number or certificate as its input, so it can only renew one certificate in one step.

To renew both certificates in a certificate pair, each one has to be renewed individually.

2.3.1.2. Renewal Types in Certificate System

As with any certificate request, a renewal request has to be approved before the CA will issue the new certificate. Certificate System has three renewal types, depending on the authorization method used to verify the requester, and any of the three types can be used to renew any kind of certificate:

- Agent-based renewal, where the agent manually approves the request
- Directory-based renewal, where the requester authenticates to an LDAP directory
- Certificate-based renewal, where the certificate stored in the browser's database is used to authenticate the requester

Authentication is covered in Chapter 8, *Authentication for Enrolling Certificates*.

Note

Email notifications can be configured for renewal requests; this is described in Section 10.2, “Setting up Automated Notifications for the CA” and Section 11.3.3, “Configuration Parameters of certRenewalNotifier”.

2.3.2. Creating Custom Renewal Profiles

Certificate renewal regenerates a certificate using its original public key, certificate extensions and constraints, and subject name. A renewed certificate is identical to the original, except that it has a new expiration date.

When a certificate is renewed, it has to be renewed using a renewal profile that corresponds to the initial enrollment profile. Certificate System supports renewals both for tokens and for regular certificates, both through the CA.

The default configuration profiles cover user certificates and other types of subsystem certificates, as well as token renewals, but it may be necessary or convenient to create a special renewal profile for a custom enrollment form.

2.3.2.1. Default Renewal Profiles

Certificate System contains three default renewal profiles for renewing user certificates.

Table 2.3. Renewal Profiles

Renewal Profile	Type
caDirUserRenewal.cfg	Directory-based
caManualRenewal.cfg	Agent-based
caSSLClientSelfRenewal.cfg	Certificate-based

2.3.2.2. Creating an Enrollment Profile

A custom profile is configured the same as described in Section 2.2, “Setting up Certificate Profiles”. There are two settings that must be present in the profile, however, to allow renewal for the certificate: a setting on whether renewal is allowed, and a setting on the time period when renewal is allowed.

The **renewal** parameter sets whether renewal is allowed. This must be **true**:

```
renewal=true
```

The renewal grace period is set through the Renewal Grace Period Constraint (in Section B.2.9, “Renewal Grace Period Constraint”). This constraint has two parameters, setting the time period before and after the expiration date that renewal can be allowed.

```
policyset.userCertSet.list=1,10,2,3,4,5,6,7,8,9
...
policyset.userCertSet.10.constraint.class_id=renewGracePeriodConstraintI
mpl
policyset.userCertSet.10.constraint.name=Renewal Grace Period Constraint
policyset.userCertSet.10.constraint.params.renewal.graceBefore=30
policyset.userCertSet.10.constraint.params.renewal.graceAfter=30
policyset.userCertSet.10.default.class_id=noDefaultImpl
policyset.userCertSet.10.default.name=No Default
```

These two configuration settings have to be set in the *original enrollment profile*, not the renewal profile. The rules for the renewal grace period are part of the original certificate and are carried over and applied for any subsequent renewals.

2.3.2.3. Creating the Renewal Profile

A renewal profile is much simpler than a standard enrollment profile because it does not need to define any defaults, extensions, or constraints; all of that information is already contained in the original certificate.

What a renewal profile does define is whether renewal is allowed, the input to use to locate the original certificate, and the output of the regenerated certificate.

The renewal option, as with the original profile, is set to either true or false.

```
renewal=true
```

The original profile must allow renewal, but the renewal profile can set the renewal is not allowed, which means that a certificate can only be renewed once.

The input depends on the way that the certificate renewal request is authorized. For agent-approved and directory-based authorization, the identity of the requester is verified independently, and then the specified certificate is pulled up using its serial number:

```
input.i1.class_id=serialNumRenewInputImpl
```

For agent-based authentication, no authorization method is required; the request will be manually reviewed and approved by a CA agent. In this case, the **auth.instance_id** parameter is empty.

Example 2.3. Agent-Based Renewal Profile

```
 desc=This certificate profile is for renewing certificates to be
approved manually by agents.
 visible=true
 enable=true
 enableBy=admin
 renewal=true
 auth.instance_id=
 name=Renew certificate to be manually approved by agents
 input.list=i1
 input.i1.class_id=serialNumRenewInputImpl
 outputlist=o1
 output.o1.class_id=certOutputImpl
```

For directory-based authentication, the requester must log into an LDAP directory and authenticate against that database, so the **auth.instance_id** parameter must be set to use directory authentication.

Example 2.4. Directory-Based Renewal Profile

```
 desc=This certificate profile is for renewing a certificate by serial
number by using directory based authentication.
 visible=true
 enable=true
 enableBy=admin
 renewal=true
 auth.instance_id=UserDirEnrollment
 authz.acl=user_origreq="auth_token.uid"
 name=Directory-Authenticated User Certificate Self-Renew profile
 input.list=i1
 input.i1.class_id=serialNumRenewInputImpl
 output.list=o1
 output.o1.class_id=certOutputImpl
```

Note

Directory-based renewal works even if the **UidPwdDir** plug-in has optional fields set to configure things such as the connection or the DN pattern. This is described in Section 8.2.1, “Setting up Directory-Based Authentication”.

However, for certificate-based renewal, the certificate is presented directly by the browser being used to open the renewal forms, and that certificate is checked in the client database. The certificate is used both to verify the identity of the requester and to get the certificate information for renewal. For certificate-based renewal, it is not necessary to specify a serial number input; instead, set the authentication module to use certificate-based authentication.

```
auth.instance_id=SSLclientCertAuth
```

Example 2.5. Certificate-Based Renewal Profile

```
 desc=This certificate profile is for renewing SSL client
certificates.
 visible=true
 enable=true
 enableBy=admin
 renewal=true
 auth.instance_id=SSLclientCertAuth
 name=Self-renew user SSL client certificates
 output.list=o1
 output.o1.class_id=certOutputImpl
```

2.4. Managing Smart Card CA Profiles

The TPS does not generate or approve certificate requests; it sends any requests approved through the Enterprise Security Client to the configured CA to issue the certificate. This means that the CA actually contains the profiles to use for tokens and smart cards. The profiles to use can be automatically assigned, based on the card type, as described in Section 5.2, “Mapping Token Types and Policies to Specified Smart Cards”.

The profile configuration files are in the **/var/lib/*instance_name*/profiles/ca/** directory with the other CA profiles. The default profiles are listed in Table 2.4, “Default Token Certificate Profiles”.

Table 2.4. Default Token Certificate Profiles

Profile Name	Configuration File	Description
Regular Enrollment Profiles		
Token Device Key Enrollment	caTokenDeviceKeyEnrollment.cfg	For enrolling tokens used for devices or servers.
Token User Encryption Certificate Enrollment	caTokenUserEncryptionKeyEnrollment.cfg	For enrolling encryption certificates on the token for a user.
Token User Signing Certificate Enrollment	caTokenUserSigningKeyEnrollment.cfg	For enrolling signing certificates on the token for a user.
Token User MS Login Certificate Enrollment	caTokenMSLoginEnrollment.cfg	For enrolling user certificates to use for single sign-on to a Windows domain or PC.
Temporary Token Profiles		

Profile Name	Configuration File	Description
Temporary Device Certificate Enrollment	caTempTokenDeviceKeyEnrollment.cfg	For enrolling certificates for a device on a temporary token.
Temporary Token User Encryption Certificate Enrollment	caTempTokenUserEncryptionKeyEnrollment.cfg	For enrolling an encryption certificate on a temporary token for a user.
Temporary Token User Signing Certificate Enrollment	caTempTokenUserSigningKeyEnrollment.cfg	For enrolling a signing certificates on a temporary token for a user.
Renewal Profiles [a]		
Token User Encryption Certificate Enrollment (Renewal)	caTokenUserEncryptionKeyRenewal.cfg	For renewing encryption certificates on the token for a user, if renewal is allowed.
Token User Signing Certificate Enrollment (Renewal)	caTokenUserSigningKeyRenewal.cfg	For renewing signing certificates on the token for a user, if renewal is allowed.

[a] Renewal profiles can only be used in conjunction with the profile that issued the original certificate. There are two settings that are beneficial:

- It is important the original enrollment profile name does not change.
- The Renew Grace Period Constraint should be set in the original enrollment profile. This defines the amount of time before and after the certificate's expiration date when the user is allowed to renew the certificate. There are only a few examples of these in the default profiles, and they are mostly not enabled by default.

2.4.1. Editing Enrollment Profiles for the TPS

Administrators have the ability to customize the default smart card enrollment profiles, used with the TPS. For instance, a profile could be edited to include the user's email address in the Subject Alternative Name extension. The email address for the user is retrieved from the authentication directory. To configure the CA for LDAP access, change the following parameters in the profile files, with the appropriate directory information:

```
policyset.set1.p1.default.params.dnpattern=UID=$request.uid$, O=Token
Key User
policyset.set1.p1.default.params.ldap.enable=true
policyset.set1.p1.default.params.ldap.basedn=ou=people,dc=host,dc=exampl
e,dc=com
policyset.set1.p1.default.params.ldapStringAttributes=uid,mail
policyset.set1.p1.default.params.ldap.ldapconn.host=localhost.example.co
m
policyset.set1.p1.default.params.ldap.ldapconn.port=389
```

These CA profiles come with LDAP lookup disabled by default. The ***ldapStringAttributes*** parameter tells the CA which LDAP attributes to retrieve from the company directory. For example, if the directory contains ***uid*** as an LDAP attribute name, and this will be used in the subject name of the certificate, then ***uid*** must be listed in the ***ldapStringAttributes*** parameter, and *request.uid* listed as one of the components in the ***dnpattern***.

Editing certificate profiles is covered in Section 2.2, “Setting up Certificate Profiles”.

The format for the ***dnpattern*** parameter is covered in Section B.2.11, “Subject Name Constraint” and Section B.1.27, “Subject Name Default”.

2.4.2. Creating Custom TPS Profiles

Certificate profiles are created as normal in the CA, but they also have to be configured in the TPS for it to be available for token enrollments.

> **Note**
>
> New profiles are added with new releases of Red Hat Certificate System. If an instance is migrated to Certificate System 9.0, then the new profiles need to be added to the migrated instance as if they are custom profiles.

1. Create a new token profile for the issuing CA. Setting up profiles is covered in Section 2.2, “Setting up Certificate Profiles”.

2. Copy the profile into the CA's profiles directory, **/var/lib/*instance_name*/profiles/ca**.

3. Edit the CA **CS.cfg** file, and add the new profile references and the profile name to the CA's list of profiles. For example:

```
vim /etc/instance_name/CS.cfg

profile.list=caUserCert,...,caManualRenewal,tpsExampleEnrollProfil
e
...
profile.caTokenMSLoginEnrollment.class_id=caUserCertEnrollImpl
profile.caTokenMSLoginEnrollment.config=/var/lib/pki/instance_name
/profiles/ca/tpsExampleEnrollProfile.cfg
```

4. Edit the TPS **CS.cfg** file, and add a line to point to the new CA enrollment profile. For example:

```
vim /etc/pki-tps/CS.cfg

op.enroll.userKey.keyGen.signing.ca.profileId=tpsExampleEnrollProf
ile
```

5. Restart the CA and TPS after editing the smart card profiles. For example:

```
systemctl restart pki-tomcatd@instance-name.service
systemctl restart pki-tomcatd@instance_name.service
```

> **Note**
>
> Enrollment profiles for the External Registration (**externalReg**) setting are configured in the user LDAP entry.

2.4.3. Using the Windows Smart Card Logon Profile

The TPS uses a profile to generate certificates to use for single sign-on to a Windows domain or PC; this is the Token User MS Login Certificate Enrollment profile (**caTokenMSLoginEnrollment.cfg**).

However, there are some special considerations that administrators *must* account for when configuring Windows smart card login.

- Issue a certificate to the domain controller, if it is not already configured for SSL.
- Configure the smart card login per user, rather than as a global policy, to prevent locking out the domain administrator.
- Enable CRL publishing to the Active Directory server because the domain controller checks the CRL at every login.

2.5. Setting the Signing Algorithms for Certificates

The CA's signing certificate can sign the certificates it issues with any public key algorithm supported by the CA. For example, an ECC signing certificate can sign both ECC and RSA certificate requests as long as both ECC and RSA algorithms are supported by the CA. An RSA signing certificate can can sign a PKCS #10 request with EC keys, but may not be able to sign CRMF certificate requests with EC keys if the ECC module is not available for the CA to verify the CRMF proof of possession (POP).

ECC and RSA are public key encryption and signing algorithms. Both public key algorithms support different cipher suites, algorithms used to encrypt and decrypt data. Part of the function of the CA signing certificate is to issue and sign certificates using one of its supported cipher suites.

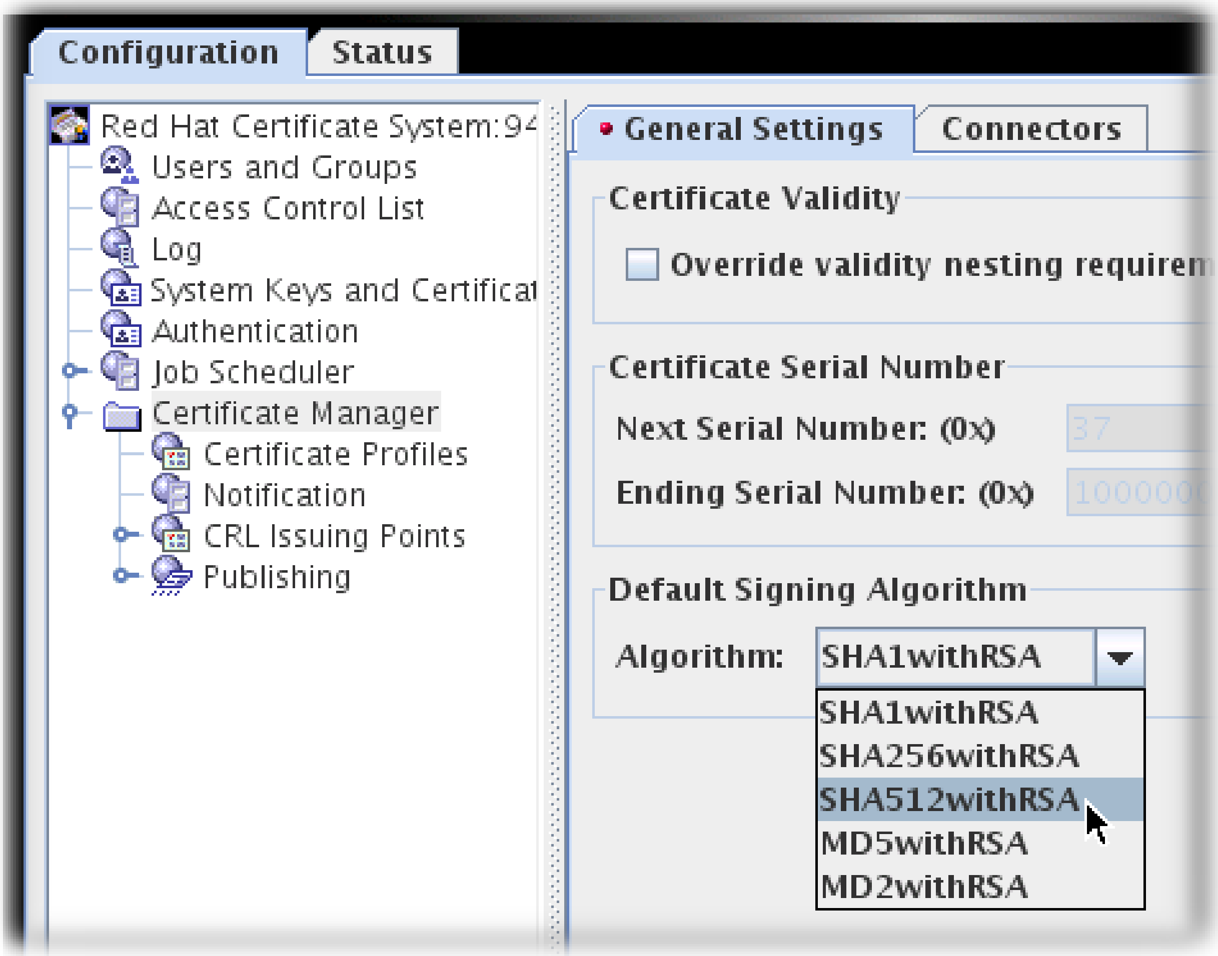
Each profile can define which cipher suite the CA should use to sign certificates processed through that profile. If no signing algorithm is set, then the profile uses whatever the default signing algorithm is.

2.5.1. Setting the CA's Default Signing Algorithm

1. Open the CA console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

2. In the **Configuration** tab, expand the **Certificate Manager** tree.
3. In the **General Settings** tab, set the algorithm to use in the **Algorithm** drop-down menu.



2.5.2. Setting the Signing Algorithm Default in a Profile

Each profile has a Signing Algorithm Default extension defined. The default has two settings: a default algorithm and a list of allowed algorithms, if the certificate request specifies a different algorithm. If no signing algorithms are specified, then the profile uses whatever is set as the default for the CA.

In the profile's **.cfg** file, the algorithm is set with two parameters:

```
policyset.serverCertSet.8.default.class_id=signingAlgDefaultImpl
policyset.serverCertSet.8.default.name=Signing Alg
policyset.serverCertSet.8.default.params.signingAlg=SHA1withRSA
policyset.serverCertSet.8.default.params.signingAlgsAllowed=SHA1withRSA,
SHA256withRSA,SHA512withRSA,MD5withRSA,MD2withRSA,SHA1withDSA,SHA1withEC
```

To configure the Signing Algorithm Default through the console:

Note

Before a profile can be edited, it must first be disabled by an agent.

1. Open the CA console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

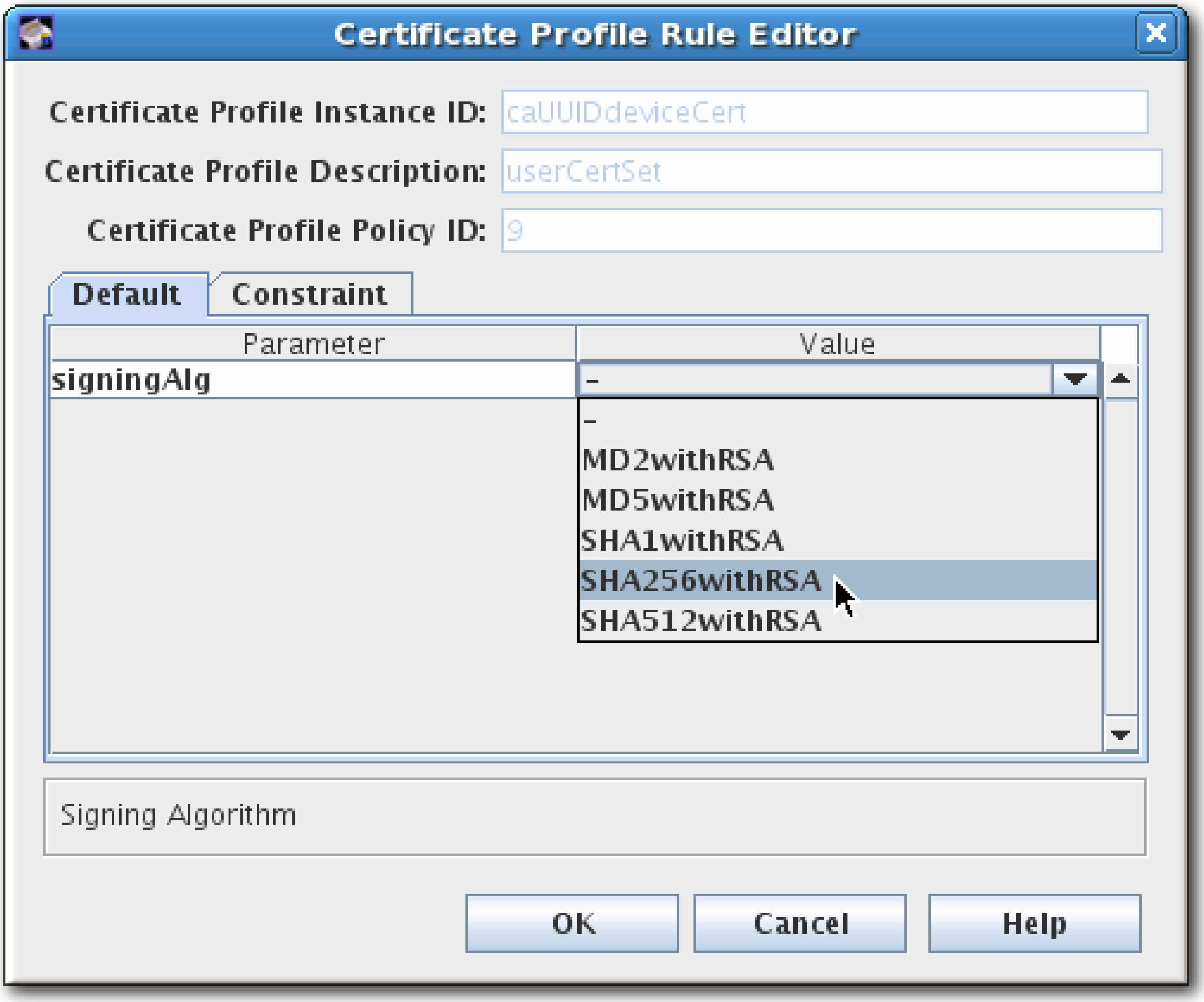
2. In the **Configuration** tab, expand the **Certificate Manager** tree.

3. Click the **Certificate Profiles** item.

4. Click the **Policies** tab.

5. Select the **Signing Alg** policy, and click the **Edit** button.

6. To set the default signing algorithm, set the value in the **Defaults** tab. If this is set to **-**, then the profile uses the CA's default.



> **Note**
>
> The CA's default signing algorithm is specified in the following CS.cfg parameter: **ca.signing.defaultSigningAlgorithm=SHA256withRSA**

7. To set a list of allowed signing algorithms which can be accepted in a certificate request, open the **Constraints** tab, and set the list of algorithms in the **Value** field for **signingAlgsAllowed**.

   The possible values for the constraint are listed in Section B.2.10, "Signing Algorithm Constraint".

2.6. Managing CA-Related Profiles

Certificate profiles and extensions must be used to set rules on how subordinate CAs can issue certificates. There are two parts to this:

- Managing the CA signing certificate
- Defining issuance rules

2.6.1. Setting Restrictions on CA Certificates

When a subordinate CA is created, the root CA can impose limits or restrictions on the subordinate CA. For example, the root CA can dictate the maximum depth of valid certification paths (the number of subordinate CAs allowed to be chained below the new CA) by setting the pathLenConstraint field of the Basic Constraints extension in the CA signing certificate.

A certificate chain generally consists of an entity certificate, zero or more intermediate CA certificates, and a root CA certificate. The root CA certificate is either self-signed or signed by an external trusted CA. Once issued, the root CA certificate is loaded into a certificate database as a trusted CA.

An exchange of certificates takes place when performing an SSL handshake, when sending an S/MIME message, or when sending a signed object. As part of the handshake, the sender is expected to send the subject certificate and any intermediate CA certificates needed to link the subject certificate to the trusted root. For certificate chaining to work properly the certificates should have the following properties:

- CA certificates must have the Basic Constraints extension.
- CA certificates must have the keyCertSign bit set in the Key Usage extension.
- When the CAs generate new keys, they must add the Authority Key Identifier extension to all subject certificates. This extensions helps distinguish the certificates from the older CA certificates. The CA certificates must contain the Subject Key Identifier extension.

For more information on certificates and their extensions, see *Internet X.509 Public Key Infrastructure - Certificate and Certificate Revocation List (CRL) Profile (RFC 5280)*, available at RFC 5280.

These extensions can be configured through the certificate profile enrollment pages. By default, the CA contains the required and reasonable configuration settings, but it is possible to customize these settings.

> **Note**
>
> This procedure describes editing the CA certificate profile used by a CA to issue CA certificates to its subordinate CAs.
>
> The profile that is used when a CA instance is first configured is **/var/lib/*instance_name*/ca/conf/caCert.profile**. This profile cannot be edited in **pkiconsole** (since it is only available before the instance is configured). It is possible to edit the policies for this profile in the template file before the CA is configured using a text editor.

To modify the default in the CA signing certificate profile used by a CA:

1. If the profile is currently enabled, it must be disabled before it can be edited. Open the agent services page, select **`Manage Certificate Profiles`** from the left navigation menu, select the profile, and click **`Disable profile`**.

2. Open the CA Console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

3. In the left navigation tree of the **`Configuration`** tab, select **`Certificate Manager`**, then **`Certificate Profiles`**.

4. Select caCACert, or the appropriate CA signing certificate profile, from the right window, and click **`Edit/View`**.

5. In the **`Policies`** tab of the **`Certificate Profile Rule Editor`**, select and edit the Key Usage or Extended Key Usage Extension Default if it exists or add it to the profile.

6. Select the Key Usage or Extended Key Usage Extension Constraint, as appropriate, for the default.

7. Set the default values for the CA certificates. For more information, see Section B.1.13, “Key Usage Extension Default” and Section B.1.8, “Extended Key Usage Extension Default”.

8. Set the constraint values for the CA certificates. There are no constraints to be set for a Key Usage extension; for an Extended Key Usage extension, set the appropriate OID constraints for the CA. For more information, see Section B.1.8, “Extended Key Usage Extension Default”.

9. When the changes have been made to the profile, log into the agent services page again, and re-enable the certificate profile.

For more information on modifying certificate profiles, see Section 2.2, “Setting up Certificate Profiles” and the *Certificate System Agents Guide*.

2.6.2. Changing the Restrictions for CAs on Issuing Certificates

The restrictions on the certificates issued are set by default after the subsystem is configured. These include:

- Whether certificates can be issued with validity periods longer than the CA signing certificate. The default is to disallow this.

- The signing algorithm used to sign certificates.

- The serial number range the CA is able to use to issue certificates.

Subordinate CAs have constraints for the validity periods, types of certificates, and the types of extensions which they can issue. It is possible for a subordinate CA to issue certificates that violate these constraints, but a client authenticating a certificate that violates those constraints will not accept that certificate. Check the constraints set on the CA signing certificate before changing the issuing rules for a subordinate CA.

To change the certificate issuance rules:

1. Open the Certificate System Console.

```
pkiconsole https://server.example.com:8443/ca
```

2. Select the **`Certificate Manager`** item in the left navigation tree of the **`Configuration`** tab.

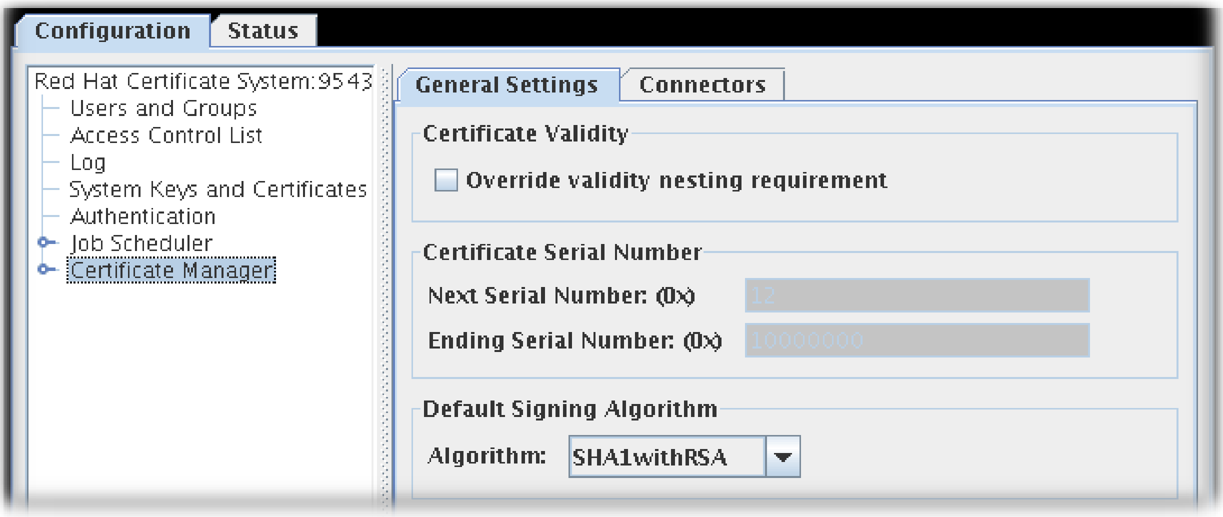


Figure 2.2. The General Settings Tab

3. The **`General Setting`** tab of the **`Certificate Manager`** tab contains the following fields:

   - **`Override validity nesting requirement.`** This checkbox sets whether the Certificate Manager can issue certificates with validity periods longer than the CA signing certificate validity period.

     If this checkbox is not selected and the CA receives a request with validity period longer than the CA signing certificate's validity period, it automatically truncates the validity period to end on the day the CA signing certificate expires.

   - **`Certificate Serial Number.`** These fields display the serial number range for certificates issued by the Certificate Manager. The server assigns the serial number in the **`Next serial number`** field to the next certificate it issues and the number in the **`Ending serial number`** to the last certificate it issues.

     The serial number range allows multiple CAs to be deployed and balances the number of certificates each CA issues. The combination of an issuer name and a serial number uniquely identifies a certificate.

> **Note**
>
> The serial number ranges with cloned CAs are fluid. All cloned CAs share a common configuration entry which defines the next available range. When one CA starts running low on available numbers, it checks this configuration entry and claims the next range. The entry is automatically updated, so that the next CA gets a new range.
>
> The ranges are defined in ***begin*Number*** and ***end*Number*** attributes, with separate ranges defined for requests and certificate serial numbers. For example:
>
> ```
> dbs.beginRequestNumber=1
> dbs.beginSerialNumber=1
> dbs.enableSerialManagement=true
> dbs.endRequestNumber=9980000
> dbs.endSerialNumber=ffe0000
> dbs.ldap=internaldb
> dbs.newSchemaEntryAdded=true
> dbs.replicaCloneTransferNumber=5
> ```
>
> Serial number management can be enabled for CAs which are not cloned, if the parameters are set in the **CS.cfg** file. However, by default, serial number management is disabled unless a system is cloned, when it is automatically enabled.

The serial number range cannot be updated manually through the console. The serial number ranges are read-only fields. If cloning or serial number management is not enabled, then the serial number range can be updated by editing the values in the **CS.cfg** file.

- **Default Signing Algorithm.** Specifies the signing algorithm the Certificate Manager uses to sign certificates. The options are **MD2withRSA**, **MD5withRSA**, **SHA1withRSA**, **SHA256withRSA**, and **SHA512withRSA**, if the CA's signing key type is RSA.

  The signing algorithm specified in the certificate profile configuration overrides the algorithm set here.

4. Click **Save**.

2.6.3. Allowing a CA Certificate to Be Renewed Past the CA's Validity Period

Normally, a certificate cannot be issued with a validity period that ends *after* the issuing CA certificate's expiration date. If a CA certificate has an expiration date of December 31, 2015, then all of the certificates it issues must expire by or before December 31, 2015.

This rule applies to other CA signing certificates issued by a CA — and this makes renewing a root CA certificate almost impossible. Renewing a CA signing certificate means it would necessarily have to have a validity period past its own expiration date.

This behavior can be altered using the CA Validity Default. This default allows a setting (**bypassCAnotafter**) which allows a CA certificate to be issued with a validity period that extends past the issuing CA's expiration (*notAfter*) date.

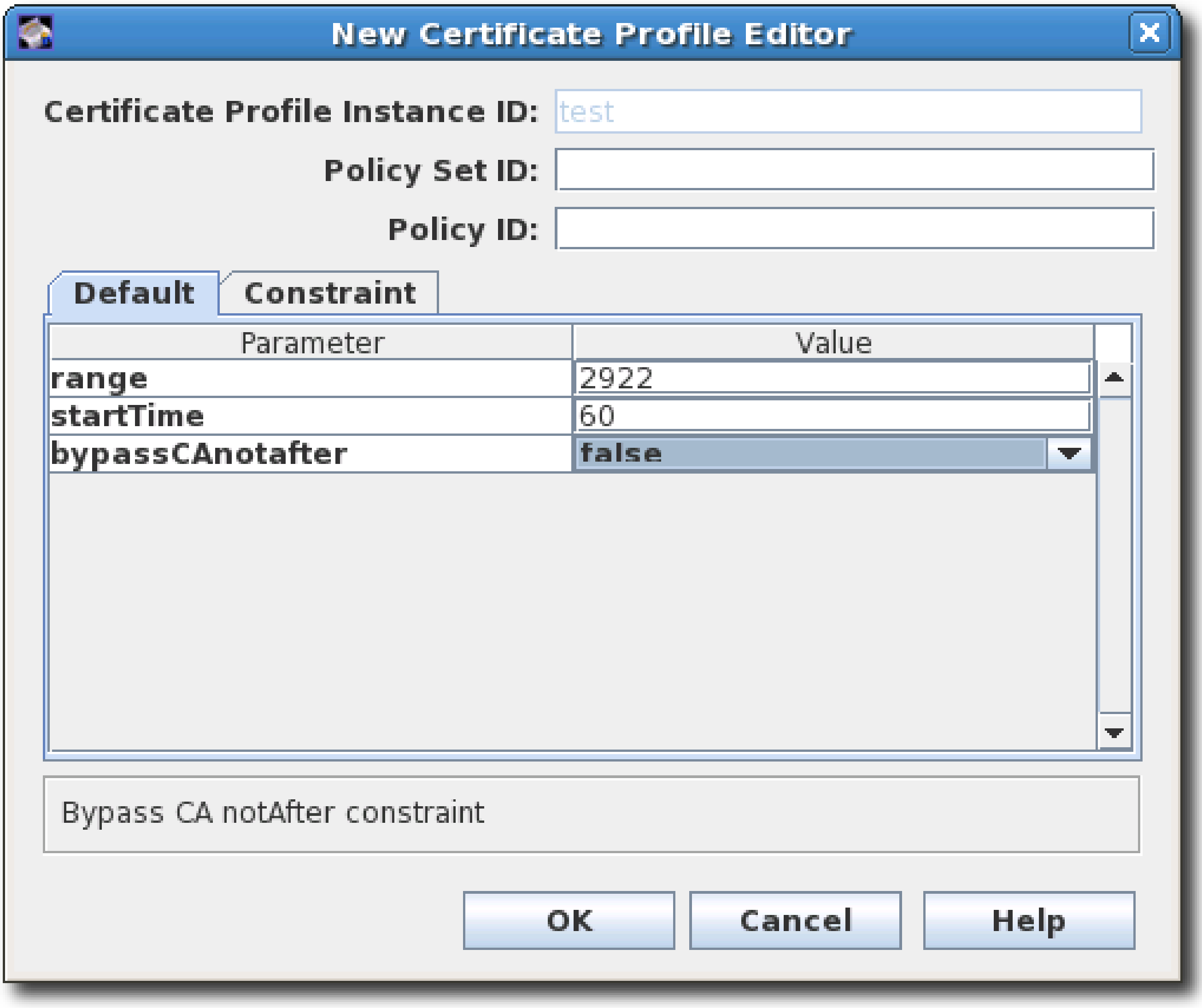


Figure 2.3. CA Validity Default Configuration

In real deployments, what this means is that a CA certificate for a root CA can be renewed, when it might otherwise be prevented.

To enable CA certificate renewals past the original CA's validity date:

1. Open the **caCACert.cfg** file.

   ```
   vim /var/lib/pki/instance_name/conf/ca/caCACert.cfg
   ```

2. The CA Validity Default should be present by default. Set the value to **true** to allow a CA certificate to be renewed past the issuing CA's validity period.

   ```
   policyset.caCertSet.2.default.name=CA Certificate Validity Default
   policyset.caCertSet.2.default.params.range=2922
   policyset.caCertSet.2.default.params.startTime=0
   policyset.caCertSet.2.default.params.bypassCAnotafter=true
   ```

3. Restart the CA to apply the changes.

When an agent reviews a renewal request, there is an option in the **Extensions/Fields** area that allows the agent to choose to bypass the normal validity period constraint. If the agent selects **false**, the constraint is enforced, even if **bypassCAnotafter=true** is set in the profile. If the agent selects true when the **bypassCAnotafter** value is not enabled, then the renewal request is rejected by the CA.

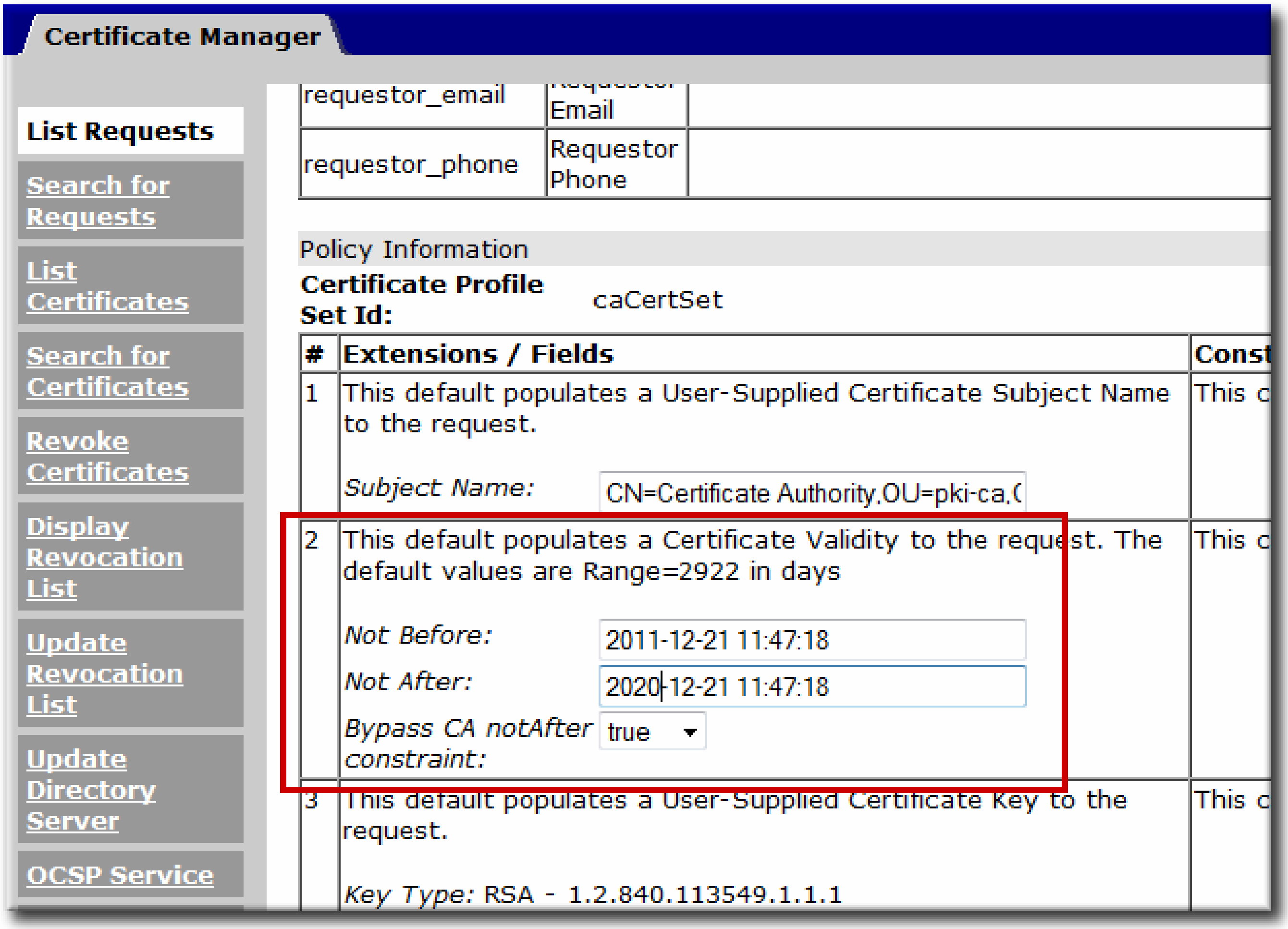


Figure 2.4. Bypass CA Constraints Option in the Agent Services Page

> **Note**
>
> The CA Validity Default only applies to CA signing certificate renewals. Other certificates must still be issued and renewed within the CA's validity period.
>
> A separate configuration setting for the CA, **ca.enablePastCATime**, can be used to allow certificates to be renewed past the CA's validity period. However, this applies to *every* certificate issued by that CA. Because of the potential security issues, this setting is not recommended for production environments.

2.7. Managing Subject Names and Subject Alternative Names

The *subject name* of a certificate is a distinguished name (DN) that contains identifying information about the entity to which the certificate is issued. This subject name can be built from standard LDAP directory components, such as common names and organizational units. These components are defined in X.500. In addition to — or even in place of — the subject name, the certificate can have a *subject alternative name*, which is a kind of extension set for the certificate that includes additional information that is not defined in X.500.

The naming components for both subject names and subject alternative names can be customized.

> **Important**
>
> If the subject name is empty, then the Subject Alternative Name extension must be present and marked critical.

2.7.1. Using the Requester CN or UID in the Subject Name

The ***cn*** or ***uid*** value from a certificate request can be used to build the subject name of the issued certificate. This section demonstrates a profile that requires the naming attribute (CN or UID) being specified in the Subject Name Constraint to be present in the certificate request. If the naming attribute is missing, the request is rejected.

There are two parts to this configuration:

- The CN or UID format is set in the **pattern** configuration in the Subject Name Constraint.
- The format of the subject DN, including the CN or UID token and the specific suffix for the certificate, is set in the Subject Name Default.

For example, to use the CN in the subject DN:

```
policyset.serverCertSet.1.constraint.class_id=subjectNameConstraintImpl
policyset.serverCertSet.1.constraint.name=Subject Name Constraint
policyset.serverCertSet.1.constraint.params.pattern=CN=[^,]+,.+
policyset.serverCertSet.1.constraint.params.accept=true
policyset.serverCertSet.1.default.class_id=subjectNameDefaultImpl
policyset.serverCertSet.1.default.name=Subject Name Default
policyset.serverCertSet.1.default.params.name=CN=$request.req_subject_na
me.cn$,DC=example, DC=com
```

In this example, if a request comes in with the CN of **cn=John Smith**, then the certificate will be issued with a subject DN of **cn=John Smith,DC=example, DC=com**. If the request comes in but it has a UID of **uid=jsmith** and no CN, then the request is rejected.

The same configuration is used to pull the requester UID into the subject DN:

```
policyset.serverCertSet.1.constraint.class_id=subjectNameConstraintImpl
policyset.serverCertSet.1.constraint.name=Subject Name Constraint
policyset.serverCertSet.1.constraint.params.pattern=UID=[^,]+,.+
policyset.serverCertSet.1.constraint.params.accept=true
```

```
policyset.serverCertSet.1.default.class_id=subjectNameDefaultImpl
policyset.serverCertSet.1.default.name=Subject Name Default
policyset.serverCertSet.1.default.params.name=UID=$request.req_subject_n
ame.uid$,DC=example, DC=com
```

The format for the ***pattern*** parameter is covered in Section B.2.11, “Subject Name Constraint” and Section B.1.27, “Subject Name Default”.

2.7.2. Inserting LDAP Directory Attribute Values and Other Information into the Subject Alt Name

Information from an LDAP directory or that was submitted by the requester can be inserted into the subject alternative name of the certificate by using matching variables in the Subject Alt Name Extension Default configuration. This default sets the type (format) of information and then the matching pattern (variable) to use to retrieve the information. For example:

```
policyset.userCertSet.8.default.class_id=subjectAltNameExtDefaultImpl
policyset.userCertSet.8.default.name=Subject Alt Name Constraint
policyset.userCertSet.8.default.params.subjAltNameExtCritical=false
policyset.userCertSet.8.default.params.subjAltExtType_0=RFC822Name
policyset.userCertSet.8.default.params.subjAltExtPattern_0=$request.requ
estor_email$
policyset.userCertSet.8.default.params.subjAltExtGNEnable_0=true
```

This inserts the requester's email as the first CN component in the subject alt name. To use additional components, increment the **Type_**, **Pattern_**, and **Enable_** values numerically, such as **Type_1**.

Configuring the subject alt name is detailed in Section B.1.23, “Subject Alternative Name Extension Default”, as well.

To insert LDAP components into the subject alt name of the certificate:

1. Inserting LDAP attribute values requires enabling the user directory authentication plug-in, **UidPwdDirAuth**.

   a. Open the CA Console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

   b. Select **Authentication** in the left navigation tree.

   c. In the **Authentication Instance** tab, click **Add**, and add an instance of the **UidPwdDirAuth** authentication plug-in.

   d. Set the information for the LDAP directory.

   e. Set the LDAP attributes to populate.

   f. Save the new plug-in instance.

   For information on configuring the LDAP authentication modules, see Section 8.2.1, “Setting up Directory-Based Authentication”.

2. When the new authentication plug-in is added, the corresponding parameters are added to the CA's **CS.cfg** file. For example, this instance of the **UidPwdDirAuth** plug-in is set to populate the ***mail*** attribute:

```
...
auths.instance.UserDirEnrollment.dnpattern=
auths.instance.UserDirEnrollment.ldapByteAttributes=
auths.instance.UserDirEnrollment.ldapStringAttributes=mail
auths.instance.UserDirEnrollment.pluginName=UidPwdDirAuth
auths.instance.UserDirEnrollment.ldap.basedn=dc=example,dc=com
auths.instance.UserDirEnrollment.ldap.maxConns=
auths.instance.UserDirEnrollment.ldap.minConns=
auths.instance.UserDirEnrollment.ldap.ldapconn.host=localhost
auths.instance.UserDirEnrollment.ldap.ldapconn.port=389
auths.instance.UserDirEnrollment.ldap.ldapconn.secureConn=false..
.
```

   The **ldapStringAttributes** parameter instructs the authentication plug-in to read the value of the ***mail*** attribute from the user's LDAP entry and put that value in the certificate request. When the value is in the request, the certificate profile policy can be set to insert that value for an extension value.

   The format for the ***dnpattern*** parameter is covered in Section B.2.11, "Subject Name Constraint" and Section B.1.27, "Subject Name Default".

3. To enable the CA to insert the LDAP attribute value in the certificate extension, edit the profile's configuration file, and insert a policy set parameter for an extension. For example, to insert the ***mail*** attribute value in the Subject Alternative Name extension in the caDirUser profile, do the following:

```
cd /var/lib/instance_name/profiles/ca

vi caDirUser.cfg

policyset.setID.8.default.params.subjAltExtPattern_0=$request.auth
_token.mail[0]$
```

4. Restart the CA.

```
systemctl restart pki-tomcatd@instance-name.service
```

For this example, certificates submitted through the caDirUser profile enrollment form will have the Subject Alternative Name extension added with the value of the requester's ***mail*** LDAP attribute. For example:

```
Identifier: Subject Alternative Name - 2.5.29.17
    Critical: no
    Value:
    RFC822Name: jsmith@example.com
```

There are many attributes which can be automatically inserted into certificates by being set as a token (*X*) in any of the **Pattern_** parameters in the policy set. The common tokens are listed in Table 2.5, "Variables Used to Populate Certificates", and the default profiles contain examples for how these tokens are used.

Table 2.5. Variables Used to Populate Certificates

Policy Set Token	Description
$request.auth_token.cn[0]$	The LDAP common name (***cn***) attribute of the user who requested the certificate.
$request.auth_token.mail[0]$	The value of the LDAP email (***mail***) attribute of the user who requested the certificate.
$request.auth_token.tokencertsubject$	The certificate subject name.
$request.auth_token.uid$	The LDAP user ID (***uid***) attribute of the user who requested the certificate.
$request.auth_token.userdn$	The user DN of the user who requested the certificate.
$request.auth_token.userid$	The value of the user ID attribute for the user who requested the certificate.
$request.uid$	The value of the user ID attribute for the user who requested the certificate.
$request.requestor_email$	The email address of the person who submitted the request.
$request.request_name$	The person who submitted the request.
$request.upn$	The Microsoft UPN. This has the format *(UTF8String)1.3.6.1.4.1.311.20.2.3,$request.upn$*.
$server.source$	Instructs the server to generate a version 4 UUID (random number) component in the subject name. This always has the format *(IA5String)1.2.3.4,$server.source$*.
$request.auth_token.user$	Used when the request was submitted by TPS. The TPS subsystem trusted manager who requested the certificate.
$request.subject$	Used when the request was submitted by TPS. The subject name DN of the entity to which TPS has resolved and requested for. For example, **cn=John.Smith.123456789,o=TMS Org**

2.7.3. Changing DN Attributes in CA-Issued Certificates

In certificates issued by the Certificate System, DNs identify the entity that owns the certificate. In all cases, if the Certificate System is connected with a Directory Server, the format of the DNs in the certificates should match the format of the DNs in the directory. It is not necessary that the names match exactly; certificate mapping allows the subject DN in a certificate to be different from the one in the directory.

In the Certificate System, the DN is based on the components, or attributes, defined in the X.509 standard. Table 2.6, “Allowed Characters for Value Types” lists the attributes supported by default. The set of attributes is extensible.

Table 2.6. Allowed Characters for Value Types

Attribute	Value Type	Object Identifier
cn	**DirectoryString**	2.5.4.3
ou	**DirectoryString**	2.5.4.11

Attribute	Value Type	Object Identifier
o	**DirectoryString**	2.5.4.10
c	**PrintableString** , two-character	2.5.4.6
l	**DirectoryString**	2.5.4.7
st	**DirectoryString**	2.5.4.8
street	**DirectoryString**	2.5.4.9
title	**DirectoryString**	2.5.4.12
uid	**DirectoryString**	0.9.2342.19200300.100.1.1
mail	**IA5String**	1.2.840.113549.1.9.1
dc	**IA5String**	0.9.2342.19200300.100.1.2.25
serialnumber	**PrintableString**	2.5.4.5
unstructuredname	**IA5String**	1.2.840.113549.1.9.2
unstructuredaddress	**PrintableString**	1.2.840.113549.1.9.8

By default, the Certificate System supports the attributes identified in Table 2.6, "Allowed Characters for Value Types". This list of supported attributes can be extended by creating or adding new attributes. The syntax for adding additional **X.500Name** attributes, or components, is as follows:

```
X500Name.NEW_ATTRNAME.oid=n.n.n.n
X500Name.NEW_ATTRNAME.class=string_to_DER_value_converter_class
```

The value converter class converts a string to an ASN.1 value; this class must implement the **netscape.security.x509.AVAValueConverter** interface. The string-to-value converter class can be one of the following:

- **netscape.security.x509.PrintableConverter** converts a string to a **PrintableString** value. The string must have only printable characters.
- **netscape.security.x509.IA5StringConverter** converts a string to an **IA5String** value. The string must have only IA5String characters.
- **netscape.security.x509.DirStrConverter** converts a string to a **DirectoryString**. The string is expected to be in **DirectoryString** format according to RFC 2253.
- **netscape.security.x509.GenericValueConverter** converts a string character by character in the following order, from the smallest characterset to the largest:
  - Printable
  - IA5String
  - BMPString
  - Universal String

An attribute entry looks like the following:

```
X500Name.MY_ATTR.oid=1.2.3.4.5.6
X500Name.MY_ATTR.class=netscape.security.x509.DirStrConverter
```

2.7.3.1. Adding New or Custom Attributes

To add a new or proprietary attribute to the Certificate System schema, do the following:

1. Stop the Certificate Manager.

   ```
   systemctl stop pki-tomcatd@instance-name.service
   ```

2. Open the **/var/lib/pki/*cs_instance*/conf/** directory.

3. Open the configuration file, **CS.cfg**.

4. Add the new attributes to the configuration file.

   For example, to add three proprietary attributes, **MYATTR1** that is a **DirectoryString**, **MYATTR2** that is an **IA5String**, and **MYATTR3** that is a **PrintableString**, add the following lines at the end of the configuration file:

   ```
   X500Name.attr.MYATTR1.oid=1.2.3.4.5.6
   X500Name.attr.MYATTR1.class=netscape.security.x509.DirStrConverter
   X500Name.attr.MYATTR2.oid=11.22.33.44.55.66
   X500Name.attr.MYATTR2.class=netscape.security.x509.IA5StringConver
   ter
   X500Name.attr.MYATTR3.oid=111.222.333.444.555.666
   X500Name.attr.MYATTR3.class=netscape.security.x509.PrintableConver
   ter
   ```

5. Save the changes, and close the file.

6. Restart the Certificate Manager.

   ```
   systemctl start pki-tomcatd@instance-name.service
   ```

7. Reload the enrollment page and verify the changes; the new attributes should show up in the form.

8. To verify that the new attributes are in effect, request a certificate using the manual enrollment form.

   Enter values for the new attributes so that it can be verified that they appear in the certificate subject names. For example, enter the following values for the new attributes and look for them in the subject name:

   ```
   MYATTR1: a_value
   MYATTR2: a.Value
   MYATTR3: aValue
   cn: John Doe
   o: Example Corporation
   ```

9. Open the agent services page, and approve the request.

10. When the certificate is issued, check the subject name. The certificate should show the new attribute values in the subject name.

2.7.3.2. Changing the DER-Encoding Order

It is possible to change the DER-encoding order of a **DirectoryString**, so that the string is configurable since different clients support different encodings.

The syntax for changing the DER-encoding order of a **DirectoryString** is as follows:

```
X500Name.directoryStringEncodingOrder=encoding_list_separated_by_commas
```

The possible encoding values are as follows:

- **Printable**
- **IA5String**
- **UniversalString**
- **BMPString**
- **UTF8String**

For example, the DER-encoding ordered can be listed as follows:

```
X500Name.directoryStringEncodingOrder=Printable,BMPString
```

To change the **DirectoryString** encoding, do the following:

1. Stop the Certificate Manager.

   ```
   systemctl stop pki-tomcatd@instance-name.service
   ```

2. Open the **/var/lib/pki/*cs_instance*/conf/** directory.

3. Open the **CS.cfg** configuration file.

4. Add the encoding order to the configuration file.

   For example, to specify two encoding values, **PrintableString** and **UniversalString**, and the encoding order is **PrintableString** first and **UniversalString** next, add the following line at the end of the configuration file:

   ```
   X500Name.directoryStringEncodingOrder=PrintableString,
   UniversalString
   ```

5. Save the changes, and close the file.

6. Start the Certificate Manager.

   ```
   systemctl start pki-tomcatd@instance-name.service
   ```

7. To verify that the encoding orders are in effect, enroll for a certificate using the manual enrollment form. Use **John_Doe** for the **cn**.

8. Open the agent services page, and approve the request.

9. When the certificate is issued, use the **dumpasn1** tool to examine the encoding of the certificate.

   The **cn** component of the subject name should be encoded as a **UniversalString**.

10. Create and submit a new request using **John Smith** for the **cn**.

    The **cn** component of the subject name should be encoded as a **PrintableString**.

Chapter 3. Setting up Key Archival and Recovery

This chapter explains how to use the Key Recovery Authority (KRA), previously known as Data Recovery Manager (DRM), to archive private keys and to recover these archived keys to restore encrypted data.

> **Note**
>
> Server-side key generation is an option provided for smart card enrollments performed through the TPS subsystem. This chapter deals with archiving keys through client-side key generation, not the server-side key generation and archivals initiated through the TPS.
>
> For information on smart card key recovery, see Section 5.8, “Automating Encryption Key Recovery”.

Archiving private keys offers protection for users, and for information, if that key is ever lost. Information is encrypted by the public key when it is stored. The corresponding private key must be available to decrypt the information. If the private key is lost, the data cannot be retrieved. A private key can be lost because of a hardware failure or because the key's owner forgets the password or loses the hardware token in which the key is stored. Similarly, encrypted data cannot be retrieved if the owner of the key is unavailable to supply it.

When the KRA is configured, joins a security domain, and is issued a subsystem certificate by a Certificate System CA, it is configured to archive and recover private encryption keys. However, if the KRA certificates are issued by an external CA rather than one of the CAs within the security domain, then the key archival and recovery process must be set up manually.

> **Note**
>
> In a cloned environment, it is necessary to set up key archival and recovery manually.

3.1. About Key Archival and Recovery

From the end user perspective, key archival requires only two things: a client (meaning a browser) which can generate dual keys and a certificate profile which is configured to support key archival.

Certificate Request Message Format (CRMF) requests allow to create, update, and revoke certificates issued by CAs. See RFC 4211 for more information about CRMF.

Some clients, such as **Firefox** version earlier than 33, can generate CRMF requests, which are used by the client’s Certificate Request Protocol (CRP) to communicate with CAs.

CRMF key generation request types are not supported in **Firefox** version 33, 35, or later. It no longer possible to perform browser-based enrollments, particularly in the key archival functionality. Only a limited support for simple keygen-based enrollments now exists for the profiles not performing key archival.

The enrollments can be performed using the **pki** CLI utility. In Red Hat Certificate System 9, the **client-cert-request** command supports both PKCS #10 and CRMF certificate requests.

To generate and submit a CRMF certificate request with key archival:

1. Download the transport certificate

   ```
   # pki cert-find --name "KRA Transport certificate's subject common name"
   # pki cert-show serial_number --output transport.pem
   ```

2. Submit the certificate request

   ```
   # pki -c password client-init
   # pki -c password client-cert-request subject_DN --profile caDualCert --type crmf --transport transport.pem
   ```

Note

For user dual key pairs, only keys that are used exclusively for encrypting data should be archived; signing keys should never be archived. Having two copies of a signing key would defeat the certainty with which the key identifies its owner; a second archived copy could be used to impersonate the digital identity of the original key owner.

With single keys, the same key is used for encryption and signing, so single keys should not be archived, for the same reason that signing keys should not be.

The KRA automatically archives private encryption keys if archiving is configured in the certificate profile.

If an end entity loses a private encryption key or is unavailable to use the private key, the key must be recovered before any data that was encrypted with the corresponding public key can be read. Recovery is possible if the private key was archived when the key was generated.

The KRA stores private encryption keys in a secure key repository in its internal database in form of key records. The Certificate Manager automatically forwards certificate requests issued by a client to the KRA, if the requests contain the key archival option. In such a case, the private key is wrapped by the KRA transport key on the client and sent as an encrypted blob to the KRA. The KRA decrypts the blob and re-encrypts the key using its storage key. The KRA then gives the encrypted blob a unique key identifier and archives it in its key repository as a key record.

The archived copy of the key remains wrapped with the KRA's storage key. It can be decrypted, or unwrapped, only by using the corresponding private key pair of the storage certificate. A combination of one or more key recovery (or KRA) agents' certificates authorizes the KRA to complete the key recovery to retrieve its private storage key and use it to decrypt/recover an archived private key. The KRA indexes stored keys by key number, owner name, and a hash of the public key, allowing for highly efficient searching.

Figure 3.1, "How the Key Archival Process Works" illustrates how the key archival process occurs when an end entity requests a certificate.

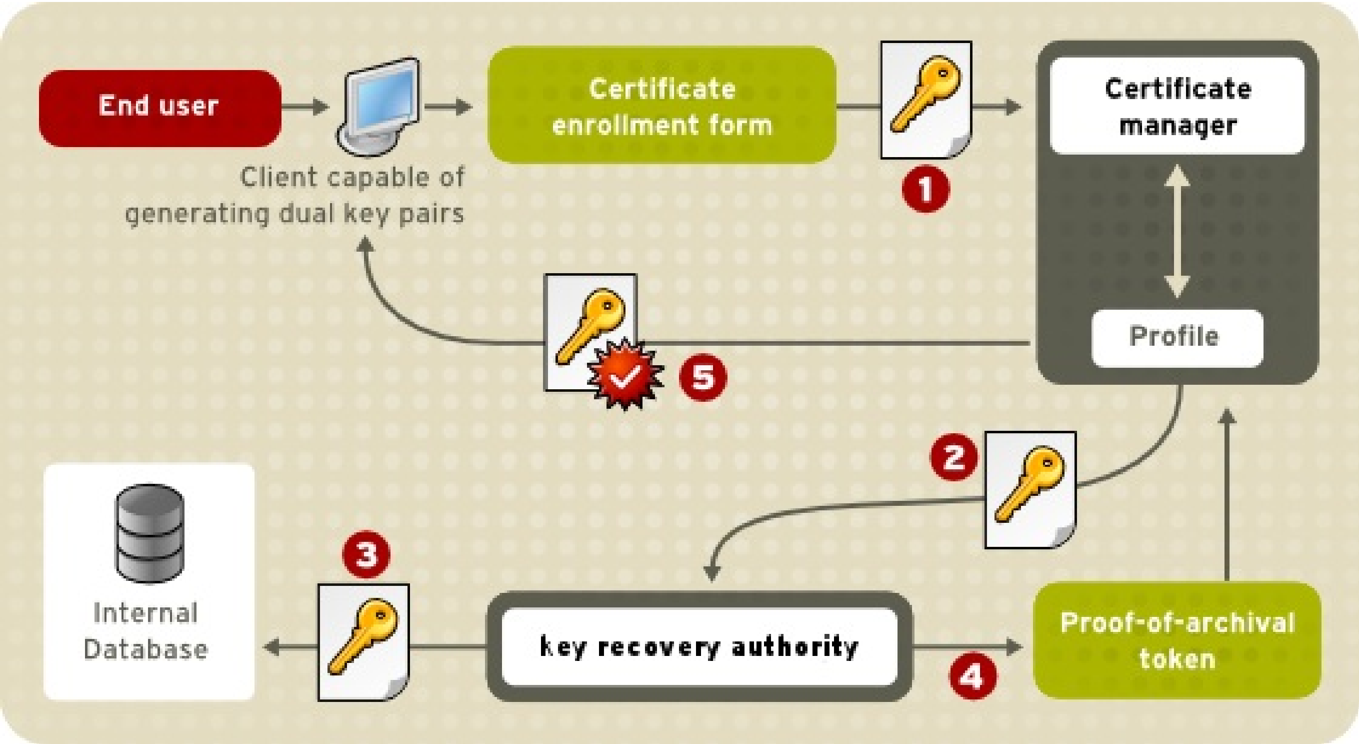


Figure 3.1. How the Key Archival Process Works

1. The client requests and generates a dual key pair.

    a. The end entity, using a client which can generate dual key pairs, submits a request through the Certificate Manager enrollment form.

    b. The client detects the JavaScript in the enrollment form and exports only the private encryption key, not the private signing key.

    c. The Certificate Manager detects the key archival option in the request and asks the client for the private encryption key.

    d. The client encrypts the private encryption key with the public key from the KRA's transport certificate embedded in the enrollment form.

2. After approving the certificate request and issuing the certificate, the Certificate Manager sends it to the KRA for storage, along with the public key. The Certificate Manager waits for verification from the KRA that the private key has been received and stored and that it corresponds to the public encryption key.

3. The KRA decrypts it with the transport private key. After confirming that the private encryption key corresponds to the public encryption key, the KRA encrypts it again with its public key pair of the storage key before storing it in its internal database.

4. Once the private encryption key has been successfully stored, the KRA uses the private key of its transport key pair to sign a token confirming that the key has been successfully stored; the KRA then sends the token to the Certificate Manager.

5. The Certificate Manager issues two certificates for the signing and encryption key pairs and returns them to the end entity.

> **Note**
>
> Key archival is only possible using clients which support dual key pairs.

Both subsystems subject the request to configured certificate profile constraints at appropriate stages. If the request fails to meet any of the profile constraints, the subsystem rejects the request.

The KRA supports agent-initiated key recovery, when designated recovery agents use the key recovery form on the KRA agent services page to process and approve key recovery requests. With the approval of a specified number of agents, an organization can recover keys when the key's owner is unavailable or when keys have been lost.

Certificate System 9 uses an *m-of-n ACL-based recovery scheme*, rather than an older secret-splitting-based recovery scheme. In versions of Certificate System older than 7.1, the password for the storage token was split and protected by individual recovery agent passwords. Now, Certificate System uses its existing access control scheme to ensure recovery agents are appropriately authenticated over SSL and requires that the agent belong to a specific recovery agent group, by default the Key Recovery Authority Agents Group. The recovery request is executed only when *m-of-n* (a required number of) recovery agents have granted authorization to the request.

The key recovery scheme can be changed by changing the KRA configuration, as in Section 3.4, “Setting up Agent-Approved Key Recovery Schemes”.

For the actual key recovery process, one of the key recovery agents informs all required recovery agents about an impending key recovery and initiates the recovery process in the KRA's agent pages. A key recovery process can either be *synchronous*, meaning that the initial session must remain open as approvals come in, or *asynchronous*, meaning that snapshots of the recovery process are stored in the internal database and updated as approvals come in.

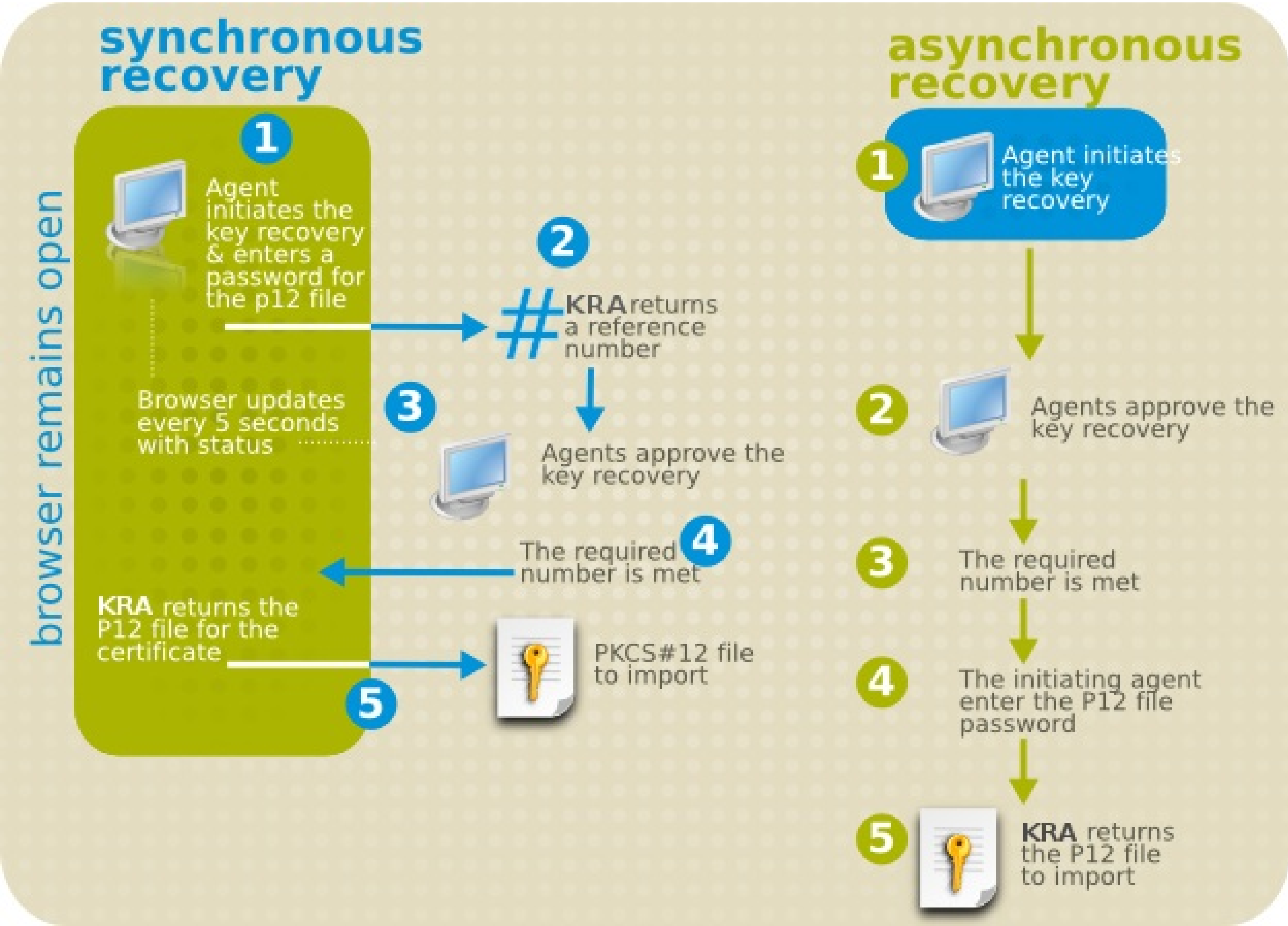


Figure 3.2. Async and Sync Recovery, Side by Side

For synchronous recovery, when the first key recovery agent initiates the recovery, the KRA returns a notification with a recovery authorization reference number identifying the particular key recovery request. Each subsequent agent uses the reference number and authorizes key recovery separately. The initial web session must remain open during this time to ensure that the recovery process completes. If the web browser is closed before the required number of agents approve the request, then the request must be resubmitted.

For asynchronous recovery, each step is saved to the internal database. Agents can search for the key to recover and then click the **Grant Recovery** button to approve the recovery. Asynchronous recoveries will persist even if the KRA is restarted.

Note

Asynchronous recovery is the default and recommended method to perform a key recovery because it is a more reliable and tolerant method of recovering keys.

For a synchronous recovery, you must keep the initiating browser window open for the entire process and the KRA cannot stop during the process. Also, the synchronous recovery process cannot last too long, or KRA performance may suffer.

3.2. Manually Setting up Key Archival

> **Important**
>
> This procedure is unnecessary if the CA and KRA are in the same security domain. This procedure is only required for CAs *outside* the security domain.

Configuring key archival manually demands two things:

- Having a trusted relationship between a CA and a KRA.
- Having the enrollment form enabled for key archival, meaning it has key archival configured and the KRA transport certificate stored in the form.

In the same security domain, both of these configuration steps are done *automatically* when the KRA is configured because it is configured to have a trusted relationship with any CA in its security domain. It is possible to create that trusted relationship with Certificate Managers outside its security domain by manually configuring the trust relationships and profile enrollment forms.

1. If necessary, create a trusted manager to establish a relationship between the Certificate Manager and the KRA.

   For the CA to be able to request key archival of the KRA, the two subsystems must be configured to recognize, trust, and communicate with each other. Verify that the Certificate Manager has been set up as a privileged user, with an appropriate SSL client authentication certificate, in the internal database of the KRA. By default, the Certificate Manager uses its subsystem certificate for SSL client authentication to the KRA.

2. Copy the base-64 encoded transport certificate for the KRA.

   The transport certificate is stored in the KRA's certificate database, which can be retrieved using the **certutil** utility. If the transport certificate is signed by a Certificate Manager, then a copy of the certificate is available through the Certificate Manager end-entities page in the **Retrieval** tab.

   Alternatively, download the transport certificate using the **pki** ultility:

   ```
   # pki cert-find --name "KRA Transport certificate's subject common name"
   # pki cert-show serial_number --output transport.pem
   ```

3. Add the transport certificate to the CA's **CS.cfg** file.

   ```
   ca.connector.KRA.enable=true
   ca.connector.KRA.host=server.example.com
   ca.connector.KRA.local=false
   ca.connector.KRA.nickName=subsystemCert cert-pki-ca
   ca.connector.KRA.port=8443
   ca.connector.KRA.timeout=30
   ca.connector.KRA.transportCert=MIIDbDCCAlSgAwIBAgIBDDANBgkqhkiG9w0
   BAQUFADA6MRgwFgYDVQQKEw9Eb21haW4gc28gbmFtZWQxHjAcBgNVBAMTFUNlcnRpZ
   mljYXRlIEF1dGhvcml0eTAeFw0wNjExMTQxODI2NDdaFw0wODEwMTQxNzQwNThaMD4
   xGDAWBgNVBAoTD0RvbWFpbiBzbyBuYW1lZDEiMCAGA1UEAxMZRFJNIFRyYW5zcG9yd
   CBDZXJ0aWZpY2F0ZTCCASIwDQYJKoZIhvcNAQEBBQADggEPADCCAQoCggEBAKnMGB3
   WkznueouwZjrWLFZBLpKt6TimNKV9iz5s0zrGUlpdt81/BTsU5A2sRUwNfoZSMs/d5
   ```

```
KLuXOHPyGtmC6yVvaY719hr9EGYuv0Sw6jb3WnEKHpjbUO/vhFwTufJHWKXFN3V4pM
bHTkqW/x5fu/3QyyUre/5IhG0fcEmfvYxIyvZUJx+aQBW437ATD99Kuh+I+FuYdW+S
qYHznHY8BqOdJwJ1JiJMNceXYAuAdk+9t70RztfAhBmkK0OOP0vH5BZ7RCwE3Y/6yc
UdSyPZGGc76a0HrKOz+lwVFulFStiuZIaG1pv0NNivzcj0hEYq6AfJ3hgxcC1h87Lm
CxgRWUCAwEAAaN5MHcwHwYDVR0jBBgwFoAURShCYtSg+Oh4rrgmLFB/Fg7X3qcwRAY
IKwYBBQUHAQEEODA2MDQGCCsGAQUFBzABhihodHRwOi8vY2x5ZGUucmR1LnJlZGhhd
C5jb206OTE4MC9jYS9vY3NwMA4GA1UdDwEB/wQEAwIE8DANBgkqhkiG9w0BAQUFAAO
CAQEAFYz5ibujdIXgnJCbHSPWdKG0T+FmR67YqiOtoNlGyIgJ42fi5lsDPfCbIAe3Y
FqmF3wU472h8LDLGyBjy9RJxBj+aCizwHkuoH26KmPGntIayqWDH/UGsIL0mvTSOeL
qI3KM0IuH7bxGXjlION83xWbxumW/kVLbT9RCbL4216tqq5jsjfOHNNvUdFhWyYdfE
Ojpp/UQZOhOM1d8GFiw8N8ClWBGc3mdlADQp6tviodXueluZ7UxJLNx3HXKFYLleew
wIFhC82zqeQ1PbxQDL8QLjzca+IUzq6Cd/t7OAgvv3YmpXgNR0/xoWQGdM1/YwHxtc
AcVlskXJw5ZR0Y2zA==
ca.connector.KRA.uri=/kra/agent/kra/connector
```

4. Then edit the enrollment form and add or replace the transport certificate value in the **keyTransportCert** method.

```
vim /var/lib/pki-ca/webapps/ca/ee/ca/ProfileSelect.template

var keyTransportCert =
MIIDbDCCAlSgAwIBAgIBDDANBgkqhkiG9w0BAQUFADA6MRgwFgYDVQQKEw9Eb21haW
4gc28gbmFtZWQxHjAcBgNVBAMTFUNlcnRpZmljYXRlIEF1dGhvcml0eTAeFw0wNjEx
MTQxODI2NDdaFw0wODEwMTQxNzQwNThaMD4xGDAWBgNVBAoTD0RvbWFpbiBzbyBuYW
1lZDEiMCAGA1UEAxMZRFJNIFRyYW5zcG9ydCBDZXJ0aWZpY2F0ZTCCASIwDQYJKoZI
hvcNAQEBBQADggEPADCCAQoCggEBAKnMGB3WkznueouwZjrWLFZBLpKt6TimNKV9iz
5s0zrGUlpdt81/BTsU5A2sRUwNfoZSMs/d5KLuXOHPyGtmC6yVvaY719hr9EGYuv0S
w6jb3WnEKHpjbUO/vhFwTufJHWKXFN3V4pMbHTkqW/x5fu/3QyyUre/5IhG0fcEmfv
YxIyvZUJx+aQBW437ATD99Kuh+I+FuYdW+SqYHznHY8BqOdJwJ1JiJMNceXYAuAdk+
9t70RztfAhBmkK0OOP0vH5BZ7RCwE3Y/6ycUdSyPZGGc76a0HrKOz+lwVFulFStiuZ
IaG1pv0NNivzcj0hEYq6AfJ3hgxcC1h87LmCxgRWUCAwEAAaN5MHcwHwYDVR0jBBgw
FoAURShCYtSg+Oh4rrgmLFB/Fg7X3qcwRAYIKwYBBQUHAQEEODA2MDQGCCsGAQUFBz
ABhihodHRwOi8vY2x5ZGUucmR1LnJlZGhhdC5jb206OTE4MC9jYS9vY3NwMA4GA1Ud
DwEB/wQEAwIE8DANBgkqhkiG9w0BAQUFAAOCAQEAFYz5ibujdIXgnJCbHSPWdKG0T+
FmR67YqiOtoNlGyIgJ42fi5lsDPfCbIAe3YFqmF3wU472h8LDLGyBjy9RJxBj+aCiz
wHkuoH26KmPGntIayqWDH/UGsIL0mvTSOeLqI3KM0IuH7bxGXjlION83xWbxumW/kV
LbT9RCbL4216tqq5jsjfOHNNvUdFhWyYdfEOjpp/UQZOhOM1d8GFiw8N8ClWBGc3md
lADQp6tviodXueluZ7UxJLNx3HXKFYLleewwIFhC82zqeQ1PbxQDL8QLjzca+IUzq6
Cd/t7OAgvv3YmpXgNR0/xoWQGdM1/YwHxtcAcVlskXJw5ZR0Y2zA==;
```

3.3. Updating CA-KRA Connector Information After Cloning

Configuration information is not updated in clone instances if it is made *after* the clone is created. Likewise, changes made to a clone are not copied back to the master instance.

If a new KRA is installed or cloned after a clone CA is created, then the clone CA does not have the new KRA connector information in its configuration. This means that the clone CA ignores any archival requests from the KRA because it does not recognize it as a legitimate client.

Whenever a new KRA is created or cloned, copy its connector information into all of the *cloned* CAs in the deployment.

1. On the master clone machine, open the master CA's **CS.cfg** file, and copy all of the ***ca.connector.KRA.**** lines for the new KRA connector.

```
[root@master ~]# vim /var/lib/pki/instance_name/conf/ca/CS.cfg
```

2. Stop the clone CA instance. For example:

```
[root@clone-ca ~] systemctl stop pki-tomcatd@instance_name.service
```

3. Open the clone CA's **CS.cfg** file.

```
[root@clone-ca ~]# vim /var/lib/pki/instance_name/conf/ca/CS.cfg
```

4. Copy in the connector information for the new KRA instance or clone.

```
ca.connector.KRA.enable=true
ca.connector.KRA.host=server-kra.example.com
ca.connector.KRA.local=false
ca.connector.KRA.nickName=subsystemCert cert-pki-ca
ca.connector.KRA.port=8443
ca.connector.KRA.timeout=30
ca.connector.KRA.transportCert=MIIDbD...ZR0Y2zA==
ca.connector.KRA.uri=/kra/agent/kra/connector
```

5. Start the clone CA.

```
[root@clone-ca ~] systemctl start pki-
tomcatd@instance_name.service
```

3.4. Setting up Agent-Approved Key Recovery Schemes

Key recovery agents collectively authorize and retrieve private encryption keys and associated certificates in a PKCS #12 package. To authorize key recovery, the required number of recovery agents access the KRA agent services page and use the **Authorize Recovery** area to enter each authorization separately.

One of the agents initiates the key recovery process. For a synchronous recovery [1], each approving agent uses the reference number (which was returned with the initial request) to open the request and then authorizes key recovery separately. For an asynchronous recovery, the approving agents all search for the key recovery request and then authorize the key recovery. Either way, when all of the authorizations are entered, the KRA checks the information. If the information presented is correct, it retrieves the requested key and returns it along with the corresponding certificate in the form of a PKCS #12 package to the agent who initiated the key recovery process.

The *key recovery agent scheme* configures the KRA to recognize to which group the key recovery agents belong and specifies how many of these agents are required to authorize a key recovery request before the archived key is restored.

3.4.1. Configuring Agent-Approved Key Recovery in the Console

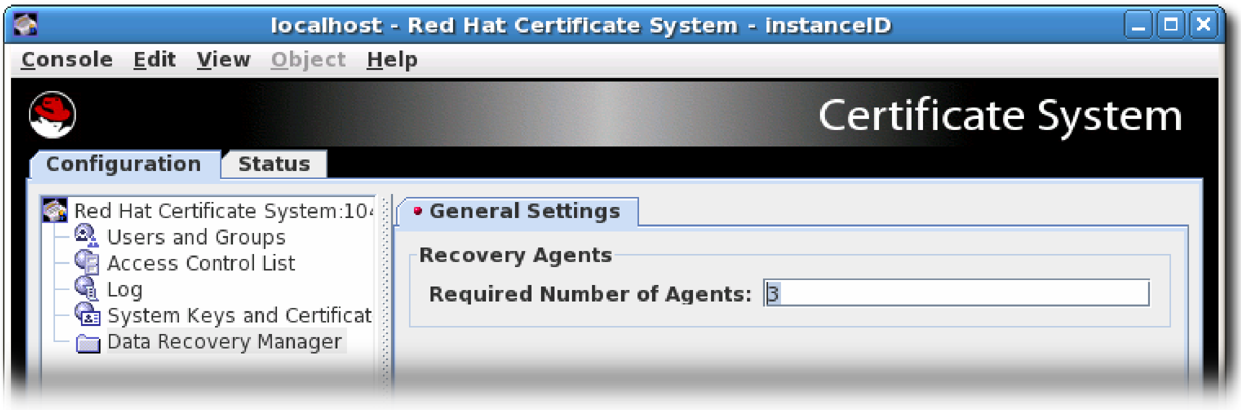
> **Note**
>
> While the *number* of key recovery agents can be configured in the Console, the *group* to use can only be set directly in the **CS.cfg** file. The Console uses the **Key Recovery Authority Agents Group** by default.

1. Open the KRA's console. For example:

```
pkiconsole https://server.example.com:8443/kra
```

2. Click the **Key Recovery Authority** link in the left navigation tree.

3. Enter the number of agents to use to approve key recover in the **Required Number of Agents** field.



3.4.2. Configuring Agent-Approved Key Recovery in the Command Line

To set up agent-initiated key recovery, edit two parameters in the KRA configuration:

- Set the number of recovery managers to require to approve a recovery.
- Set the group to which these users must belong.

These parameters are set in the KRA's **CS.cfg** configuration file.

1. Stop the server before editing the configuration file.

```
systemctl stop pki-tomcatd@pki-tomcat.service
```

2. Open the KRA's **CS.cfg** file.

```
vim /var/lib/pki-kra/conf/CS.cfg
```

3. Edit the two recovery scheme parameters.

```
kra.noOfRequiredRecoveryAgents=3
kra.recoveryAgentGroup=Key Recovery Authority Agents
```

4. Restart the server.

```
systemctl start pki-tomcatd@pki-tomcat.service
```

3.4.3. Customizing the Key Recovery Form

The default key agent scheme requires a single agent from the Key Recovery Authority Agents group to be in charge of authorizing key recovery.

It is also possible to customize the appearance of the key recovery form. Key recovery agents need an appropriate page to initiate the key recovery process. By default, the KRA's agent services page includes the appropriate HTML form to allow key recovery agents to initiate key recovery, authorize key recovery requests, and retrieve the encryption keys. This form is located in the **`/var/lib/pki/pki-tomcat/kra/webapps/kra/agent/kra/`** directory, called **`confirmRecover.html`**.

> **Important**
>
> If the key recovery confirmation form is customized, do not to delete any of the information for generating the response. This is vital to the functioning of the form. Restrict any changes to the content in and appearance of the form.

3.5. Testing the Key Archival and Recovery Setup

To test whether a key can be successfully archived:

1. Enroll for dual certificates using the CA's **`Manual User Signing & Encryption Certificates Enrollment`** form.

2. Submit the request. Log in to the agent services page, and approve the request.

3. Log into the end-entities page, and check to see if the certificates have been issued. In the list of certificates, there should be two new certificates with consecutive serial numbers.

4. Import the certificates into the web browser.

5. Confirm that the key has been archived. In the KRA's agent services page, select **`Show completed requests`**. If the key has been archived successfully, there will be information about that key. If the key is not shown, check the logs, and correct the problem. If the key has been successfully archived, close the browser window.

6. Verify the key. Send a signed and encrypted email. When the email is received, open it, and check the message to see if it is signed and encrypted. There should be a security icon at the top-right corner of the message window that indicates that the message is signed and encrypted.

7. Delete the certificate. Check the encrypted email again; the mail client should not be able to decrypt the message.

8. Test whether an archived key can be recovered successfully:

   a. Open the KRA's agent services page, and click the **`Recover Keys`** link. Search for the key by the key owner, serial number, or public key. If the key has been archived successfully, the key information will be shown.

b. Click **Recover**.

c. In the form that appears, enter the base-64 encoded certificate that corresponds to the private key to recover; use the CA to get this information. If the archived key was searched for by providing the base-64 encoded certificate, then the certificate does not have to be supplied here.

d. Make sure that the **Async Recovery** checkbox is selected to allow the browser session to be closed while recovery is ongoing.

> **Note**
>
> An async recovery is teh default and recommended way to perform a key recovery. If you want to perform a synchronous key recovery, the browser window cannot be shut and the KRA cannot be stopped during the recovery process.

e. Depending on the agent scheme, a specified number of agents must authorize this key recovery. Have the agents search for the key to recover and then to approve the initiated recovery.

f. Once all the agents have authorized the recovery, the next screen requests a password to encrypt the PKCS #12 file with the certificate.

g. The next screen returns a link to download a PKCS #12 blob containing the recovered key pair. Follow the link, and save the blob to file.

9. Restore the key to the browser's database. Import the **.p12** file into the browser and mail client.

10. Open the test email. The message should be shown again.

3.6. Rewrapping Keys in a New Private Storage Key

Some private keys (mainly in older deployments) were wrapped in SHA-1, 1024-bit storage keys when they were archived in the KRA. These algorithms have become less secure as processor speeds improve and algorithms have been broken. As a security measure, it is possible to rewrap the private keys in a new, stronger storage key (SHA-256, 2048-bit keys).

3.6.1. About KRATool

Rewrapping and moving keys and key enrollment and recovery requests is done using the **KRATool** utility (known in previous versions of Red Hat Certificate System as **DRMTool**).

The **KRATool** performs two operations: it can rewrap keys with a new private key, and it can renumber attributes in the LDIF file entries for key records, including enrollment and recovery requests. At least one operation (rewrap or renumber) must be performed and both can be performed in a single invocation.

For rewrapping keys, the tool accesses the key entries in an exported LDIF file for the original KRA, unwraps the keys using the original KRA storage key, and then rewraps the keys in the new KRA's stronger storage key.

Example 3.1. Rewrapping Keys

```
KRATool -kratool_config_file "/usr/share/pki/java-tools/KRATool.cfg" -
source_ldif_file "/tmp/files/originalKRA.ldif" -target_ldif_file
"/tmp/files/newKRA.ldif" -log_file "/tmp/kratool.log" -
source_pki_security_database_path "/tmp/files/" -
source_storage_token_name "Internal Key Storage Token" -
source_storage_certificate_nickname "storageCert cert-pki-tomcat KRA"
-target_storage_certificate_file "/tmp/files/omega.cert"
```

When multiple KRA instances are being merged into a single instance, it is important to make sure that no key or request records have conflicting CNs, DNs, serial numbers, or request ID numbers. These values can be processed to append a new, larger number to the existing values.

Example 3.2. Renumbering Keys

```
KRATool -kratool_config_file "/usr/share/pki/java-tools/KRATool.cfg" -
source_ldif_file "/tmp/files/originalKRA.ldif" -target_ldif_file
"/tmp/files/newKRA.ldif" -log_file "/tmp/kratool.log" -
append_id_offset 100000000000 -source_kra_naming_context "pki-tomcat-
KRA" -target_kra_naming_context "pki-tomcat-2-KRA" -
process_requests_and_key_records_only
```

The **`KRATool`** options and its configuration file are discussed in more detail in the *Command-Line Tools Guide*.

3.6.2. Rewrapping and Merging Keys from One or More KRAs into a Single KRA

This procedure rewraps the keys stored in one or more Certificate System KRA (for example, **`pki-tomcat`** on *sourcekra.example.com*) and stores them into another Certificate System KRA (for example, **`pki-tomcat-2`** on *targetkra.example.com*). This is not the only use case; the tool can be run on the same instance as both the source and target, to rewrap existing keys, or it can be used simply to copy keys from multiple KRA instances into a single instance without rewrapping the keys at all.

Important

The storage key size and type in the **`pki-tomcat-2`** KRA must be set to 2048-bit and RSA.

1. Log in to *targetkra.example.com*.
2. Stop the **`pki-tomcat-2`** KRA.

   ```
   [root@targetkra ~]# systemctl stop pki-tomcatd@pki-tomcat-
   2.service
   ```

3. Create a data directory to store the key data that will be imported from the **pki-tomcat** KRA instance residing on *sourcekra.example.com*.

```
[root@targetkra ~]# mkdir -p /export/pki
```

4. Export the public storage certificate for the **pki-tomcat-2** KRA to a flat file in the new data directory.

```
[root@targetkra ~]# certutil -L -d /var/lib/pki/pki-tomcat-2/alias
-n "storageCert cert-pki-tomcat-2 KRA" -a >
/export/pki/targetKRA.cert
```

5. Stop the Directory Server instance for the **pki-tomcat-2** KRA, if it is on the same machine.

```
[root@newkra ~]# systemctl stop dirsrv.target
```

6. Export the configuration information for the **pki-tomcat-2** KRA.

```
[root@targetkra ~]# grep nsslapd-localuser
/etc/dirsrv/slapd-instanceName/dse.ldif nsslapd-localuser: nobody

[root@targetkra ~]# chown nobody:nobody /export/pki

[root@targetkra ~]# /usr/lib64/dirsrv/slapd-instanceName/db2ldif -
n pki-tomcat-2-KRA -a /export/pki/pki-tomcat-2.ldif
```

Important

Make sure that the LDIF file contains a single blank line at the end.

7. Log in to *sourcekra.example.com*.

8. Stop the **pki-tomcat** KRA.

```
[root@sourcekra ~]# systemctl stop pki-tomcatd@pki-tomcat.service
```

9. Create a data directory to store the key data that will be exported to the **pki-tomcat-2** KRA instance residing on *targetkra.example.com*.

```
[root@sourcekra ~]# mkdir -p /export/pki
```

10. Stop the Directory Server instance for the **pki-tomcat** KRA, if it is on the same machine.

```
[root@sourcekra ~]# systemctl stop dirsrv.target
```

11. Export the configuration information for the **pki-tomcat** KRA.

```
[root@sourcekra ~]# grep nsslapd-localuser
/etc/dirsrv/slapd-instanceName/dse.ldif nsslapd-localuser: nobody
```

```
[root@sourcekra ~]# chown nobody:nobody /export/pki

[root@sourcekra ~]# /usr/lib64/dirsrv/slapd-instanceName/db2ldif -
n pki-tomcat-KRA -a /export/pki/pki-tomcat.ldif
```

> **Important**
>
> Make sure that the LDIF file contains a single blank line at the end.

12. Copy the **pki-tomcat** KRA NSS security databases to this directory.

```
[root@sourcekra ~]# cp -p /var/lib/pki/pki-tomcat/alias/cert8.db
/export/pki

[root@sourcekra ~]# cp -p /var/lib/pki/pki-tomcat/alias/key3.db
/export/pki

[root@sourcekra ~]# cp -p /var/lib/pki/pki-tomcat/alias/secmod.db
/export/pki
```

13. Copy the file with the public storage key from the **pki-tomcat-2** KRA machine to this machine. For example:

```
[root@sourcekra ~]# cd /export/pki

[root@sourcekra ~]# sftp root@targetkra.example.com
sftp> cd /export/pki
sftp> get targetKRA.cert
sftp> quit
```

14. If necessary, edit the default **KRATool.cfg** file to use with the tool. The default file can also be used without changes.

15. Run the **KRATool**; all of these parameters should be on a single line:

```
[root@sourcekra ~]# KRATool -kratool_config_file
"/usr/share/pki/java-tools/KRATool.cfg"
        -source_ldif_file /export/pki/pki-tomcat.ldif
        -target_ldif_file /export/pki/source2targetKRA.ldif
        -log_file /export/pki/kratool.log
        -source_pki_security_database_path /export/pki
        -source_storage_token_name 'Internal Key Storage Token'
        -source_storage_certificate_nickname 'storageCert cert-
pki-tomcat KRA'
        -target_storage_certificate_file
/export/pki/targetKRA.cert
        -append_id_offset 100000000000
        -source_kra_naming_context "pki-tomcat-KRA"
        -target_kra_naming_context "pki-tomcat-2-KRA"
        -process_requests_and_key_records_only
```

Note

The command may prompt for the password to the token stored in the **pki-tomcat** KRA NSS security databases.

When it is done, the command creates the file specified in the **-target_ldif_file** parameter, **source2targetKRA.ldif**.

16. Copy this LDIF file over to the **pki-tomcat-2** KRA machine. For example:

```
[root@sourcekra ~]# scp /export/pki/source2targetKRA.ldif
root@targetkra.example.com:/export/pki
```

Important

Make sure that the LDIF file contains a single blank line at the end.

17. If multiple KRA instances are being merged, their data can be merged into a single import operation. Simply perform the same procedure for every KRA, which will be merged.

Important

Make sure to specify unique values for the **-target_ldif_file** parameter to create separate LDIF files, and to specify unique **-append_id_offset** values so that there are no conflicts when the LDIF files are concatenated.

18. On the **pki-tomcat-2** KRA machine, import the LDIF file(s) with the other key data by concatenating the **pki-tomcat-2** KRA configuration LDIF file and every exported LDIF file for the other KRA instances. For example:

```
[root@targetkra ~]# cd /export/pki
[root@targetkra ~]# cat pki-tomcat-2.ldif source2targetKRA.ldif >
combined.ldif
```

19. Import this combined LDIF file into the Directory Server database for the **pki-tomcat-2** KRA instance.

```
[root@targetkra ~]# /usr/lib64/dirsrv/slapd-instanceName/ldif2db -
n pki-tomcat-2-KRA -i /export/pki/combined.ldif
```

20. Start the Directory Server instance for the **pki-tomcat-2** KRA.

```
[root@targetkra ~]# systemctl start dirsrv.target
```

21. Start the **pki-tomcat-2** KRA.

```
[root@targetkra ~]# systemctl start pki-tomcatd@pki-tomcat-
2.service
```

[1] For synchronous key recovery, the initial browser page must stay open and it refreshes every few seconds until the key recovery is complete. If this page is closed, then the recovery request must be re-initiated.

Chapter 4. Requesting, Enrolling, and Managing Certificates

Certificates are requested and used by end users. Although certificate enrollment and renewal are operations that are not limited to administrators, understanding the enrollment and renewal processes can make it easier for administrators to manage and create appropriate certificate profiles, as described in Section 2.2, “Setting up Certificate Profiles”, and to use fitting authentication methods (described in Chapter 8, *Authentication for Enrolling Certificates*) for each certificate type.

This chapter discusses requesting, receiving, and renewing certificates for use outside Certificate System. For information on requesting and renewing Certificate System subsystem certificates, see Chapter 16, *Managing Subsystem Certificates*.

4.1. About Enrolling and Renewing Certificates

Enrollment is the process for requesting and receiving a certificate. The mechanics for the enrollment process are slightly different depending on the type of certificate, the method for generating its key pair, and the method for generating and approving the certificate itself. Whatever the specific method, certificate enrollment, at a high level, has the same basic steps:

1. A user generates a certificate request.

   There are several methods of generating a certificate request, and it depends on the type of certificate which method is best. The **certutil** command can be used to generate a certificate request for any certificate type, and then this request is submitted to the CA's end entities forms; this is most appropriate for server or device certificates. Some certificate profiles accept inputs that generate both the request and (when approved) the certificate; this is the easiest method for user certificates. Lastly, all Certificate System subsystems (CA, KRA, OCSP, TKS, and TPS) can generate certificate request for their subsystem certificates through their consoles.

2. The certificate request is submitted to the CA using its relevant end-entity web forms.

3. The request is verified by authenticating the entity which requested it and by confirming that the request meets the certificate profile rules which were used to submit it.

4. The request is approved.

5. The user retrieves the new certificate.

When the certificate reaches the end of its validity period, it can be renewed through the end user services pages. The renewal forms use the serial number or the certificate itself to identify the certificate entry in the CA databases. The renewal process then pulls up the original key, certificate request, and profile, and regenerates the certificate.

4.2. Configuring Internet Explorer to Enroll Certificates

Because of the security settings in Microsoft Windows, requesting and enrolling certificates through the end entities pages using Internet Explorer requires additional browser configuration. The browser has to be configured to trust the CA before it can access the CA's end-entities pages.

4.2.1. About Key Limits and Internet Explorer

Microsoft uses certain cryptographic providers which support only a subset of potential key sizes for RSA and for ECC keys. These are listed in Table 4.1, “Providers and Key Sizes”.

The key size support can impact the configuration of profiles that will be used with Internet Explorer. Configuring profiles is covered in Chapter 2, *Making Rules for Issuing Certificates (Certificate Profiles)*.

Table 4.1. Providers and Key Sizes

Algorithm	Provider	Supported Key Sizes
ECC	Microsoft Software Key Storage Provider	nistp256 nistp384 nistp521
ECC	Microsoft Smart Card Key Storage Provider	nistp256 nistp384 nistp521
RSA	Microsoft Base Cryptographic Provider	1024
RSA	Microsoft Strong Cryptographic Provider	1024 2048 3072 4096 8192
RSA	Enhanced Cryptographic Provider	1024 2048 3072 4096 8192
RSA	Microsoft Software Key Storage Provider	1024 2048 3072 4096 8192

4.2.2. Configuring Internet Explorer

1. Open Internet Explorer.

2. Import the CA certificate chain.

    a. Open the unsecured end services page for the CA, for example:

    ```
    http://server.example.com:8080/ca/ee/ca
    ```

    b. Click the **Retrieval** tab.

    c. Click **Import CA Certificate Chain** in the left menu, and then select **Download the CA certificate chain in binary form**.

    d. When prompted, save the CA certificate chain file.

    e. In the Internet Explorer menu, click **Tools**, and select **Internet Options**.

    f. Open the **Content** tab, and click the **Certificates** button.

    g. Click the **Import** button. In the import window, browse for and select the imported certificate chain.

       The import process prompts for which certificate store to use for the CA certificate chain. Select **Automatically select the certificate store based on the type of certificate**.

    h. Once the certificate chain is imported, open the **Trusted Root Certificate Authorities** tab to verify that the certificate chain was successfully imported.

3. Configure Internet Explorer to prompt to allow unsafe ActiveX controls to be used for scripting. If this is not allowed and an end entity attempts to enroll a certificate in the standard (non-SSL) end-entites pages, Internet Explorer will block these pages.

    a. In the Internet Explorer menu, click **Tools** and select **Internet Options**.

    b. Open the **Security** tab and click **Custom Level**.

    c. In the **ActiveX Controls and Plugins** area, change the value of the **Initialize and script ActiveX controls not marked as safe** setting to **Prompt**.

4. After the certificate chain is imported, Internet Explorer can access the secure end services pages. Open the secure site, for example:

    ```
    https://server.example.com:8443/ca/ee/ca
    ```

5. There is probably a security exception when opening the end services pages. Add the CA services site to Internet Explorer's **Trusted Sites** list.

    a. In the Internet Explorer menu, click **Tools**, and select **Internet Options**.

    b. Open the **Security** tab and click **Sites** to add the CA site to the trusted list.

    c. Set the **Security level for this zone** slider for the CA services page to **Medium**; if this security setting is too restrictive in the future, then try resetting it to **Medium-low**.

6. Close the browser.

To verify that Internet Explorer can be used for enrollments, try enrolling a user certificate as described in Section 4.3.1, “Requesting and Receiving a User or Agent Certificate through the End-Entities Page”.

4.3. Requesting and Receiving Certificates

The first step to obtain a certificate is generating the request, which is then submitted to the issuing CA. Some Certificate System profiles allow users to request a certificate right through the web services pages, and the profile generates and submits the request in a single step. For other profiles, the request must be generated separately.

Virtually, all certificate requests are processed through the end entities services for the CA, which provide the web-based profile forms, and the issued certificates are then retrieved from these pages. This section details the most common certificate enrollment processes.

4.3.1. Requesting and Receiving a User or Agent Certificate through the End-Entities Page

End entities can use the HTML enrollment forms on the Certificate Management end-entities page to create user certificates for email and SSL authentication. Other enrollment forms are available for adding certificates to tokens and signing files. For more information about the end-entities enrollment forms, see the *Certificate System Agents Guide*.

The following profiles are used to create user certificates:

- Manual User Dual-Use Certificate Enrollment
- Manual User Signing and Encryption Certificates Enrollment
- Directory-Authenticated User Dual-Use Certificate Enrollment (if directory authentication has been configured)

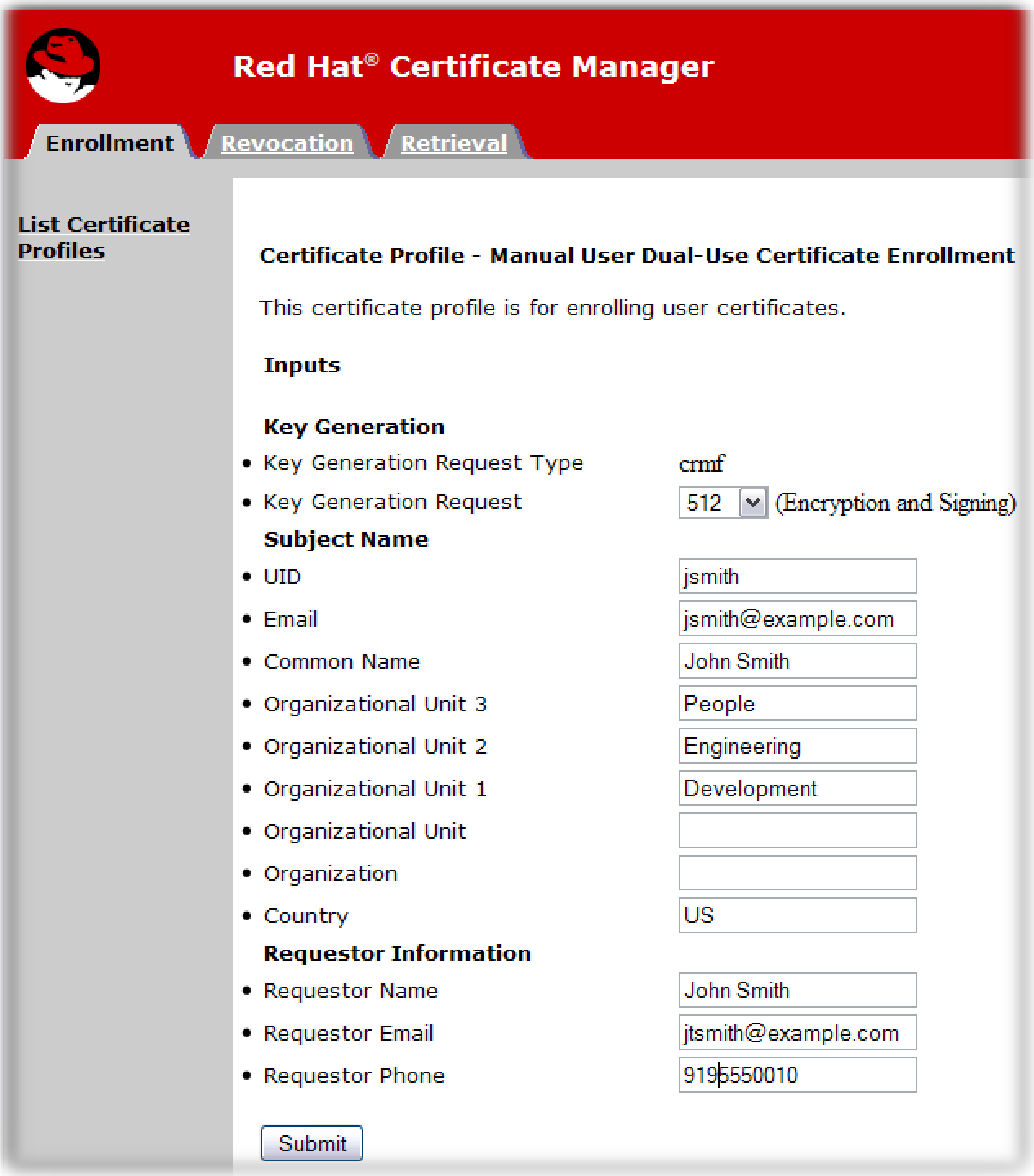
> **Note**
>
> The agent or user have to generate and submit the client request from the computer that will be used later to access the subsystem. It is important because part of the request process generates a private key on the local machine. If location independence is required, the user can also use a hardware token, such as a smart card, to store the key pair and the certificate.

1. Open the Certificate Manager's end-entities page, for example:

   ```
   https://server.example.com:8443/ca/ee/ca
   ```

2. Select the user certificate enrollment form from the list of certificate profiles.

3. Fill in the user information.



Note

The CA certificate request forms support all UTF-8 characters for the common name, organizational unit, and requester name fields. The common name and organization unit fields are included in the subject name of the certificate.

This support does not include supporting internationalized domain names.

> **Note**
>
> CRMF requests are no longer supported in Firefox 35 or later.

4. Click **Submit**.

5. The key pairs for the user certificate are generated, and the certificate request is sent to the agent queue. Alternatively, if automatic enrollment is configured, the certificate is approved (or rejected) by the CA, and the new certificate is displayed in the web browser window.

6. Once the certificate is approved and generated, the CA sends a notification that you can retrieve the certificate.

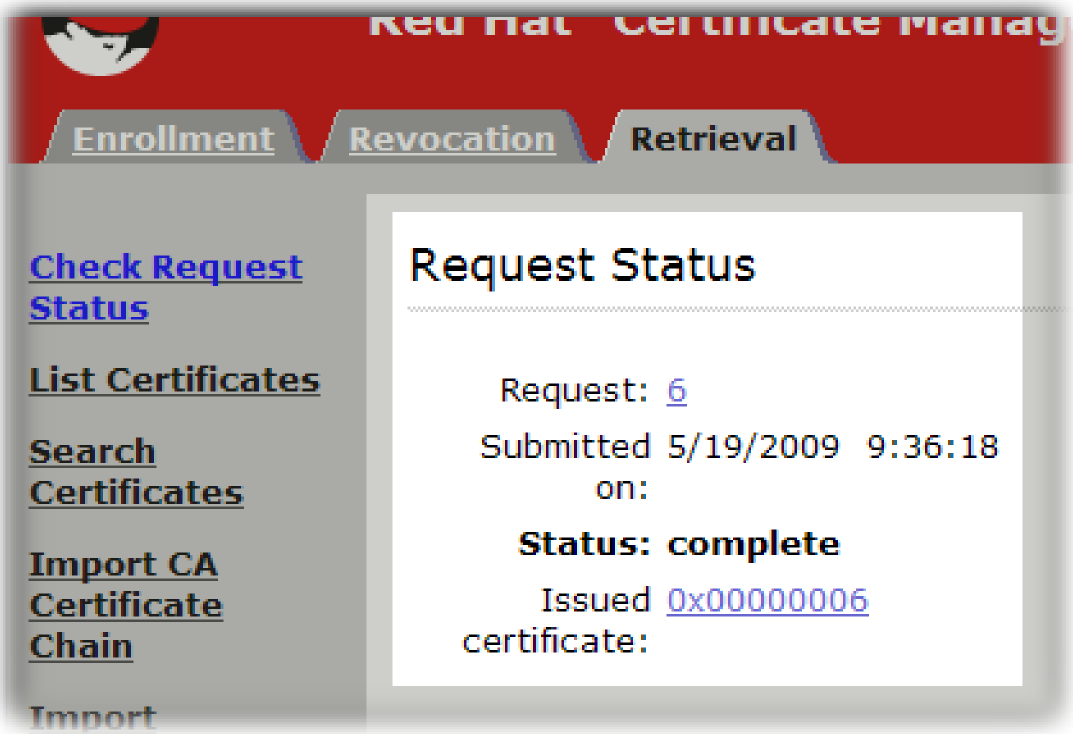
   a. Open the Certificate Manager end-entities page, for example:

   ```
   https://server.example.com:8443/ca/ee/ca
   ```

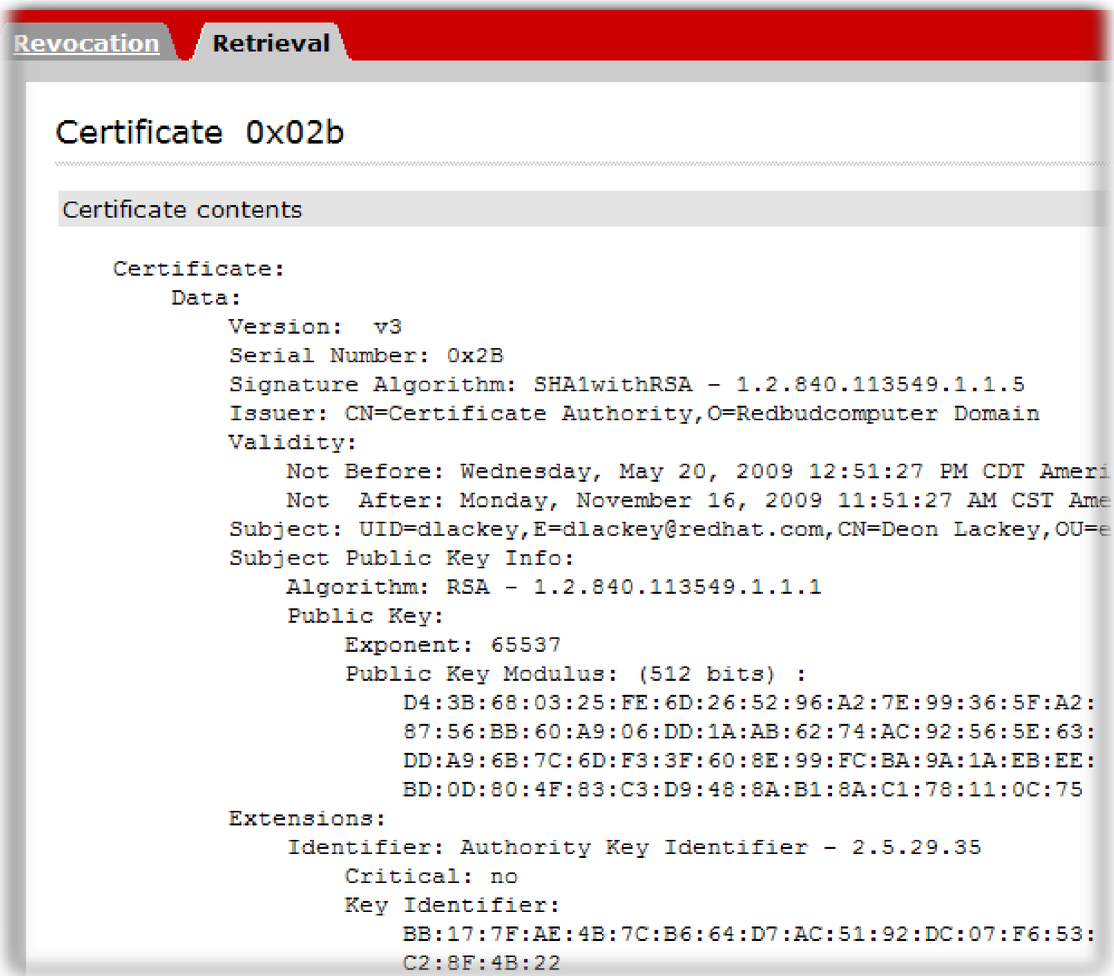
   b. Click the **Retrieval** tab.

   c. Fill in the request ID number that was created when the certificate request was submitted, and click **Submit**.

   d. The next page shows the status of the certificate request. If the status is **complete**, then there is a link to the certificate. Click the **Issued certificate** link.



   e. The new certificate information is shown in pretty-print format, in base-64 encoded format, and in PKCS #7 format.



The following actions can be taken through this page:

- To install this certificate on a server or other application, scroll down to the **Installing This Certificate in a Server** section, which contains the base-64 encoded certificate.

- If this is a client certificate that will be installed directly in the web browser, scroll down to the **Importing This Certificate** section, and click the **Import your certificate** or **Import S/MIME certificate** button.

f. Copy the base-64 encoded certificate, including the **-----BEGIN CERTIFICATE-----** and **-----END CERTIFICATE-----** marker lines, to a text file. Save the text file, and use it to store a copy of the certificate in a subsystem's internal database. See Section 14.4.2.1, “Creating Users”.

4.3.2. Requesting Certificates Using certutil

> **Note**
>
> ECC certificates cannot be *requested* using the end user pages, but ECC certificate requests can be *submitted* through those pages. Therefore, if a user wants to request an ECC certificate and the CA is ECC-enabled, then the request can be generated using the **certutil** command.

1. Change to the certificate database directory of the instance for which the certificate is being requested, for example:

   ```
   cd /var/lib/pki/instance_name/alias
   ```

2. Run the **certutil** command, defining the key settings, subject name, validity period, and extensions:

   ```
   certutil -R -k rsa -g 2048 -s "CN=example cert
   server.example.com,e=admin@example.com,O=Example Domain" -o
   request.cert -v 12 -d . -1 -7 -8
   ```

   To request an ECC certificate, use **-k ec -g 256** to set the ECC key type and length.

   The required options are listed in Table 4.2, “Options for Requesting Certificates with certutil”.

3. Ensure that the certificate request file is correct, for example:

   ```
   cat request.cert

   -----BEGIN NEW CERTIFICATE REQUEST-----
   MIICbTCCAVUCAQAwKDEQMA4GA1UEChMHRXhhbXBsZTEUMBIGA1UEAxMLZXhhbXBs
   ZSBuZXcwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQDcH3CcFbSWFYCV
   WrR1pJf8OaLLvTJB45A+grnNqCAQHnsOKO7XLuO+oLt+r1oEtM7o5eXlwZT1BZT5
   bodglwJgo/GXxElqX49EnPdwyNLiK8bMKRkKnPiIi9jkaGbiTnQLrKMO8/sGKTB+
   DGu1VIsj9a/4tt2Kt5wwhtEMIfeNZ4Alk9UCWpC8r/0I3eNzyyk4pJ9qWDzYEpV3
   TVFco/1FWo+yangv7ThSnOJprILIOpcir0vm5zPSlON6JHyJq9O94wSqnIYs/xqC
   iR4SCEx2I3y0Gaym+C78zxJfGFyALFr8LISQLKWJBZhPrUgDwv44x9KSKIkRM9wa
   l6l4eLl5AgMBAAGgADANBgkqhkiG9w0BAQUFAAOCAQEAo3+dEKvtKJlFadlNC7fH
   Ob/aiO2JYfjRFg4qZEXjAAvtl4OiJ0bqdimP5JYv5DLUpdqVZbXFPE5/2OmOCJOi
   kpBKdyBabOTPfoXQe2Nvzw5RoEwT4/vFtRm1bGTHUKQlugfdj26PnMlOWoMn9rCN
   dtEE5eDVeuyWzhj+Ik35AyVhvCXzBQRo3XjFS8Pb/VdhRL/s57eY+pwMaGIyOWgd
   dlf2nmU9e7LL6MrkkZmJeIm8YdDPwMUkK7uzPu3429CERgtkN1UnuIfniKg8rlt2
   gEm12Q6lfGYoZK8Yuaor4pSiQrMHi3xXDQqkjA/hz853wkSWpQAAtjqIzSljdLMY
   Ng==
   -----END NEW CERTIFICATE REQUEST-----
   ```

4. Submit the certificate request to the CA.

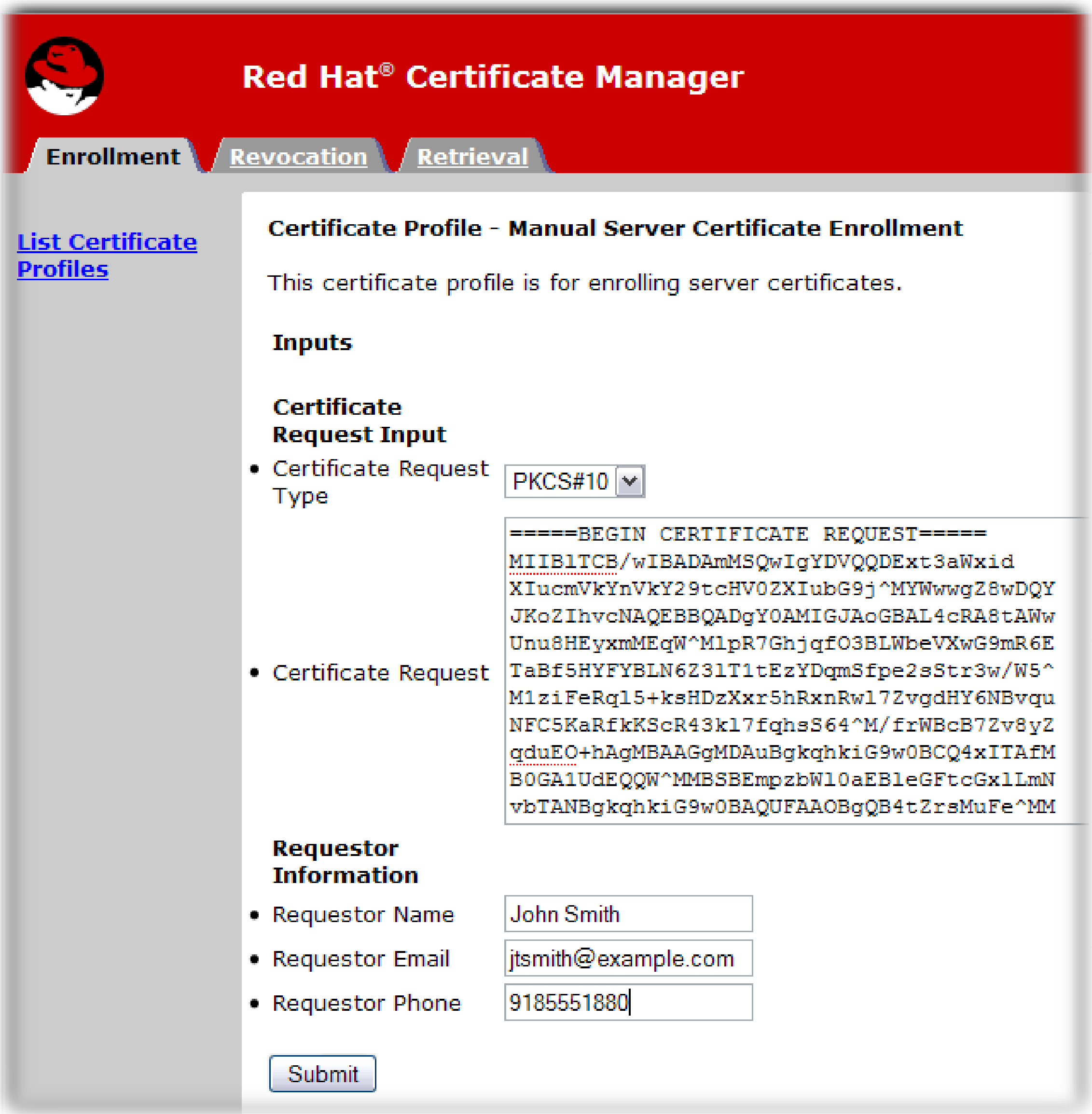
   a. Copy the certificate request, including the marker lines **-----BEGIN NEW CERTIFICATE REQUEST-----** and **-----END NEW CERTIFICATE REQUEST-----** to a text file or into the clipboard.

   b. Open the end-entity services page of the Certificate Manager, for example:

      ```
      https://server.example.com:8443/ca/ee/ca
      ```

   c. In **Certificate Profiles** of the **Enrollment** tab, click on the appropriate form to submit the request. The default profiles are listed in Section 2.2.6, “List of Certificate Profiles”.

   d. In the certificate enrollment form, enter the required information.



The standard requirements are as follows:

- **`Certificate Request Type`**. This is either PKCS#10 or CRMF. Certificate requests created through the subsystem administrative console are PKCS #10; those created through the **`certutil`** tool and other utilities are usually PKCS #10.

- **`Certificate Request`**. Paste the base-64 encoded blob, including the **`-----BEGIN NEW CERTIFICATE REQUEST-----`** and **`-----END NEW CERTIFICATE REQUEST-----`** marker lines.

- **`Requester Name`**. This is the common name of the person requesting the certificate.

- **`Requester Email`**. This is the email address of the requester. The agent or CA system will use this address to contact the requester when the certificate is issued. For example, **`jdoe@someCompany.com`**.

- **`Requester Phone`**. This is the contact phone number of the requester.

The submitted request is queued for agent approval. An agent needs to process and approve the certificate request, which the CA signs then and delivers back to the email address specified in the request. If the requester has agent access, the requester can log in as an agent and approve the request.

5. Retrieve the certificate.

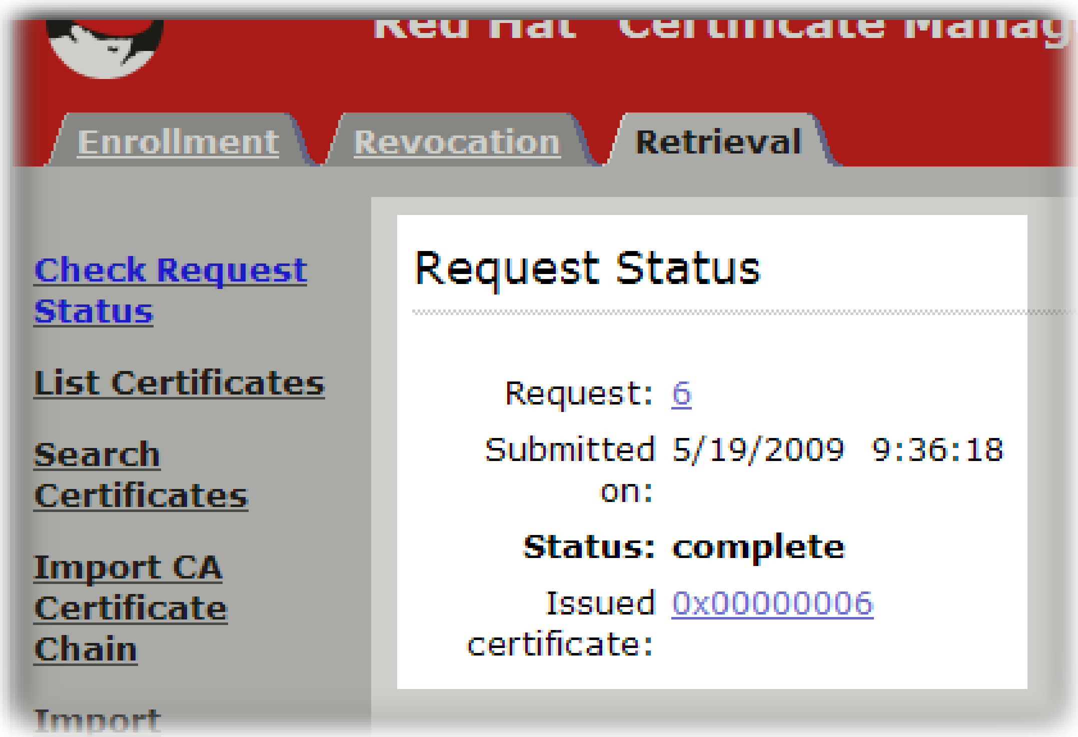
   a. Open the Certificate Manager end-entities page, for example:

   ```
   https://server.example.com:8443/ca/ee/ca
   ```

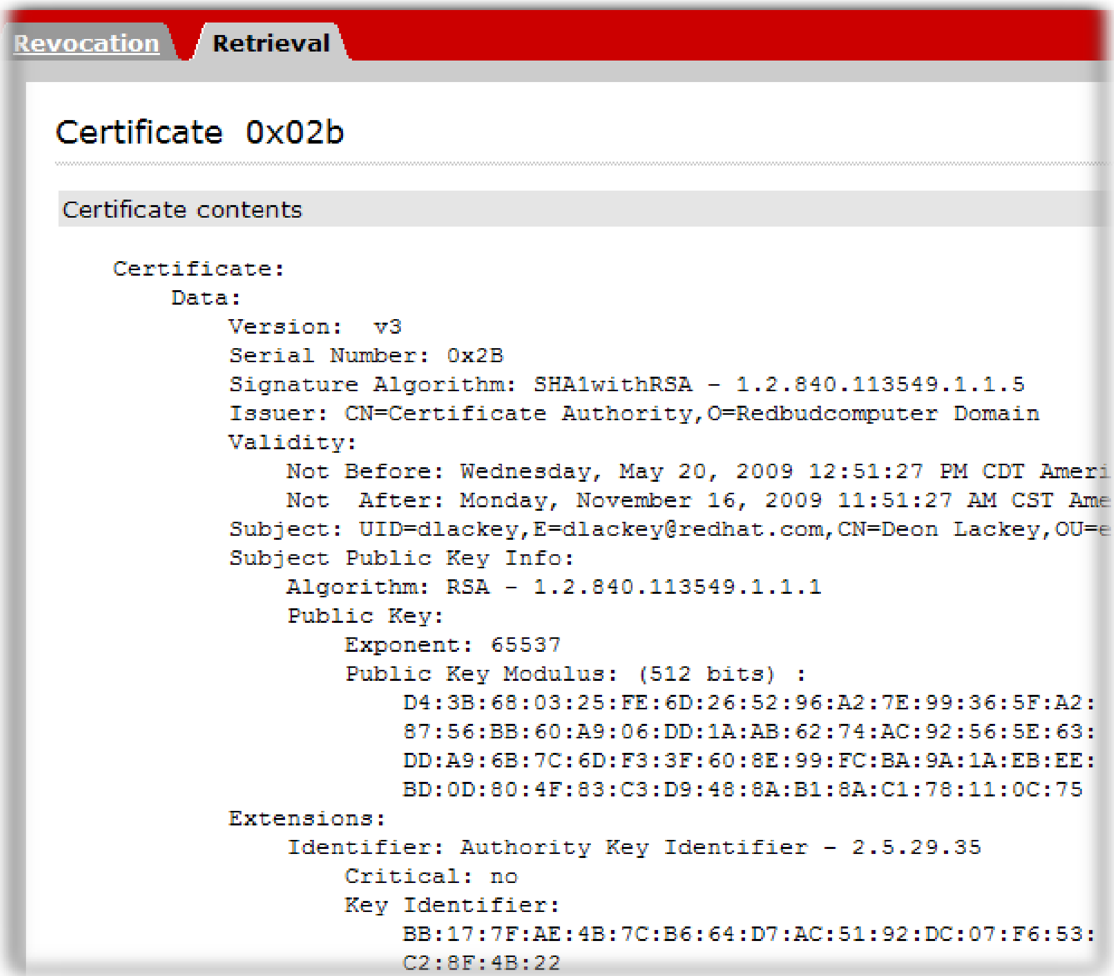
   b. Click the **Retrieval** tab.

   c. Fill in the request ID number that was created when the certificate request was submitted, and click **Submit**.

   d. The next page shows the status of the certificate request. If the status is **complete**, then there is a link to the certificate. Click the **Issued certificate** link.



   e. The new certificate information is shown in pretty-print format, in base-64 encoded format, and in PKCS #7 format.



The following actions can be taken through this page:

- To install this certificate on a server or other application, scroll down to the **`Installing This Certificate in a Server`** section, which contains the base-64 encoded certificate.

- If this is a client certificate that will be installed directly in the web browser, scroll down to the **`Importing This Certificate`** section, and click the **`Import your certificate`** or **`Import S/MIME certificate`** button.

f. Copy the base-64 encoded certificate, including the **`-----BEGIN CERTIFICATE-----`** and **`-----END CERTIFICATE-----`** marker lines, to a text file. Save the text file, and use it to store a copy of the certificate in a subsystem's internal database. See Section 14.4.2.1, “Creating Users”.

For information about using the **`certutil`** command, see http://www.mozilla.org/projects/security/pki/nss/tools/certutil.html.

Table 4.2. Options for Requesting Certificates with certutil

Option	Description
-R	The flag to generate a certificate request.
-k	The key type to use; the only native option is **rsa**. If the CA is ECC-enabled (described in the *Planning, Installation, and Deployment Guide*), then this can also be **ec**.

Option	Description
-g	The key size. The recommended size for RSA keys is 2048 and for ECC, 256.
-s	The subject name of the certificate. **Note** Certificate System supports all UTF-8 characters for the common name and organizational unit elements included in the subject name of the certificate.
-o	The output file to which to save the certificate request.
-v	The validity period, in months.
-d	Certificate database directory; this is the directory for the subsystem instance.
numbers 1-8	These set the available certificate extensions. Only eight can be specified through the **`certutil`** tool: - Key Usage: 1 - Basic Constraints: 2 - Certificate Authority Key ID: 3 - CRL Distribution Point: 4 - Netscape Certificate Type: 5 - Extended Key Usage: 6 - Email Subject Alternative Name: 7 - DNS Subject Alternative Name: 8
-a	Outputs the certificate request to an ASCII file instead of binary.

4.4. Signing Files with Certificates

Certificate System can sign files on a file system or available over through a URL; this generates a file hash and protects the file using a certificate.

The **`Agent-Authenticated File Signing`** profile is used to sign certificates. The only required input is the file location, **`URL Of File Being Signed`**. This value can be a real URL, such as **`http://server.example.com/data/myFile.txt`**, or it can be the full path to a file on the local system, such as **`file:///home/jsmith/files/myFile.txt`**.

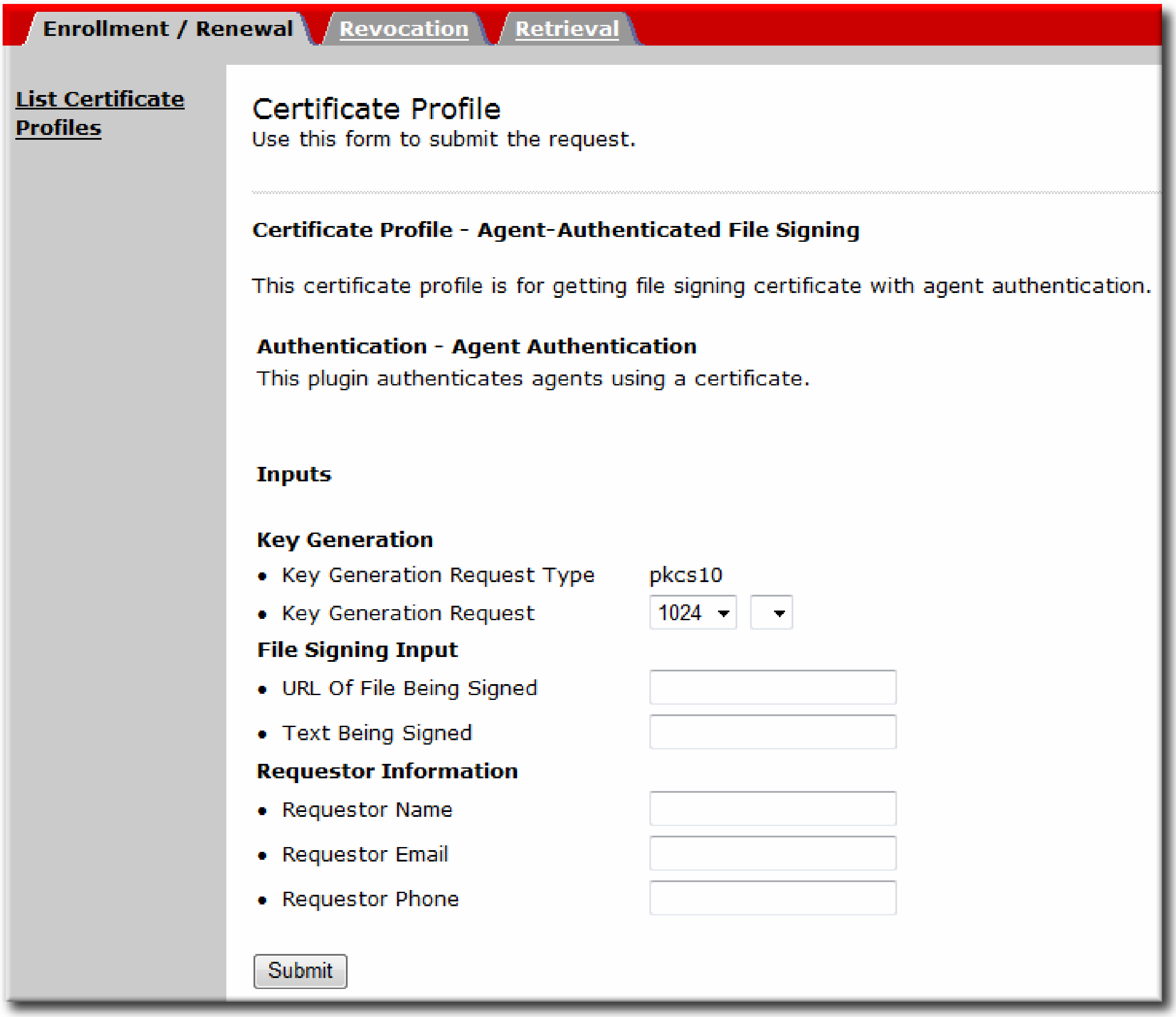


Figure 4.1. File-Signing Profile

When the file is signed, a corresponding certificate is created with a subject DN that reflects the file information:

```
Subject:CN=(Name)(Text)(Size)(DigestType)(Digest)
```

- (Name) is the optional requestor name.
- (Text) is the (optional) information given in the **`Text Being Signed`** field. The subject DN does not contain the filename or location. That information can either be stored independently or the **`Text Being Signed`** input can be used to enter descriptive information, such as the filename or a description of the file content, which can be used to identify the signed file.
- (Size) is the size of the signed file.
- (DigestType) is the algorithm used to generate the file hash.
- (Digest) is the generated hash or digest for the file.

For example:

```
Subject:CN=(Name)John Smith(Text)Signed text:
myFile.txt(Size)5833(DigestType)SHA256(Digest)79aaf14442ab811ace123d9d69
17c055636475fbd2b7d921e730fd25d9d3f760
```

The file digest can be verified by running the **sha256sum** command.

```
sha256sum /home/jsmith/files/myFile.txt
79aaf14442ab811ace123d9d6917c055636475fbd2b7d921e730fd25d9d3f760
myFile.txt
```

The file digest and all other information included in the subject name are protected by the certificate signature.

4.5. Performing Bulk Issuance

There can be instances when an administrator needs to submit and generate a large number of certificates simultaneously. A combination of tools supplied with Certificate System can be used to post a file containing certificate requests to the CA. This example procedure uses the **PKCS10Client** command to generate the requests and the **sslget** command to send the requests to the CA.

1. Since this process is scripted, multiple variables need to be set to identify the CA (host, port) and the items used for authentication (the agent certificate and certificate database and password). For example, set these variables for the session by exporting them in the terminal:

   ```
   export d=/var/tmp/testDir
   export p=password
   export f=/var/tmp/server.csr.txt
   export nick="CA agent cert"
   export cahost=1.2.3.4
   export caport=8443
   ```

> **Note**
>
> The local system must have a valid security database with an agent's certificate in it. To set up the databases:
>
> a. Export or download the agent user certificate and keys from the browser and save to a file, such as **agent.p12**.
>
> b. If necessary, create a new directory for the security databases.
>
> ```
> mkdir ${d}
> ```
>
> c. If necessary, create new security databases.
>
> ```
> certutil -N -d ${d}
> ```
>
> d. Stop the Certificate System instance.
>
> ```
> systemctl stop pki-tomcatd@instance_name.service
> ```
>
> e. Use **pk12util** to import the certificates.
>
> ```
> # pk12util -i /tmp/agent.p12 -d ${d} -W p12filepassword
> ```
>
> If the procedure is successful, the command prints the following output:
>
> ```
> pk12util: PKCS12 IMPORT SUCCESSFUL
> ```
>
> f. Start the Certificate System instance.
>
> ```
> systemctl start pki-tomcatd@instance_name.service
> ```

2. Two additional variables must be set. A variable that identify the CA profile to be used to process the requests, and a variable that is used to send a post statement to supply the information for the profile form.

```
export
post="cert_request_type=pkcs10&xmlOutput=true&profileId=caAgentSer
verCert&cert_request="
export url="/ca/ee/ca/profileSubmitSSLClient"
```

> **Note**
>
> This example submits the certificate requests to the **caAgentServerCert** profile (identified in the **profileId** element of the **post** statement. Any certificate profile can be used, including custom profiles.

3. Test the variable configuration.

```
echo ${d} ${p} ${f} ${nick} ${cahost} ${caport} ${post} ${url}
```

4. Generate the certificate requests using (for this example) **PKCS10Client**:

```
time for i in {1..10}; do /usr/bin/PKCS10Client -d ${d} -p ${p} -o
${f}.${i} -s "cn=testms${i}.example.com"; cat ${f}.${i} >> ${f};
done

perl -pi -e 's/\r\n//;s/\+/%2B/g;s/\//%2F/g' ${f}

wc -l ${f}
```

5. Check the status and the transaction logs for the CA.

```
/etc/init.d/pki-ca status

tail -f /var/log/pki-ca/transactions&
```

6. Submit the bulk certificate request file created in step 4 to the CA profile interface using **sslget**. For example:

```
cat ${f} | while read thisreq; do /usr/bin/sslget -n "${nick}" -p
${p} -d ${d} -e ${post}${thisreq} -v -r ${url}
${cahost}:${caport}; done
```

4.6. Enrolling a Certificate on a Cisco Router

Simple Certificate Enrollment Protocol (SCEP), designed by Cisco, is a way for a router to communicate a certificate issuing authority, such as a CA, to enroll certificates for the router.

Normally, a router installer enters the CA's URL and a challenge password (also called a one-time PIN) into the router and issues a command to initiate the enrollment. The router then communicates with the CA over SCEP to generate, request, and retrieve the certificate. The router can also check the status of a pending request using SCEP.

4.6.1. Enabling SCEP Enrollments

For security reasons, SCEP enrollments are disabled by default in the CA. To allow routers to be enrolled, SCEP enrollments must be manually enabled for the CA.

1. Stop the CA server, so that you can edit the configuration files.

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Open the CA's **CS.cfg** file.

```
vim /var/lib/pki/instance_name/ca/conf/CS.cfg
```

3. Set the ***ca.scep.enable*** to true. If the parameter is not present, then add a line with the parameter.

```
ca.scep.enable=true
```

4. Restart the CA server.

```
systemctl start pki-tomcatd@instance_name.service
```

4.6.2. Configuring Security Settings for SCEP

Several different parameters allow administrators to set specific security requirements for SCEP connections, such as not using the same certificate for enrollment authentication and regular certificate enrollments, or setting allowed encryption algorithms to prevent downgrading the connection strength. These parameters are listed in Table 4.3, "Configuration Parameters for SCEP Security".

Table 4.3. Configuration Parameters for SCEP Security

Parameter	Description
ca.scep.encryptionAlgorithm	Sets the default or preferred encryption algorithm.
ca.scep.allowedEncryptionAlgorithms	Sets a comma-separated list of allowed encryption algorithms.
ca.scep.hashAlgorithm	Sets the default or preferred hash algorithm.
ca.scep.allowedHashAlgorithms	Sets a comma-separated list of allowed hash algorithms.
ca.scep.nickname	Gives the nickname of the certificate to use for SCEP communication. The default is to use the CA's key pair and certificate unless this parameter is set.
ca.scep.nonceSizeLimit	Sets the maximum nonce size, in bytes, allowed for SCEP requests. The default is 16 bytes.

To set security settings for connections for SCEP enrollments:

1. Stop the CA server, so that you can edit the configuration files.

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Open the CA's **CS.cfg** file.

```
vim /var/lib/pki/instance_name/ca/conf/CS.cfg
```

3. Set the desired security parameters, as listed in Table 4.3, "Configuration Parameters for SCEP Security". If the parameter is not already present, then add it to the **CS.cfg** file.

```
ca.scep.encryptionAlgorithm=DES3
ca.scep.allowedEncryptionAlgorithms=DES3
ca.scep.hashAlgorithm=SHA1
ca.scep.allowedHashAlgorithms=SHA1,SHA256,SHA512
ca.scep.nickname=Server-Cert
ca.scep.nonceSizeLimit=20
```

4. Restart the CA server.

```
systemctl start pki-tomcatd@instance_name.service
```

4.6.3. Configuring a Router for SCEP Enrollment

> **Note**
>
> Not all versions of router IOS have the relevant crypto features. Make sure that the firmware image has the Certification Authority Interoperability feature.
> Certificate System SCEP support was tested on a Cisco 2611 router running IOS C2600 Software (C2600-JK9S-M), version 12.2(40), RELEASE SOFTWARE (fc1).

Before enrolling SCEP certificates on the router, make sure that the router is appropriately configured:

- The router must be configured with an IP address, DNS server, and routing information.
- The router's date/time must be correct.
- The router's hostname and dnsname must be configured.

See the router documentation for instructions on configuring the router hardware.

4.6.4. Generating the SCEP Certificate for a Router

The following procedure details how to generate the SCEP certificate for a router.

1. Pick a random PIN.
2. Add the PIN and the router's ID to the **flatfile.txt** file so that the router can authenticate directly against the CA. For example:

   ```
   vim /var/lib/pki/instance_name/ca/conf/flatfile.txt

   UID:172.16.24.238
   PWD:Uojs93wkfd0IS
   ```

   Be sure to insert an empty line after the **PWD** line.

   The router's IP address can be an IPv4 address or an IPv6 address.

   Using flat file authentication is described in Section 8.2.4, "Configuring Flat File Authentication".
3. Log into the router's console. For this example, the router's name is **scep**:

   ```
   scep>
   ```
4. Enable privileged commands.

   ```
   scep> enable
   ```

5. Enter configuration mode.

```
scep# conf t
```

6. Import the CA certificate for every CA in the certificate chain, starting with the root. For example, the following command sequence imports two CA certificates in the chain into the router:

```
scep(config)# crypto ca trusted-root1
scep(ca-root)# root CEP http://server.example.com:8080/ca/cgi-
bin/pkiclient.exe
scep(ca-root)# crl optional
scep(ca-root)# exit
scep(config)# cry ca authenticate 1
scep(config)# crypto ca trusted-root0
scep(ca-root)# root CEP http://server.example.com:8080/ca/cgi-
bin/pkiclient.exe
scep(ca-root)# crl optional
scep(ca-root)# exit
scep(config)# cry ca authenticate 0
```

7. Set up a CA identity, and enter the URL to access the SCEP enrollment profile. For example, for the CA:

```
scep(config)# crypto ca identity CA
scep(ca-identity)# enrollment url
http://server.example.com:8080/ca/cgi-bin
scep(ca-identity)# crl optional
```

8. Get the CA's certificate.

```
scep(config)# crypto ca authenticate CA
Certificate has the following attributes:
Fingerprint: 145E3825 31998BA7 F001EA9A B4001F57
% Do you accept this certificate? [yes/no]: yes
```

9. Generate RSA key pair.

```
scep(config)# crypto key generate rsa
The name for the keys will be: scep.server.example.com
Choose the size of the key modulus in the range of 360 to 2048 for
your
General Purpose Keys. Choosing a key modulus greater than 512 may
take
a few minutes.

How many bits in the modulus [512]:
Generating RSA keys ...
[OK]
```

10. Lastly, generate the certificate on the router.

```
scep(config)# crypto ca enroll CA
%
```

```
% Start certificate enrollment ..
% Create a challenge password. You will need to verbally provide
this
password to the CA Administrator in order to revoke your
certificate.
For security reasons your password will not be saved in the
configuration.
Please make a note of it.

Password: secret
Re-enter password: secret

% The subject name in the certificate will be:
scep.server.example.com
% Include the router serial number in the subject name? [yes/no]:
yes
% The serial number in the certificate will be: 57DE391C
% Include an IP address in the subject name? [yes/no]: yes
% Interface: Ethernet0/0
% Request certificate from CA? [yes/no]: yes
% Certificate request sent to Certificate Authority
% The certificate request fingerprint will be displayed.
% The 'show crypto ca certificate' command will also show the
fingerprint.

% Fingerprint:D89DB555 E64CC2F7 123725B4 3DBDF263

Jan 12 13:41:17.348: %CRYPTO-6-CERTRET: Certificate received from
Certificate
```

11. Close configuration mode.

```
 scep(config)# exit
```

12. To make sure that the router was properly enrolled, list all of the certificates stored on the router.

```
scep# show crypto ca certificates
Certificate
 Status: Available
 Certificate Serial Number: 0C
 Key Usage: General Purpose
 Issuer:
 CN = Certificate Authority
  O = Sfbay Red hat Domain 20070111d12
 Subject Name Contains:
 Name: scep.server.example.com
 IP Address: 10.14.1.94
 Serial Number: 57DE391C
 Validity Date:
 start date: 21:42:40 UTC Jan 12 2007
 end date: 21:49:50 UTC Dec 31 2008
 Associated Identity: CA

CA Certificate
```

```
Status: Available
Certificate Serial Number: 01
Key Usage: Signature
Issuer:
CN = Certificate Authority
 O = Sfbay Red hat Domain 20070111d12
Subject:
CN = Certificate Authority
 O = Sfbay Red hat Domain 20070111d12
Validity Date:
start date: 21:49:50 UTC Jan 11 2007
end date: 21:49:50 UTC Dec 31 2008
Associated Identity: CA
```

4.6.5. Working with Subordinate CAs

Before a router can authenticate to a CA, every CA certificate in the CA's certificate chain must be imported into the router, starting with the root. For example, the following command sequence imports two CA certificates in the chain into the router:

```
scep(config)# crypto ca trusted-root1
scep(ca-root)# root CEP http://server.example.com:8080/ca/cgi-
bin/pkiclient.exe
scep(ca-root)# crl optional
scep(ca-root)# exit
scep(config)# cry ca authenticate 1
scep(config)# crypto ca trusted-root0
scep(ca-root)# root CEP http://server.example.com:8080/ca/cgi-
bin/pkiclient.exe
scep(ca-root)# crl optional
scep(ca-root)# exit
scep(config)# cry ca authenticate 0
```

If the CA certificates do not have the CRL distribution point extension set, turn off the CRL requirement by setting it to **`optional`**:

```
scep(ca-root)# crl optional
```

After that, set up the CA identity as described in Section 4.6.4, “Generating the SCEP Certificate for a Router”.

4.6.6. Re-enrolling a Router

Before a router can be re-enrolled with new certificates, the existing configuration has to be removed.

1. Remove (zeroize) the existing keys.

   ```
   scep(config)# crypto key zeroize rsa
   % Keys to be removed are named scep.server.example.com.
   Do you really want to remove these keys? [yes/no]: yes
   ```

2. Remove the CA identity.

```
scep(config)# no crypto ca identity CA
% Removing an identity will destroy all certificates received from
the related Certificate Authority.

Are you sure you want to do this? [yes/no]: yes
% Be sure to ask the CA administrator to revoke your certificates.

No enrollment sessions are currently active.
```

4.6.7. Enabling Debugging

The router provides additional debugging during SCEP operations by enabling the debug statements.

```
scep# debug crypto pki callbacks
Crypto PKI callbacks debugging is on

scep# debug crypto pki messages
Crypto PKI Msg debugging is on

scep# debug crypto pki transactions
Crypto PKI Trans debugging is on

scep#debug crypto verbose
verbose debug output debugging is on
```

4.7. Renewing Certificates

Almost any certificate issued by Certificate System can be renewed (assuming the original issuing profile allows it). Renewing certificates rather than requesting new certificates can be one way of smoothly transitioning between subsystem certificates as they expire, and is especially useful for CA signing certificates.

Certificate System subsystem and user certificates, as well as end user certificates, can be renewed by resubmitting the original certificate request using the original keys. The renewal process can be done by accessing the end user forms or by generating a new certificate request using the old keys with the **certutil** command.

There are two methods for renewing certificates in the end users forms. Agent-approved and directory-based renewal require submitting the serial number for the certificate, and the CA draws the information from its current certificate directory entry. Certificate-based renewal uses the certificate in the browser database to regenerate the new certificate, which makes it common for user certificate renewals.

Note

Encryption and signing certificates are created in a single step. However, the renewal process only renews one certificate at a time.

To renew both certificates in a certificate pair, each one has to be renewed individually.

4.7.1. Agent-Approved or Directory-Based Renewals

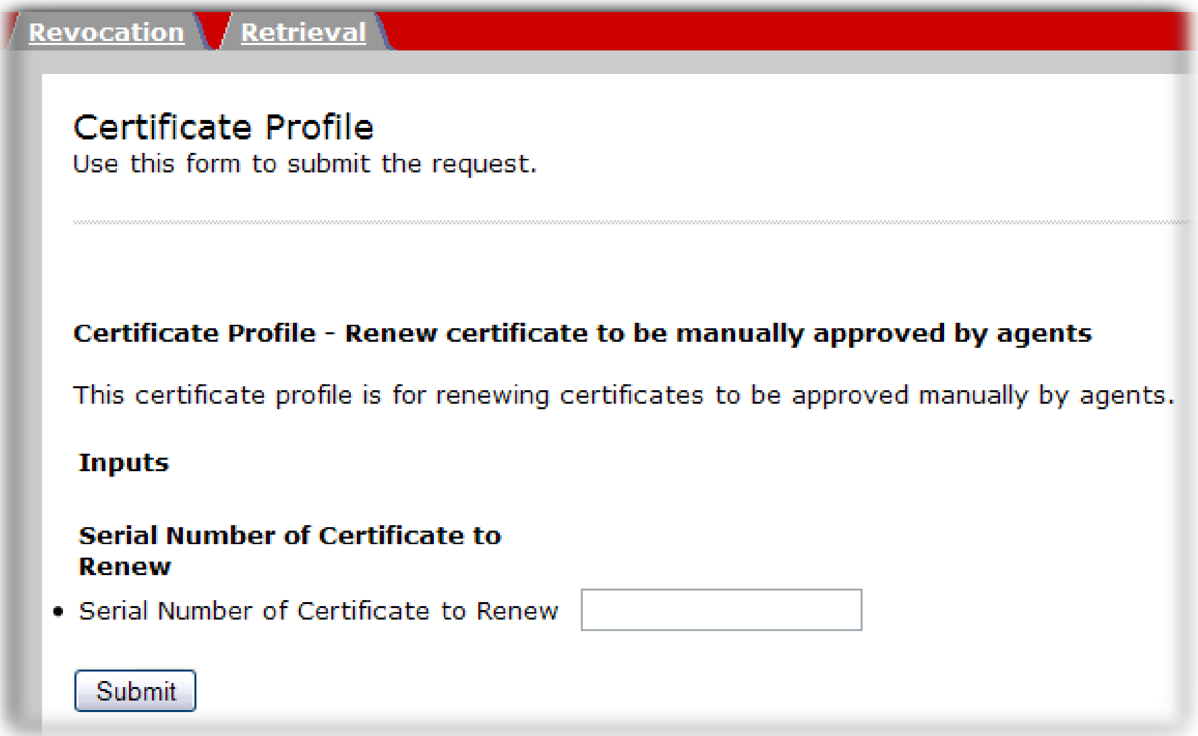
Sometimes, a certificate renewal request has to be manually approved, either by a CA agent or by your providing login information for the user directory.

1. Open the end-entities services page for the CA which issued the certificate (or its clone).

```
https://server.example.com:8443/ca/ee/ca
```

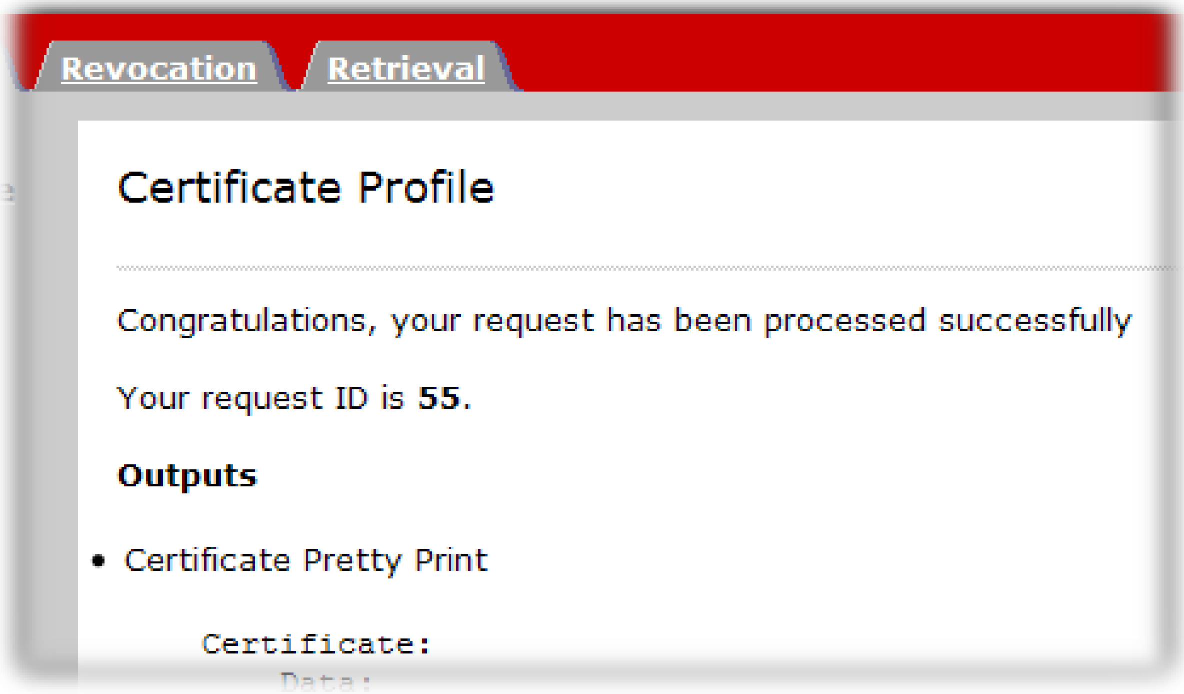
2. Click the name of the renewal form to use.

3. Enter the serial number of the certificate to renew. This can be in decimal or hexadecimal form.



4. Click the renew button.

5. The request is submitted. For directory-based renewals, the renewed certificate is automatically returned. Otherwise, the renewal request will be approved by an agent.



4.7.2. Certificate-Based Renewal

Some user certificates are stored directly in your browser, so some renewal forms will simply check your browser certificate database for a certificate to renew. If a certificate can be renewed, then the CA automatically approved and reissued it.

Important

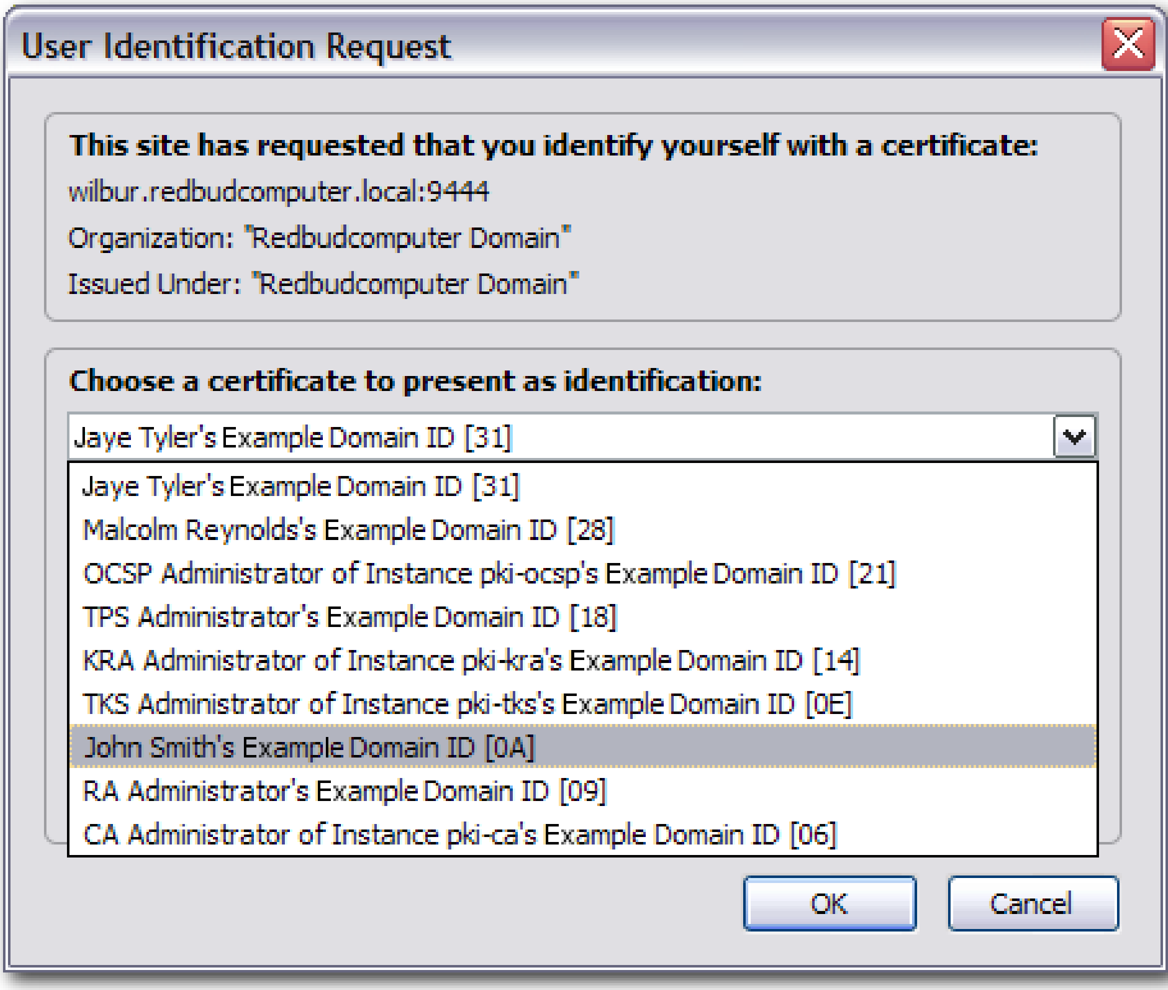
If the certificate which is being renewed has *already* expired, then it probably cannot be used for certificate-based renewal. The browser client may disallow any SSL client authentication with an expired certificate.

In that case, the certificate must be renewed using one of the other renewal methods.

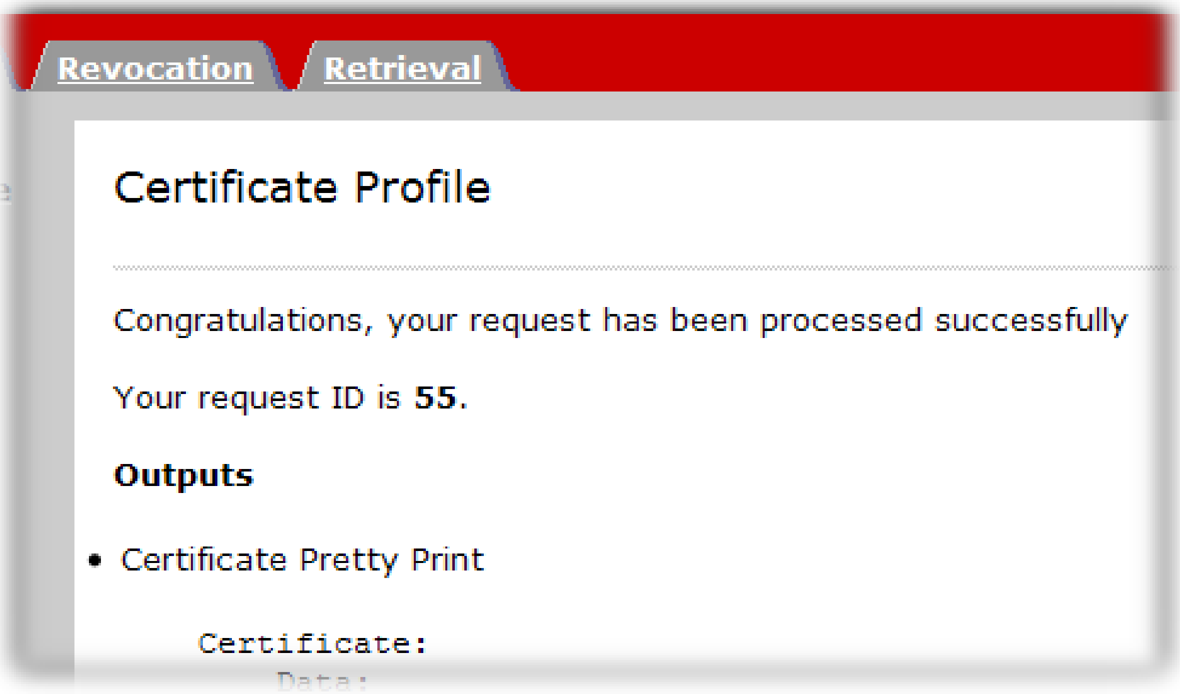
1. Open the end-entities services page for the CA which issued the certificate (or its clone).

   ```
   https://server.example.com:8443/ca/ee/ca
   ```

2. Click the name of the renewal form to use.
3. There is no input field, so click the **Renew** button.
4. When prompted, select the certificate to renew.



5. The request is submitted and the renewed certificate is automatically returned.



4.7.3. Re-keying Certificates

Re-keying a certificate resubmits the original certificate request to the original profile, but generates a new key pair.

Re-keying a certificate is done using the **certutil** command to redo the certificate request and then is submitted using the regular end-entities forms.

1. List the certificates for the instance.

```
certutil -L -d /var/lib/pki/instance_name/alias

Certificate Authority - Example Domain    CT,c,
subsystemCert cert-instance_name              u,u,u
Server-Cert cert-instance_name                u,u,u
```

2. Delete the original certificate from the database.

```
certutil -D -n "subsystemCert cert-instance_name" -d
/var/lib/pki/instance_name/alias
```

3. Generate a new key and request for the new certificate.

```
certutil -d /var/lib/pki/instance_name/alias -R -s
"CN=server.example.com,OU=pki-ca,O=Example Domain pki-ca" -o
newcert.req -h "NSS Certificate DB" -a
```

4. Submit and approve the certificate, as described in Section 4.7.1, “Agent-Approved or Directory-Based Renewals”.

Important

In the renewal form, use the same serial number as the original certificate.

5. Import the new certificate into the subsystem's certificate database.

```
certutil -A -d /var/lib/pki/instance_name/alias -n "subsystemCert
cert-instance_name" -t "u,u,u" -i /tmp/newcert.cert
```

Chapter 5. Using and Configuring the Token Management System: TPS, TKS, and Enterprise Security Client

This chapter gives an overview of using hardware security modules, also called *HSMs* or *tokens*, to generate and store Certificate System instance certificates and keys. This chapter includes installation and usage considerations for supported HSMs, describes different tasks for managing tokens, and contains other information for using hardware tokens with Certificate System.

5.1. Configuring TPS Smart Card Operation Policies

The way that the TPS is configured effects how smart card operations are handled, both coming in from the Enterprise Security Client and going between the CA and TPS, depending on the nature of the operation.

There are three operations that are performed through the TPS:

- Formatting the smart card, which can include upgrading the applet version on the smart card
- Enrolling the smart card, which includes requesting and installing certificates on the card, renewing certificates on the card, and, optionally, upgrading the applet version on the smart card
- Changing the password (PIN) on the smart card

Each of these operations is configured in the TPS instance's **`CS.cfg`** file, similar to a CA enrollment profile.

5.1.1. Configuring Format Policies

When the TPS is contacted by a smart card for a format operation, there are several different operations the TPS can perform, depending on the status of the smart card.

- Whether an empty token should be rejected or have the required applet (card format) uploaded, so it is made usable.
- Whether a smart card with an outdated applet should be upgraded and, if so, which version of applet to upload.
- Whether a smart card with outdated keys should be updated with new symmetric keys. Keys can become outdated if the TKS had a master key changeover.
- Whether to revoke the certificates associated with the token.

For example, to configure the TPS to reject a smart card without an applet, to update a smart card with new symmetric keys, and to revoke certificates associated with the smart card, the following parameters are set:

```
op.format.tokenKey.update.applet.emptyToken.enable=true
op.format.tokenKey.update.symmetricKeys.enable=true
op.format.tokenKey.revokeCert=true
```

The different format operations can be configured to happen automatically by setting the appropriate parameters in the **CS.cfg** file. The TPS can also be configured with other options, such as requiring LDAP authentication and setting which subsystem instances will process the formatting operations. The parameters are listed in Table 5.1, “Format Operation Parameters”.

Table 5.1. Format Operation Parameters

Parameter	Description
op.format.*tokenType*.update.applet.emptyToken.enable	Specifies whether TPS should upload an applet to the token when it does not have one. The valid values are **true|false**.
op.format.*tokenType*.update.applet.requiredVersion	The version of the applet to use. It should be the file name of the applet without the **.ijc** extension.
op.format.*tokenType*.update.applet.directory	The local (to the TPS) filesystem directory where the applets are located
op.format.*tokenType*.update.symmetricKeys.enable	Specifies if the key changeover feature should be enabled. The valid values are **true|false**. When enabled, TPS checks to see the key version sent by the token matches **symmetricKeys.requiredVersion**.
op.format.*tokenType*.update.symmetricKeys.requiredVersion	The required key version.
op.format.*tokenType*.revokeCert	Specifies if TPS should revoke the certificates associated with the token during this format operation. **Note** This parameter also specifies if the certificates should be revoked when performing an *enrollment* operation if **RE_ENROLL** is set to true in the enrollment policy, meaning that renewals are *not* allowed. The default is **true**. The valid values are **true|false**.
op.format.*tokenType*.ca.conn	The CA connection to use.
op.format.*tokenType*.loginRequest.enable	Specifies if the login request should be sent to the client. This parameter enables authentication. The valid values are **true|false**.
op.format.*tokenType*.tks.conn	The TKS connection to use.
op.format.*tokenType*.auth.id	The LDAP authentication instance to use. The default value is **ldap1**.
op.format.*tokenType*.auth.enable	Specifies whether to authenticate the user information. The valid values are **true|false**.

Parameter	Description
op.format.*tokenType*.issuerinfo.enable	Specifies whether the Phone Home information for the Enterprise Security Client is written to the token. The valid values are **true|false**.
op.format.*tokenType*.issuerinfo.value	Sets the Phone Home URL; this is the URL for the TPS which the Enterprise Security Client will contact for token operations; this value is set on the token when it is formatted. For example, **https://tps.example.com:8443/tps/phoneHome**.

5.1.2. Configuring TPS Enrollment Policies

Enrollment covers nearly every step of managing certificates on the token, from issuing them to recovering them if they are lost to revoking them.

Most enrollment parameters occur in pairs, one for signing certificates and one for encryption certificates. The processes for both can be slightly different, as in the case of recovery, even for the same certificate pair. For example:

```
op.enroll.userKey.keyGen.encryption.ca.profileId=caTokenUserEncryptionKe
yEnrollment
op.enroll.userKey.keyGen.signing.ca.profileId=caTokenUserSigningKeyEnrol
lment
```

Each token type, such as **userKey** for regular users, has its own **op.enroll** profile definition.

Each enrollment profile definition has two parts for managing keys: how to generate new keys for the enrollment type and how to recover lost keys for the enrollment type. The profile also defines the CA to connection to, the CA profile to use, the LDAP instance to authenticate to, and whether to perform key archival. For example:

```
... LDAP authentication connection ...
 op.enroll.userKey.auth.enable=true
 op.enroll.userKey.auth.id=ldap2

... card issuer information ...
 op.enroll.userKey.cardmgr_instance=A0000000030000
 op.enroll.userKey.issuerinfo.enable=true
 op.enroll.userKey.issuerinfo.value=https://tps.example.com:8443/tps/pho
neHome
... CA connection and profile ...
 op.enroll.userKey.keyGen.encryption.ca.conn=ca1
 op.enroll.userKey.keyGen.encryption.ca.profileId=caTokenUserEncryptionK
eyEnrollment
 op.enroll.userKey.keyGen.encryption.certAttrId=c2
 op.enroll.userKey.keyGen.encryption.certId=C2

... key generation information ...
 op.enroll.userKey.keyGen.encryption.cuid_label=$cuid$
 op.enroll.userKey.keyGen.encryption.keySize=1024
 op.enroll.userKey.keyGen.encryption.keyUsage=0
```

```
 op.enroll.userKey.keyGen.encryption.keyUser=0
 op.enroll.userKey.keyGen.encryption.label=encryption key for $userid$
 op.enroll.userKey.keyGen.encryption.overwrite=true

... recovering lost tokens ...
 op.enroll.userKey.keyGen.encryption.recovery.destroyed.revokeCert=false
 op.enroll.userKey.keyGen.encryption.recovery.destroyed.revokeCert.reaso
n=0
 op.enroll.userKey.keyGen.encryption.recovery.destroyed.scheme=RecoverLa
st
 op.enroll.userKey.keyGen.encryption.recovery.keyCompromise.revokeCert=t
rue
 op.enroll.userKey.keyGen.encryption.recovery.keyCompromise.revokeCert.r
eason=1
 op.enroll.userKey.keyGen.encryption.recovery.keyCompromise.scheme=Gener
ateNewKey
 op.enroll.userKey.keyGen.encryption.recovery.onHold.revokeCert=true
 op.enroll.userKey.keyGen.encryption.recovery.onHold.revokeCert.reason=6
 op.enroll.userKey.keyGen.encryption.recovery.onHold.scheme=GenerateNewK
ey
 op.enroll.userKey.keyGen.encryption.revokeCert=true

... key archival information ...
 op.enroll.userKey.keyGen.encryption.serverKeygen.archive=true
 op.enroll.userKey.keyGen.encryption.serverKeygen.kra.conn=kra1
 op.enroll.userKey.keyGen.encryption.serverKeygen.enable=true

... PKCS #11 parameters for keys ...
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.decrypt=true
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.derive=false
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.encrypt=fals
e
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.private=true
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.sensitive=tr
ue
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.sign=false
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.signRecover=
false
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.token=true
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.unwrap=true
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.verify=false
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.verifyRecove
r=false
op.enroll.userKey.keyGen.encryption.private.keyCapabilities.wrap=false
op.enroll.userKey.keyGen.encryption.privateKeyAttrId=k4
op.enroll.userKey.keyGen.encryption.privateKeyNumber=4
```

Note

There are a number of other parameters which are used by the TPS and are included in the configuration which are never to be altered from the default. For creating new enrollment operation profiles, simply copy these parameters from an existing profile. The list of verboten parameters is in Table 5.3, "Important Enrollment Parameters That Should Never Be Edited".

Table 5.2. Enrollment Operation Parameters

Parameter	Description
op.enroll.*tokenType*.temporaryToken.tokenType	The *tokenType* to use for temporary tokens. *tokenType* typically refers to the profile defining how many certificates should be generated, how keys should be recovered, and what format should be used.
op.enroll.*tokenType*.keyGen.recovery.destroyed.keyType.num	Specifies number of **keyTypes**. The default value is **2**.
op.enroll.*tokenType*.keyGen.recovery.destroyed.keyType.value.#	Specifies **keyType**. The valid values are **signing|encryption**.
op.enroll.*tokenType*.keyGen.signing.recovery.destroyed.scheme	Specifies the signing certificate recovery scheme for destroyed tokens. The default value is **GenerateNewKey**. The other possible values are **RecoverLast** and **GenerateNewKeyAndRecoverLast** (which generates a new signing key and recovers the last encryption key).
op.enroll.*tokenType*.keyGen.signing.recovery.destroyed.revokeCert	Sets whether signing certificates should be revoked. The valid values are **true|false**. The default value is true.
op.enroll.*tokenType*.keyGen.signing.recovery.destroyed.revokeCert.reason	Sets what the signing certificate revocation reason should be. The default value is **0**. The valid values are as follows: • 0 - Unspecified. • 1 - Key compromised. • 2 - CA key compromised. • 3 - Affiliation changed. • 4 - Certificate superseded. • 5 - Cessation of operation. • 6 - Certificate is on hold.
op.enroll.*tokenType*.keyGen.encryption.recovery.destroyed.scheme	Specifies the encryption certificate recovery scheme for destroyed tokens. The default value is **RecoverLast**. The other possible values are **GenerateNewKey** and **GenerateNewKeyAndRecoverLast** (which generates a new signing key and recovers the last encryption key).
op.enroll.*tokenType*.keyGen.encryption.recovery.destroyed.revokeCert	Specifies if the encryption certificate should be revoked. The valid values are **true|false**. The default value is **true**.
op.enroll.*tokenType*.keyGen.encryption.recovery.destroyed.revokeCert.reason	

Parameter	Description
op.enroll.*tokenType*.keyGen.encryption.recovery.destroyed.revokeCert.reason	Specifies what the encryption certificate revocation reason should be. The default value is **0**. The valid values are as follows: » 0 - Unspecified. » 1 - Key compromised. » 2 - CA key compromised. » 3 - Affiliation changed. » 4 - Certificate superseded. » 5 - Cessation of operation. » 6 - Certificate is on hold.
op.enroll.*tokenType*.keyGen.recovery.keyCompromise.keyType.num	The number of key types for recovery for the tokens whose keys are compromised.
op.enroll.*tokenType*.keyGen.recovery.keyCompromise.keyType.value.#	Specifies **keyType**. The default values are **signing|encryption**.
op.enroll.*tokenType*.keyGen.signing.recovery.keyCompromise.scheme	Specifies the signing certificate recovery scheme for tokens whose keys are compromised. The default value is **GenerateNewKey**. The other possible values are **RecoverLast** and **GenerateNewKeyAndRecoverLast** (which generates a new signing key and recovers the last encryption key).
op.enroll.*tokenType*.keyGen.signing.recovery.keyCompromise.revokeCert	Specifies if the signing certificate should be revoked if the original token's key has been comprised. The valid values are **true|false**.
op.enroll.*tokenType*.keyGen.signing.recovery.keyCompromise.revokeCert.reason	Specifies what the signing certificate revocation reason should be. The default value is **0**. The valid values are as follows: » 0 - Unspecified. » 1 - Key compromised. » 2 - CA key compromised. » 3 - Affiliation changed. » 4 - Certificate superseded. » 5 - Cessation of operation. » 6 - Certificate is on hold.
op.enroll.*tokenType*.keyGen.encryption.recovery.keyCompromise.scheme	Specifies encryption certificate recovery scheme for tokens whose key is compromised. The valid values include **GenerateNewKey**, **RecoverLast**, and **GenerateNewKeyAndRecoverLast** (which generates a new signing key and recovers the last encryption key).
op.enroll.*tokenType*.keyGen.encryption.recovery.keyCompromise.revokeCert	Specifies if the encryption certificate should be revoked if the token's key has been comprised. The valid values are **true|false**.

Parameter	Description
op.enroll.*tokenType*.keyGen.encryption.recovery.keyCompromise.revokeCert.reason	Specifies what the signing certificate revocation reason should be. The default value is **0**. The valid values are as follows: • 0 - Unspecified. • 1 - Key compromised. • 2 - CA key compromised. • 3 - Affiliation changed. • 4 - Certificate superseded. • 5 - Cessation of operation. • 6 - Certificate is on hold.
op.enroll.*tokenType*.keyGen.recovery.onHold.keyType.num	The number of key types for the tokens to put on hold for temporary loss reasons. The valid values are integers. The default is **2**.
op.enroll.*tokenType*.keyGen.recovery.onHold.keyType.value.#	Specifies **keyType**. The default values are **signing|encryption**.
op.enroll.*tokenType*.keyGen.signing.recovery.onHold.scheme	The recovery scheme for signing certificates for tokens that are to be put on hold. The valid values are **GenerateNewKey**, **RecoverLast**, and **GenerateNewKeyAndRecoverLast** (which generates a new signing key and recovers the last encryption key).
op.enroll.*tokenType*.keyGen.signing.recovery.onHold.revokeCert	Specifies if the signing certificate should be revoked if the token's key has been comprised. This setting is also checked after a signing certificate which was on hold is recovered. If this value is true, meaning that the certificate was revoked when the token went on hold, then the certificate is unrevoked. A new signing key is still generated. The valid values are **true|false**.
op.enroll.*tokenType*.keyGen.signing.recovery.onHold.revokeCert.reason	Specifies what the signing certificate revocation reason should be. The default value is **0**. The valid values are as follows: • 0 - Unspecified. • 1 - Key compromised. • 2 - CA key compromised. • 3 - Affiliation changed. • 4 - Certificate superseded. • 5 - Cessation of operation. • 6 - Certificate is on hold.

Parameter	Description
op.enroll.*tokenType*.keyGen.encryption.recovery.onHold.scheme	The recovery scheme for encryption certificates for tokens that are to be put on hold. The valid values are **GenerateNewKey**, **RecoverLast**, and **GenerateNewKeyAndRecoverLast** (which generates a new signing key and recovers the last encryption key).
op.enroll.*tokenType*.keyGen.encryption.recovery.onHold.revokeCert	Specifies if the encryption certificate should be revoked if the token's key has been comprised. This setting is also checked after an encryption certificate which was on hold is recovered. If this value is true, meaning that the certificate was revoked when the token went on hold, then the certificate is unrevoked. The valid values are **true|false**.
op.enroll.*tokenType*.keyGen.encryption.recovery.onHold.revokeCert.reason	Specifies what the signing certificate revocation reason should be. The default value is **0**. The valid values are as follows: » 0 - Unspecified. » 1 - Key compromised. » 2 - CA key compromised. » 3 - Affiliation changed. » 4 - Certificate superseded. » 5 - Cessation of operation. » 6 - Certificate is on hold.
op.enroll.*tokenType*.keyGen.tokenName	The name of the token to use. The TPS can substitute some special strings. For example, if using **cuid**, the **tokenName** is substituted with the CUID of the token; if using **uid**, the **tokenName** is substituted with the UID of the authenticating user.
op.enroll.*tokenType*.keyGen.keyType.num	The number of keys/certificates to be generated for the profile. The values are integers. The default is **2**.
op.enroll.*tokenType*.keyGen.keyType.value.#	Specifies **keyType**. The default values are **signing|encryption**.
op.enroll.*tokenType*.keyGen.signing.keySize	Specifies the key size to use for key generation. The recommended setting is **2048**.
op.enroll.*tokenType*.keyGen.signing.label	The token label for the signing certificate. The valid values are **$pretty_cuid$**, **$cuid$**, **msn**, **$userid$**, and **$profileId$**. These variables are replaced by the user-supplied information when the certificate is generated.
op.enroll.*tokenType*.keyGen.signing.cuid_label	The CUID to show in the certificate.

Parameter	Description
op.enroll.*tokenType*.keyGen.signing.overwrite	Specifies if the TPS should overwrite the existing signing certificate. The valid values are **true|false**.
op.enroll.*tokenType*.keyGen.signing.ca.profileId	The CA profile that should be used for creating the signing certificate. The default is **caTokenUserSigningKeyEnrollment**.
op.enroll.*tokenType*.keyGen.signing.ca.conn	The CA connection to use. The default value is **ca1**.
op.enroll.*tokenType*.keyGen.encryption.keySize	The key size for the encryption key. The recommended setting is **2048**.
op.enroll.*tokenType*.keyGen.encryption.label	The token label for the encryption certificate. The valid values are **$pretty_cuid$**, **$cuid$**, **msn**, **$userid$**, and **$profileId$**. These variables are replaced by the user-supplied information when the certificate is generated.
op.enroll.*tokenType*.keyGen.encryption.cuid_label	The CUID to show in the certificate.
op.enroll.*tokenType*.keyGen.encryption.overwrite	Specifies if the encryption certificate on the token should be overwritten. The valid values are **true|false**.
op.enroll.*tokenType*.keyGen.encryption.ca.profileId	The CA profile to use for enrolling encryption certificates. The default value is **caTokenUserEncryptionKeyEnrollment**.
op.enroll.*tokenType*.keyGen.encryption.ca.conn	The CA connection to use to generate encryption certs. The default value is **ca1**.
op.enroll.*tokenType*.update.applet.emptyToken.enable	Specifies whether TPS should upload an applet to the token when it does not have one. The valid values are **true|false**.
op.enroll.*tokenType*.update.applet.enable	Specifies if applet upgrade is turned on. The valid values are **true|false**.
op.enroll.*tokenType*.update.applet.requiredVersion	The version of the applet to use. It should be the file name of the applet without the **.ijc** extension.
op.enroll.*tokenType*.update.applet.directory	The local filesystem directory where the applets are located.
op.enroll.*tokenType*.update.symmetricKeys.enable	Specifies if the key changeover feature should be enabled. The valid values are **true|false**. When enabled, TPS checks to see the key version sent by the token matches **symmetricKeys.requiredVersion**.
op.enroll.*tokenType*.update.symmetricKeys.requiredVersion	The required key version.
op.enroll.*tokenType*.loginRequest.enable	Specifies if the login request should be sent to the token. This parameter enables authentication. The valid values are **true|false**.
op.enroll.*tokenType*.pinReset.enable	Specifies if the token's PIN should be reset. The default value is **true**. The valid values are **true|false**.

Parameter	Description
op.enroll.*tokenType*.pinReset.pin.minLen	The minimum number of characters for the PIN.
op.enroll.*tokenType*.pinReset.pin.maxRetries	The maximum number of times PIN authentication can be attempted on the token before the key is locked. This value is set on the token when the token is formatted.
op.enroll.*tokenType*.pinReset.pin.maxLen	The maximum number of characters for the PIN.
op.enroll.*tokenType*.tks.conn	The TKS connection to use.
op.enroll.*tokenType*.auth.id	The LDAP authentication instance to use. The default value is **ldap1**.
op.enroll.*tokenType*.auth.enable	Specifies whether to authenticate the user information. The valid values are **true|false**.

There are some parameters in the **CS.cfg** file that are set to configure signing and encryption enrollment operations which should never be altered.

Table 5.3. Important Enrollment Parameters That Should Never Be Edited

Parameter	Description
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.decrypt	Specifies whether the key (public or private) is to be used to decrypt information. The valid values are **true|false**. For private encryption keys, this is true.
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.derive	Specifies whether the key is used to derive a master key. The valid values are **true|false**. For both signing and encryption keys (public and private), this is false.
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.encrypt	Specifies whether the key (public or private) is to be used to encrypt information. The valid values are **true|false**. For *public encryption* keys, this is true.
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.private	Specifies whether the key is a private key. The valid values are **true|false**.
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.sensitive	Specifies whether the key is sensitive (meaning, private) material. The valid values are **true|false**. For private keys, this is true.
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.sign	Specifies whether this is a signing key. The valid values are **true|false**. For *private signing* keys, this is true.
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.signRecover	
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.token	Specifies whether the key will be used on a token. The valid values are **true|false**.

Parameter	Description
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.unwrap	Specifies whether the key will be used to unwrap (decrypt) information. The valid values are **`true|false`**. For *private encryption* keys, this is true.
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.verify	
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.verifyRecover	
op.enroll.*tokenType*.keyGen.*keyType*.private|public.keyCapabilities.wrap	Specifies whether the key will be used to wrap (encrypt) information. The valid values are **`true|false`**. For *public encryption* keys, this is true.
op.enroll.*tokenType*.keyGen.*keyType*.privateKeyAttrId op.enroll.*tokenType*.keyGen.*keyType*.publicKeyAttrId	Gives a unique identifier for the public or the private key. There is a close relationship between the **`certAttrId`** value and the **`privateKeyAttrId`** and **`publicKeyAttrId`**. The first key is always 2 * C and the second key is always 2 * C + 1. For example, if the operation has a value of **`c1`**, then one key has a value of **k2** and the next of **k3**. **Warning** The public and private key values cannot collide. It is also critical that the mathematical relationship between the certificate and key AttrIds be maintained. Do not alter the default values.
op.enroll.*tokenType*.keyGen.*keyType*.privateKeyNumber op.enroll.*tokenType*.keyGen.*keyType*.publicKeyNumber	Gives the number of the key attribute, without the **k** prefix.
op.enroll.*tokenType*.pkcs11obj.compress.enable=true	
op.enroll.*tokenType*.pkcs11obj.enable=true	

5.1.3. Configuring TPS Renewal Operations

Renewal operations regenerate the certificates on a token, using existing key pairs to recreate the certificates. This means that the renewal profile mirrors the enrollment configuration that relates directly to generating the certificate. Other aspects of the enrollment operations — such as recovering a lost token — are still managed through the enrollment configuration.

As with enrollment parameters, the renewal parameters occur in pairs, one for signing certificates and one for encryption certificates.

Each token type, such as **userKey** for regular users, has its own **op.renewal** profile definition.

Table 5.4. Renewal Operation Parameters

Parameter	Description
op.renewal.*tokenType*.keyType.num	The number of keys/certificates that are generated for the profile. The values are integers. The default is **2**.
op.renewal.*tokenType*.keyType.value.#	Specifies the key type. The default values are **signing|encryption**.
op.renewal.*tokenType*.signing.enable	Sets whether the signing certificate renewal profile is enabled.
op.renewal.*tokenType*.signing.certAttrId	Identifies which key on the token is used for the signing certificate.
op.renewal.*tokenType*.signing.certId	Identifies which key on the token is used for the signing certificate.
op.renewal.*tokenType*.signing.ca.profileId	The CA profile that should be used for renewing the signing certificate. The default is **caTokenUserSigningKeyRenewal**.
op.renewal.*tokenType*.signing.ca.conn	The CA connection to use. The default value is **ca1**.
op.renewal.*tokenType*.encryption.enable	Sets whether the encryption certificate renewal profile is enabled.
op.renewal.*tokenType*.encryption.certAttrId	Identifies which key on the token is used for the encryption certificate.
op.renewal.*tokenType*.encryption.certId	Identifies which key on the token is used for the encryption certificate.
op.renewal.*tokenType*.encryption.ca.profileId	The CA profile to use for renewing encryption certificates. The default value is **caTokenUserEncryptionKeyRenewal**.
op.renewal.*tokenType*.encryption.ca.conn	The CA connection to use to generate encryption certs. The default value is **ca1**.

5.1.4. Configuring the PIN Reset Policies

The PIN is the password which protects the certificates and keys on the smart card. The TPS can place two restrictions on the PIN: the maximum length and the minimum length. For example, to require PINs to be between 6 and 12 characters, the following parameters are set:

```
op.pinReset.userKey.pinReset.pin.maxLen=12
op.pinReset.userKey.pinReset.pin.minLen=6
```

Like the formatting operation, the TPS can be configured to update the symmetric key, require LDAP authentication, and set which subsystem instances will process the operation. The **CS.cfg** file parameters for resetting the PIN are listed in Table 5.5, “PIN Reset Operation Parameters”.

The parameters which should never be modified are listed in Table 5.6, "PIN Reset Operation Parameters That Should Never Be Edited".

Note

PIN reset operations cannot logically follow an applet upgrade operation, because the upgrade process removes any previous settings, including the PIN. Therefore, the applet upgrade parameters for the PIN reset operation should be false. For example:

```
op.pinReset.userKey.update.applet.directory=/usr/share/pki/tps/appl
ets
op.pinReset.userKey.update.applet.emptyToken.enable=false
op.pinReset.userKey.update.applet.enable=false
op.pinReset.userKey.update.applet.encryption=true
op.pinReset.userKey.update.applet.requiredVersion=1.4.499dc06c
```

Table 5.5. PIN Reset Operation Parameters

Parameter	Description
op.pinReset.*tokenType*.update.symmetricKeys.enable	Specifies if the key changeover feature should be enabled. The valid values are **true|false**. When enabled, TPS checks to see the key version sent by the token matches **symmetricKeys.requiredVersion**.
op.pinReset.*tokenType*.update.symmetricKeys.requiredVersion	The required key version.
op.pinReset.*tokenType*.loginRequest.enable	Specifies if the login request should be sent to the token. This parameter enables authentication. The valid values are **true|false**.
op.pinReset.*tokenType*.pinReset.pin.minLen	The minimum number of characters for the PIN.
op.pinReset.*tokenType*.pinReset.pin.maxRetries	The maximum number of times PIN authentication can be attempted on the token before the key is locked. This value is set on the token when the PIN is set or reset.
op.pinReset.*tokenType*.pinReset.pin.maxLen	The maximum number of characters for the PIN.
op.pinReset.*tokenType*.tks.conn	The TKS connection to use.
op.pinReset.*tokenType*.auth.id	The LDAP authentication instance to use. The default value is **ldap1**.
op.pinReset.*tokenType*.auth.enable	Specifies whether to authenticate the user information. The valid values are **true|false**.

Table 5.6. PIN Reset Operation Parameters That Should Never Be Edited

op.pinReset.*tokenType*.update.applet.emptyToken.enable

op.pinReset.*tokenType*.update.applet.enable
op.pinReset.*tokenType*.update.applet.requiredVersion
op.pinReset.*tokenType*.update.applet.directory

5.1.5. Configuring the Applet Update Policies

The TPS communicates with an applet on the smart card. The smart cards can be manufactured with both a card manager applet and a vendor applet or with only the card manager applet. If the cards only have the card manager applet, the TPS can install the Certificate System applet onto the smart card. Similarly, an old applet can be replaced with a new applet. Any keys or certificates created or managed with the old applet are destroyed.

> **Note**
>
> The CoolKey applets available for use are shipped with the TPS system.

To upgrade the applet in the TPS, put the new applet in the applet directory, and set the **update.applet.enable** parameter in the **CS.cfg** file to **true**. For example, to update the applet when enrolling a smart card of the type **userKey**, the parameters would be the following:

```
op.enroll.userKey.update.applet.enable=true
op.enroll.userKey.update.applet.emptyToken.enable=false
op.enroll.userKey.update.applet.requiredVersion=1.3.44724DDE
op.enroll.userKey.update.applet.directory=/usr/share/pki/tps/applets
op.enroll.userKey.update.applet.encryption=true
```

If a smart card only has the card manager, then the card manager capability must be enabled by editing the following parameter:

```
op.operation.key_type.update.applet.emptyToken.enable=true
```

> **Note**
>
> If the filename set in the **update.applet.requiredVersion** parameter contains *any* alphabetic characters, then all of these alphabetic characters must always be uppercase letters; this applies to the actual name of the file, as well as the **update.applet.requiredVersion** parameter.

The TPS queries the applet version on the smart card before trying to execute any operations.

If the update feature is enabled and the applet version from the client is different from the one specified by the **update.applet.requiredVersion** parameter, the TPS updates the applet automatically.

> **Note**
>
> The TPS audit log shows whether the applet update worked successfully.

The parameters to enable upgrading the applets are set in the TPS operation configurations. The parameters for upgrading the applet during a formatting operation are in Table 5.1, “Format Operation Parameters”; the parameters for upgrading the applet when resetting the PIN are listed in Table 5.5, “PIN Reset Operation Parameters”; and the parameters for upgrading the applet during an enrollment operation are in Table 5.2, “Enrollment Operation Parameters”.

5.1.6. Editing TPS Policies in the TPS UI

The TPS policies are configured as operation-based profiles. While each policy is configured in the **CS.cfg** file, each operation policy can also be edited in the TPS administrative web UI. The configuration is exactly the same in the TPS UI and the **CS.cfg** file, but the UI shows the changelog before saving changes and provides a layer of validation before accepting changes.

> **Note**
>
> Every configuration change performed through the TPS web UI is automatically recorded to the TPS audit logs. For change tracking, it is very useful to make configuration changes only in the TPS admin UI.

5.2. Mapping Token Types and Policies to Specified Smart Cards

The TPS can be configured to use specific token profiles to format a new smart card, based on some attribute of the smart card, such as its answer-to-reset (ATR) message or a range of serial numbers for the smart cards.

This is useful to manage multiple types of smart card profiles in a single deployment to determine and assign the smart card profile automatically based on physical distribution of those cards, rather than some software process change.

There are three steps to configuring type-specific formatting operations:

1. Configure the type-specific TPS profile, as in Section 5.1, “Configuring TPS Smart Card Operation Policies”.

2. Configure the type-specific authentication profile, as in Section 5.11.3, “Configuring or Disabling LDAP Authentication”.

3. Configure the mapping filter and target, as in Section 5.2.2, “Mapping Token Types to Smart Card Operation Policies”.

5.2.1. Default Token Types

There are several default token types already configured for smart card operations, as listed in Table 5.7, “Default Token Types”. There are several profiles available for regular users, and devices.

Table 5.7. Default Token Types

Token Type	Description
cleanToken	For operations for any blank token, without any other applied token types.
tokenKey	For operations for generating keys for uses with servers or devices.
userKey	For operations for regular user tokens.
userKeyTemporary	For operations for temporary user tokens.

5.2.2. Mapping Token Types to Smart Card Operation Policies

Each type of operation contains a parameter **mapping.**#. containing mapping IDs.

Note

If the **mapping.**#. parameter contains more than one mapping ID, then each mapping ID is processed in sequential order until a target is determined or an error is returned. If the **mapping.**#. parameter is missing, then the code returns an error.

Each mapping ID references a series of parameters called *filters*. Each filter may contain a specific value for the request to be tested against. Empty or missing filters act as a wildcard and allow the request to contain any value and are thus inherently true. If the request passes all filters, then the specified target token profile is used.

The filter is then mapped to a target profile or token type. Any token which initiates a format operation which matches that filter is automatically formatted according to the specific token type format profile.

For example:

```
... this maps CUIDs 1 through 100 to exampleKey ...
op.format.mapping.0.filter.appletMajorVersion=
op.format.mapping.0.filter.appletMinorVersion=
op.format.mapping.0.filter.tokenATR=
op.format.mapping.0.filter.tokenCUID.end=1
op.format.mapping.0.filter.tokenCUID.start=100
op.format.mapping.0.filter.tokenType=exampleKey
op.format.mapping.0.target.tokenType=exampleKey

... this matches every token ...
op.format.mapping.6.filter.appletMajorVersion=
op.format.mapping.6.filter.appletMinorVersion=
op.format.mapping.6.filter.tokenATR=
op.format.mapping.6.filter.tokenCUID.end=
op.format.mapping.6.filter.tokenCUID.start=
op.format.mapping.6.target.tokenType=tokenKey

op.format.mapping.order=0,1,2,3,4,5,6
```

Blank attributes match every token.

The configuration file parameters used to set up mapping and filters are in Table 5.8, “Mapping and Filters”.

Table 5.8. Mapping and Filters

Parameter	Description
op.*operation* [a].mapping.order	The order of the mappings. The format is *n,n,n*. For example, **0,1,2**. These mapping IDs must be defined in **op.Operation.mapping.**# parameters, where # is one of the mapping IDs specified in the order.
op.*operation*.mapping.# [b].filter.tokenType	The filter based on the **tokenType** sent by the Enterprise Security Client. This is the expected **tokenType** that TPS will receive from the Enterprise Security Client. For example, **userKey**. The target **tokenType** will be matched if the **tokenType** sent by the Enterprise Security Client also matches.
op.*operation*.mapping.#.filter.tokenATR	The filter based on the ATR sent by the Enterprise Security Client. This is the expected ATR that the TPS will receive from the Enterprise Security Client. For example, **1234**. The target **tokenType** will be matched if the ATR of the token and the ATR mentioned here matches.
op.*operation*.mapping.#.filter.tokenCUID.start	The filter based on the CUID range. The target **tokenType** will be matched if the CUID falls within the start-end range.
op.*operation*.mapping.#.filter.tokenCUID.end	The filter based on the CUID range. The target **tokenType** will be matched if the CUID falls within the start-end range.
op.*operation*.mapping.#.filter.appletMajorVersion	The filter based on the applet version. This filter can be empty or an applet major version specified by the client. If both the major and minor versions are both zero, this indicates there is no applet on the token.
op.*operation*.mapping.#.filter.appletMinorVersion	The filter based on the minor applet version. For an applet file named **1.3.423FFAZ.ijc**, **3** is the minor version. The target **tokenType** will be matched if the applet's minor version sent by the Enterprise Security Client matches this parameter.
op.*operation*.mapping.#.target.tokenType	Set this parameter to the **tokenType** to select for this mapping. For example, **userKey**.

[a] *operation* can be enroll, PIN reset, or format.
[b] # is an integer.

5.2.3. Mapping Token Types and TPS Policies in the TPS UI

The policy and smart card mappings can be configured, by default, in the TPS admin UI. The configuration is exactly the same in the TPS UI and the **CS.cfg** file, but the UI shows the changelog before saving changes and provides a layer of validation before accepting changes.

> **Note**
>
> Every configuration change performed through the TPS web UI is automatically recorded to the TPS audit logs. For change tracking, it is very useful to make configuration changes only in the TPS admin UI.

5.2.4. Example: Token Mapping with Two Different Token Types

The process for a format operation is as follows:

1. The user inserts the token. The token is recognized by its CUID in the Enterprise Security Client.
2. The user selects the token and clicks **Format**.
3. The Enterprise Security Client prompts for LDAP authentication.
4. The format operation completes.

When the token is selected in the Enterprise Security Client, the Enterprise Security Client sends in the applet version, CUID, ATR, and other information about the token to the TPS server — including the type of token [2] in the extension **tokenType=***name*. TPS server checks the **op.format.mapping..** section in the **CS.cfg** file and figures out which **tokenType** to use for the token, in this example either **devKey** or **qaKey**. It then uses the appropriate **op.format...** section to perform LDAP authentication to the appropriate server and to the corresponding TKS for generating session keys.

Example 5.1. Mapping Tokens to Different Profiles

An administrator needs to configure two different sets of tokens distinguished by their CUID ranges. These sets have the following settings:

- The development team has 100 tokens and the token set CUIDs from 1000-0000-0000-0000 to 1000-0000-0000-0100.
- The QA team that has 100 tokens and the token set CUIDs from 2000-0000-0000-0000 to 2000-0000-0000-0100.
- The development team uses the LDAP server ldap-dev, and the QA team uses the LDAP server ldap-qa for authentication.

Configuring the format operation in the TPS involves the following changes to the TPS configuration file, **CS.cfg**.

```
######################################################################
####
# Create two mappings
```

```
######################################################################
####
op.format.mapping.0.filter.tokenCUID.start=1000000000000000
op.format.mapping.0.filter.tokenCUID.end=1000000000000100
######################################################################
####
op.format.mapping.1.filter.tokenCUID.start=2000000000000000
op.format.mapping.1.filter.tokenCUID.end=2000000000001000
######################################################################
####
# Profile for DevKey
######################################################################
####
op.format.devKey.update.applet.emptyToken.enable=true
op.format.devKey.update.applet.requiredVersion=1.3.427BDDB8
op.format.devKey.update.applet.directory=/usr/share/pki/tps/applets
op.format.devKey.update.applet.encryption=true
op.format.devKey.update.symmetricKeys.enable=false
op.format.devKey.update.symmetricKeys.requiredVersion=1
op.format.devKey.revokeCert=true
op.format.devKey.ca.conn=ca1
op.format.devKey.loginRequest.enable=true
op.format.devKey.tks.conn=tks1
op.format.devKey.auth.id=ldap-dev
op.format.devKey.auth.enable=true
######################################################################
####
# Profile for QAKey
######################################################################
####
op.format.qaKey.update.applet.emptyToken.enable=true
op.format.qaKey.update.applet.requiredVersion=1.3.427BDDB8
op.format.qaKey.update.applet.directory=/usr/share/tps/applets
op.format.qaKey.update.applet.encryption=true
op.format.qaKey.update.symmetricKeys.enable=false
op.format.qaKey.update.symmetricKeys.requiredVersion=1
op.format.qaKey.revokeCert=true
op.format.qaKey.ca.conn=ca1
op.format.qaKey.loginRequest.enable=true
op.format.qaKey.tks.conn=tks1
op.format.qaKey.auth.id=ldap-qa
op.format.qaKey.auth.enable=true
######################################################################
####
# LDAP Connection settings for devKey
######################################################################
####
auth.instance.0.type=LDAP_Authentication
auth.instance.0.libraryName=/usr/lib/libldapauth.so
auth.instance.0.libraryFactory=GetAuthentication
auth.instance.0.authId=ldap-dev
auth.instance.0.hostport=ldap-dev.example.com:1111
auth.instance.0.SSLOn=false
auth.instance.0.retries=1
auth.instance.0.retryConnect=3
auth.instance.0.baseDN=o=dev
```

```
auth.instance.0.ui.title.en=LDAP Authentication
auth.instance.0.ui.description.en=This authenticates user against the
DEV
   LDAP directory.
auth.instance.0.ui.id.UID.name.en=LDAP User ID
auth.instance.0.ui.id.PASSWORD.name.en=LDAP Password
auth.instance.0.ui.id.UID.description.en=DEV LDAP User ID
auth.instance.0.ui.id.PASSWORD.description.en=DEV LDAP Password
######################################################################
####
 # LDAP Connection settings for qaKey
######################################################################
####
auth.instance.1.type=LDAP_Authentication
auth.instance.1.libraryName=/usr/lib/libldapauth.so
auth.instance.1.libraryFactory=GetAuthentication
auth.instance.1.authId=ldap-qa
auth.instance.1.hostport=ldap-qa.example.com:2222
auth.instance.1.SSLOn=false
auth.instance.1.retries=1
auth.instance.1.retryConnect=3
auth.instance.1.baseDN=o=qa
auth.instance.1.ui.title.en=LDAP Authentication
auth.instance.1.ui.description.en=This authenticates user against the
QA
   LDAP directory.
auth.instance.1.ui.id.UID.name.en=LDAP User ID
auth.instance.1.ui.id.PASSWORD.name.en=LDAP Password
auth.instance.1.ui.id.UID.description.en=QA LDAP User ID
auth.instance.1.ui.id.PASSWORD.description.en=QA LDAP Password
######################################################################
####
```

- The two format operation profiles are **devKey** and **qaKey**.
- The two mapping order 0 refers to the **devKey** and 1 refers to the **qaKey**.
- The two authentication instances 0 and 1 correspond to **ldap-dev** and **ldap-qa**, respectively.

5.3. Creating Custom User Token Profiles

An organization may have different types of users who will all be enrolling tokens against the same TPS backend. There are default user types already defined and mapped for the TPS (Section 5.2.1, “Default Token Types”), but, realistically, an organization may need to define its own user types and create an Enterprise Security Client UI that automatically plugs those users into the correct token profile.

1. Create the token profiles in the TPS's **CS.cfg** file, as described in Section 5.1, “Configuring TPS Smart Card Operation Policies”.
2. Create the Phone Home CGI file to be used by the profile. The *Phone Home* URL is a value set either directly on the token or in the profile which points the specific smart card to the TPS instance which will process its token operations. When creating a new user type, it should have its own Phone Home pages.

Create the directory within the TPS's CGI directory for the new custom user pages.

```
mkdir /var/lib/pki/instance_name/ts/conf/phoneHome.xml
```

Create the **index.cgi** file. For example:

```
<ServiceInfo>
<IssuerName>FedoraProject</IssuerName>
<Services>
<Operation>http://localhost.localdomain:8080/tps/tps</Operation>
<UI></UI>
<EnrolledTokenBrowserURL>http://fedoraproject.org</EnrolledTokenBr
owserURL>
<EnrolledTokenURL></EnrolledTokenURL>
<TokenType>userKey</TokenType>
</Services>
</ServiceInfo>
```

Note

The external enrollment UI is currently not supported.

5.4. Allowing Token Renewal

There are two default policies to allow encryption and signing certificates to be renewed on a token. Whether a token can be renewed depends on whether the user policy for the token allows it to be renewed.

Setting the token policy is a TPS agent task and is described in the *Certificate System Agents Guide*.

Note

A token cannot be renewed if the CA which issued its certificates has been retired. In that case, token certificates need to be re-keyed, rather than renewed. The concept of re-keying as a method of renewal is covered in Section 4.7.3, “Re-keying Certificates”.

To enable re-keying, change the profile policy to **RE_ENROLL=YES**.

5.5. Changing the Token Policy

A token policy sets rules on what the user can do after the token is enrolled, such as whether the user can reset the password or reuse the token.

There are three supported token policies:

- **RE_ENROLL**, which allows a user to re-enroll certificates with the same token.

- **PIN_RESET**, which allows the token user to initiate a PIN reset operation.
- **RENEW**, which allows a user to regenerate their existing certificates using the original keys and an extended validity period.
- **FORCE_FORMAT**, which causes every enrollment operation to prompt a format operation. This is a last-step option to allow tokens to be reset without a user having to return it to an administrator.

> **Important**
>
> If this policy is set, then this should be the only token policy configured. This takes precedence over any other policy.

The token policy settings are configured through the TPS agent services page, as described in the *Certificate System Agents Guide*. The way to edit the token policy for a specific token is to select it from the list of tokens in the **Agent Operations** tab.

To edit a token's policy in the UI, select **Main Menu** → **Tokens**. From a list of tokens, select one by clicking it. This will show a token editing field. Go to upper right and click **Edit**. Fill in a field called **Policy**.

The supported token policies accept values of either **YES** or **NO**. To set two policies, separate them with a semi-colon. For example:

```
RE_ENROLL=NO;PIN_RESET=YES

RENEW=NO;PIN_RESET=NO
```

If both **RE_ENROLL** and **RENEW** are set to **YES**, then the renewal setting takes precedence, the token certificates are renewed when they expire.

The default values for all three parameters can be set in the TPS's **CS.cfg** file in the **tokendb.defaultPolicy** parameter. For example:

```
tokendb.defaultPolicy=RE_ENROLL=YES
```

> **Note**
>
> If the **PIN_RESET** policy is not set, then user-initiated PIN resets are allowed by default. If the policy is present and is changed from **NO** to **YES**, then a PIN reset can be initiated by the user once; after the PIN is reset, the policy value automatically changes back to **NO**.

5.6. Defining Specific Certificates to Add or Recover on a Token

When a token is enrolled, the TPS automatically generates a certain number of new certificates — commonly identity, signing, and encryption certificates — which are stored on the token. The generated certificates are defined in the token profile.

There can be circumstances where *existing* certificates should be added to a token as part of an enrollment operation. For example, a user may use the same identity certificate but requires different encryption certificates for different job functions. In that case, predefined certificates can be set on a user entry in the authentication database, and then those existing certificates are added to the token along with whatever new certificates are generated.

> **Note**
>
> This is also called *token recovery* because the process of adding an existing certificate to a token is essentially a certificate recovery process.

This method of adding or restoring certificates on a token bypasses the normal TPS token profiles used in the enrollment process and instead goes by the attributes in the user entry alone. This means that the TPS uses an *external registration server* to process the enrollment requests.

The certificate is associated with a user by being added to the user entry. It is associated with a token in one of three ways:

- Based on the user ID of the user. This is the simplest, because it simply matches the logged-in user in the Enterprise Security Client to the LDAP UID in the authentication database.
- Based on the token CUID value rather than the user ID. In this case, a token enrollment is only allowed if the CUID matches the value in the user entry. This could allow different user IDs to be used at each enrollment but enforces that it can only be enrolled on a specified token. This is useful when multiple users will have a shared certificate.
- Based on the subject DN and subject alternate name patterns. This identifies *two* distinct users, one which is authorized to use the certificates of the other. This is a *delegated* registration. This is most commonly used when there is an executive or manager which needs to delegate some activities to a subordinate, such as reading emails or editing files.

> **Note**
>
> If encryption keys will be recovered to the token, then it is required that a KRA be installed and configured to work with the TPS so that the keys can also be recovered.

5.6.1. Example Recovery Profiles and Planning New Profiles

For most environments, it will be necessary to create a new profile to define the enrollment process to recover tokens. Creating a new profile is covered in Section 5.3, “Creating Custom User Token Profiles”. There are several major decisions to be made when creating the recovery profile.

The authentication instance

A single authentication LDAP database is used globally to search for users for the token recovery. The authID value of the authentication instance is specified in the ***externalReg.authId*** parameter.

The authentication LDAP database entry itself defines what attributes, within the user entry, to use when recovering a certificate. There are three LDAP attributes available for user entries:

- ***certsToAdd***, which lists the certificates to add in the format *ca_connection_id,cert_serial_#,kra_connection_id,key_#*. This is a multi-valued attribute. This (or an equivalent attribute) is set in the ***auth.instance.3.externalReg.certs.recoverAttributeName*** parameter.
- ***tokenCUID***, for the CUID of the user's token. This (or an equivalent attribute) is set in the ***auth.instance.3.externalReg.cuidAttributeName*** parameter.
- ***tokenype***, for the profile associated with the user entry. This (or an equivalent attribute) is set in the ***auth.instance.3.externalReg.tokenTypeAttributeName*** parameter.

Last, there is a list of LDAP attributes which will be used to construct a subject DN and subject alternative name for delegated token recovery. Each listed attribute can be used as a variable in the DN or SubjectAltName value, in the form **$auth.***LDAP_attr***$**. The attributes are defined in a comma-separated list in the ***auth.instance.#.attributes*** parameter. Some additional LDAP attributes are available for the delegation configuration, including ***edipi*** and ***exec-edipi*** (which use the electronic data interchange personal identifier of the CAC card for the user) and ***pcc*** and ***exec-pcc*** (which use the personal category code for the user, a common designation in government organizations).

For example:

```
auth.instance.2.authId=ldap3
auth.instance.2.externalReg.tokenTypeAttributeName=tokenType
auth.instance.2.externalReg.cuidAttributeName=tokenCUID
auth.instance.2.externalReg.certs.recoverAttributeName=certsToAdd
...
auth.instance.2.attributes=mail,cn,uid,tokenCUID,tokenType,sn,givenname,
edipi,pcc,exec-edipi,exec-pcc,exec-mail,certsToAdd
```

The default token type

Each user entry can have a special profile associated with it to process token recoveries, meaning different types of certificates can be recovered and newly-generated for different users. A global default can be specified to be used in case the ***tokenType*** attribute is missing from the user entry. This default does not need to be a special recovery profile; a standard profile such as **userKey** will generate identity, signing, and encryption certificates, and additional certificates can simply be added to the token.

What certificates to generate

All profiles have a block of ***.keyGen.*** parameters which define what keys are generated. If a key type is listed, that key is created new. If it is not, then no key of that type is created. There are three types of keys: ***keyGen.authentication*** for identity keys, ***keyGen.signing*** for signing keys, and ***keyGen.encryption*** for encryption keys. Any combination of keys can be generated. If no ***.keyGen.*** parameters are given, then only existing certificates are added to the token, and no new keys or certificates are generated.

Format operations

There is a parameter which sets whether an LDAP login is required to perform a format operation. By default, this is disabled, so no login is required to format a token. If this is set to true, it means that a token type is not set in the user entry.

Delegating certificates

Delegation gives one user the encryption certificate of another user. This is a powerful configuration and, thus, is disabled by default. This must be explicitly enabled.

> **Important**
>
> For data security, it is strongly recommended that delegates only be given an encryption certificate and never a signing certificate. An encryption certificate essentially grants read access to encrypted materials, which can be a necessary function. However, a signing certificate would allow the delegate to *impersonate* the executive, which breaks the integrity of the PKI system. This should be avoided.

There are three example profiles provided.

Example 5.2. Only Recover Certificates: externalRegAddToToken

The simplest profile matches the token to the LDAP entry for the logged-in user and adds any specified certificates to the token. Since no ***.keyGen.*** parameters are given, no new certificates are generated.

All of the information required to recover certificates is specified in the global configuration and the LDAP attributes on the entry. The only information given in this profile is the authID of the authenticaiton database and a parameter to enable the external registration process, essentially echoing the global configuration.

```
op.enroll.externalRegAddToToken.auth.enable=true
op.enroll.externalRegAddToToken.auth.id=ldap3
```

There may be additional parameters to define PIN reset or format operations.

Example 5.3. Delegating Certificates: delegateIEtoken and delegateISEtoken

There are two profiles to delegate an encryption certificate to another user. One also generates a new identity certificate and encryption certificate for the delegate user, while the other generates all new identity, encryption, and signing certificates.

These profiles are very similar (one has a ***keyGen.signing*** section). There are several critical configuration requirements for a delegation profile:

- The newly-generated identity certificate requires that the subject DN contains information for the delegate user (the one who owns the token), and then it must have a subject alternative name that contains the other principal name (UPN) of the executive user.

- The newly-generated signing certificate requires that the subject DN contains information for the delegate user (the one who owns the token), and then it must have a subject alternative name that contains the RFC 822 name of the executive (in other words, the executive's email address).
- The encryption certificate must be recovered, meaning it is an exact copy of the executive's existing encryption certificate.
- Every ***.keyGen.*** section must reference a CA profile to use to create the key. For delegation tokens, this is either ***caTokenUserDelegateAuthKeyEnrollment*** for the authentication key or ***caTokenUserDelegateSigningKeyEnrollment*** for the signing key.

For example:

```
op.enroll.delegateISEtoken.auth.enable=true
op.enroll.delegateISEtoken.auth.id=ldap3
...
op.enroll.delegateISEtoken.keyGen.signing.dnpattern=cn=$auth.givenname
$.$auth.sn$.$auth.edipi$,e=$auth.mail$,o=Example Org
op.enroll.delegateISEtoken.keyGen.signing.SANpattern=$auth.exec-mail$
op.enroll.delegateISEtoken.keyGen.signing.ca.profileId=caTokenUserDele
gateSigningKeyEnrollment
...
op.enroll.delegateISEtoken.keyGen.authentication.dnpattern=cn=$auth.gi
venname$.$auth.sn$.$auth.edipi$,e=$auth.mail$,o=Example Org
op.enroll.delegateISEtoken.keyGen.authentication.SANpattern=$auth.exec
-edipi$.$auth.exec-pcc$@example.com
op.enroll.delegateISEtoken.keyGen.authentication.ca.profileId=caTokenU
serDelegateAuthKeyEnrollment
...
op.format.delegateISEtoken.*
```

There may be additional parameters to define PIN reset or format operations.

5.6.2. Creating a Profile for a Logged-In User to Add Certificates

This procedure follows the steps to recover certificates on a token based on the user name. The specific configuration of the profile is flexible, as covered in Section 5.6.1, “Example Recovery Profiles and Planning New Profiles”.

1. Create the profile.

   a. Stop the TPS.

   ```
   [root@server ~]# systemctl stop pki-
   tomcatd@instance_name.service
   ```

   b. Open the TPS **CS.cfg** file.

   ```
   [root@server ~]# vim /etc/pki-tps/CS.cfg
   ```

   c. Configure the authentication database. Set all of the LDAP attributes that will contain the required certificate and token information in the user entries. For example:

```
auth.instance.2.authId=regDS
auth.instance.2.externalReg.tokenTypeAttributeName=tokenType
auth.instance.2.externalReg.cuidAttributeName=tokenCUID
auth.instance.2.externalReg.certs.recoverAttributeName=certsT
oAdd
...
auth.instance.2.attributes=mail,cn,uid,tokenCUID,tokenType,sn
,givenname,edipi,pcc,exec-edipi,exec-pcc,exec-mail,certsToAdd
```

d. Set the global configuration for the recovered token profiles. This includes the authentication database ID and the argument to enable token recovery from a user entry. This can also contain global defaults, such as the recovery profile to use if the user entry does not specify one. **Delegation is disabled.**

```
externalReg.authId=regDS
externalReg.default.tokenType=exampleUserRecovery
externalReg.delegation.enable=true
externalReg.enable=true
externalReg.format.loginRequest.enable=false
```

e. Configure the keys to generate, as in Section 5.1, “Configuring TPS Smart Card Operation Policies”. For example, this creates a new identity certificate, but no other certificates.

```
op.enroll.exampleUserRecovery.auth.enable=true
op.enroll.exampleUserRecovery.auth.id=regDS
...
op.enroll.exampleUserRecovery.keyGen.authentication.dnpattern
=cn=$auth.givenname$.$auth.sn$,e=$auth.mail$,o=Example Org
op.enroll.exampleUserRecovery.keyGen.authentication.ca.profil
eId=caTokenUserAuthenticationKeyEnrollment
...
```

f. Start the TPS.

```
[root@server ~]# systemctl start pki-
tomcatd@instance_name.service
```

2. Enroll for certificates for the user in the end-entities pages of the CA, using a general profile such as Manual Signing and Encryption Certificates. Enrolling for certificates is covered in Chapter 4, *Requesting, Enrolling, and Managing Certificates*.

3. Once the requests are approved, record the serial numbers of all certificates. For encryption certificates, also note the serial number for the keys.

4. Create or edit the user entry to contain the required information to enroll the token. This includes the token profile (***tokenType***) and the certificate serial numbers to include (***certsToAdd***).

   For the certificates, the value is *ca_connection_id, serial_#* for identity and signing certificates and *ca_connection_id, serial_#, kra_connection_id,key_serial_#* for encryption certificates. Both the CA and KRA are identified by their connector ID in the TPS profile configuration.

```
[root@server ~]# ldapmodify -a -x -D "cn=directory manager" -w
secret -p 389 -h ldap.example.com

dn: uid=jsmith,ou=people,dc=example,dc=com
objectClass: top
objectClass: person
objectClass: organizationalPerson
objectClass: inetorgperson
objectClass: extensibleObject
uid: jsmith
cn: John Smith
sn: Smith
givenname: John
userPassword: {SSHA}1KvkyymH93B7Pd1LxtrCIJSkpBnMZHIjP421oA==
certstoadd: 200,ca1,88,kra1 // this is an encryption certificate
tokenType: exampleUserRecovery
```

5. Enroll the token. At the end of the operation, there will be two certificates on the token, the existing encryption certificate and the new identity certificate.

When the token is initially enrolled, the CUID for the token is added to the user entry automatically in the ***tokenCUID*** attribute. After that, every token operation for the user must match the stored CUID.

5.6.3. Creating a Recovery Profile for a Shared Certificate

This procedure follows the steps to add a shared certificate to different user entries, using the token CUID to verify the users. The specific configuration of the profile is flexible, as covered in Section 5.6.1, “Example Recovery Profiles and Planning New Profiles”.

By using the CUID rather than the logged-in user ID, an administrator can create a shared certificate and then enroll multiple tokens to use it.

1. Create the profile.

   a. Stop the TPS.

   ```
   [root@server ~]# systemctl stop pki-
   tomcatd@instance_name.service
   ```

   b. Open the TPS **CS.cfg** file.

   ```
   [root@server ~]# vim /etc/pki-tps/CS.cfg
   ```

   c. Configure the authentication database. Set all of the LDAP attributes that will contain the required certificate and token information in the user entries. For example:

   ```
   auth.instance.2.authId=regDS
   auth.instance.2.externalReg.tokenTypeAttributeName=tokenType
   auth.instance.2.externalReg.cuidAttributeName=tokenCUID
   auth.instance.2.externalReg.certs.recoverAttributeName=certsT
   ```

```
oAdd
...
auth.instance.2.attributes=mail,cn,uid,tokenCUID,tokenType,sn
,givenname,edipi,pcc,exec-edipi,exec-pcc,exec-mail,certsToAdd
```

d. Set the global configuration for the recovered token profiles. This includes the authentication database ID and the argument to enable token recovery from a user entry. This can also contain global defaults, such as the recovery profile to use if the user entry does not specify one. **Delegation is disabled.**

```
externalReg.authId=regDS
externalReg.default.tokenType=exampleUserRecovery
externalReg.delegation.enable=true
externalReg.enable=true
externalReg.format.loginRequest.enable=false
```

e. Configure the profile settings, as in Section 5.6.1, “Example Recovery Profiles and Planning New Profiles”. This example enables the profile but does not generate any other certificates.

```
op.enroll.exampleSharedRecovery.auth.enable=true
op.enroll.exampleSharedRecovery.auth.id=regDS
...
```

f. Start the TPS.

```
[root@server ~]# systemctl start pki-
tomcatd@instance_name.service
```

2. Enroll for the shared certificate for the user in the end-entities pages of the CA, using a general profile such as Manual Signing and Encryption Certificates. Enrolling for certificates is covered in Chapter 4, *Requesting, Enrolling, and Managing Certificates*.

3. Once the requests are approved, record the serial numbers of the certificate.

4. Edit each user entry to contain the certificate serial number and the CUID of their given token. For the certificates, the ***certsToAdd*** value is *ca_connection_id, serial_#* for identity and signing certificates and *ca_connection_id, serial_#, kra_connection_id,key_serial_#* for encryption certificates. Both the CA and KRA are identified by their connector ID in the TPS profile configuration.

```
[root@server ~]# ldapmodify -a -x -D "cn=directory manager" -w
secret -p 389 -h ldap.example.com

dn: uid=jsmith,ou=people,dc=example,dc=com
objectClass: top
objectClass: person
objectClass: organizationalPerson
objectClass: inetorgperson
objectClass: extensibleObject
uid: jsmith
cn: John Smith
sn: Smith
```

```
givenname: John
userPassword: {SSHA}1KvkyymH93B7Pd1LxtrCIJSkpBnMZHIjP421oA==
certstoadd: 200,ca1,88,kra1 // this is an encryption certificate
tokenCUID: 01234567890
```

5. Enroll the token. At the end of the operation, there will be two certificates on the token, the existing encryption certificate and the new identity certificate.

5.6.4. Creating a Delegation Profile

1. Create the profile.

   a. Stop the TPS.

   ```
   [root@server ~]# systemctl stop pki-
   tomcatd@instance_name.service
   ```

   b. Open the TPS **CS.cfg** file.

   ```
   [root@server ~]# vim /etc/pki-tps/CS.cfg
   ```

   c. Configure the authentication database. Set all of the LDAP attributes that will contain the required certificate and token information in the user entries. For example:

   ```
   auth.instance.2.authId=regDS
   auth.instance.2.externalReg.tokenTypeAttributeName=tokenType
   auth.instance.2.externalReg.cuidAttributeName=tokenCUID
   auth.instance.2.externalReg.certs.recoverAttributeName=certsT
   oAdd
   ...
   auth.instance.2.attributes=mail,cn,uid,tokenCUID,tokenType,sn
   ,givenname,edipi,pcc,exec-edipi,exec-pcc,exec-mail,certsToAdd
   ```

   d. Set the global configuration for the recovered token profiles. This includes the authentication database ID and the argument to enable token recovery from a user entry. This can also contain global defaults, such as the recovery profile to use if the user entry does not specify one.

   Delegation must be enabled.

   ```
   externalReg.authId=regDS
   externalReg.default.tokenType=exampleUserRecovery
   xternalReg.delegation.enable=true
   externalReg.enable=true
   externalReg.format.loginRequest.enable=false
   ```

   e. Configure the keys to generate, as in Section 5.1, “Configuring TPS Smart Card Operation Policies”. For example, this creates new identity and new signing certificates for the delegate and recovers the executive's encryption certificate.

   The configuration must include a pattern to construct the subject DN based on the delegate user entry, and then another pattern to create a subject alternative name for the other principal name (UPN) of the executive for the identity certificate and from the RFC 822 name of the executive for the signing key. The executive information must be stored in special attributes in the delegate user entry; the executive user entry is not accessed during the enrollment process.

```
op.enroll.exampleDelegateTOken.auth.enable=true
op.enroll.exampleDelegateTOken.auth.id=regDS
...
op.enroll.exampleDelegateTOken.keyGen.signing.dnpattern=cn=$a
uth.givenname$.$auth.sn$.$auth.edipi$,e=$auth.mail$,o=Example
Org
op.enroll.exampleDelegateTOken.keyGen.signing.SANpattern=$aut
h.exec-mail$
op.enroll.exampleDelegateTOken.keyGen.signing.ca.profileId=ca
TokenUserDelegateSigningKeyEnrollment
...
op.enroll.exampleDelegateTOken.keyGen.authentication.dnpatter
n=cn=$auth.givenname$.$auth.sn$.$auth.edipi$,e=$auth.mail$,o=
Example Org
op.enroll.exampleDelegateTOken.keyGen.authentication.SANpatte
rn=$auth.exec-edipi$.$auth.exec-pcc$@example.com
op.enroll.exampleDelegateTOken.keyGen.authentication.ca.profi
leId=caTokenUserDelegateAuthKeyEnrollment
...
op.format.exampleDelegateTOken.*
```

f. Start the TPS.

```
[root@server ~]# systemctl start pki-
tomcatd@instance_name.service
```

2. Enroll for certificates for the executive user in the end-entities pages of the CA, using a general profile such as Manual Signing and Encryption Certificates. Enrolling for certificates is covered in Chapter 4, *Requesting, Enrolling, and Managing Certificates*.

3. Once the requests are approved, record the certificate and key serial numbers of the encryption certificate.

4. Create or edit the delegate entry to contain the required information to enroll the token. This includes the attributes with the executive's information and the certificate serial numbers to include (***certsToAdd***). For the certificates to add, the value is *ca_connection_id, serial_#, kra_connection_id,key_serial_#*. Both the CA and KRA are identified by their connector ID in the TPS profile configuration.

```
[root@server ~]# ldapmodify -a -x -D "cn=directory manager" -w
secret -p 389 -h ldap.example.com

dn: uid=jsmith,ou=people,dc=example,dc=com
objectClass: top
objectClass: person
objectClass: organizationalPerson
objectClass: inetorgperson
objectClass: extensibleObject
uid: jsmith
cn: John Smith
```

```
sn: Smith
givenname: John
userPassword: {SSHA}1KvkyymH93B7Pd1LxtrCIJSkpBnMZHIjP421oA==
certstoadd: 200,ca1,88,kra1 // this is an encryption certificate
tokenType: exampleDelegateToken
edipi: 123456789
pcc: AA
mail: jsmith@EXAMPLE.com
exec-edipi: 999999999
exec-pcc: BB
exec-mail: bjensen@EXAMPLE.com
```

5. Enroll the token. At the end of the operation, there will be three certificates on the token, the existing encryption certificate for the executive and the new identity and signing certificates for the delegate, with the executive information in the subject alternative name.

5.7. Setting Token Status Transitions

The status of a token helps control the use of that token if it is somehow lost or inaccessible. The status is a signal if the token is active, out of use for some reason, revoked, or not yet formatted.

A token can move from one status to another when an operation is performed (such as when it is enrolled) or if the agent changes its state (such as when a token is lost or found). The move from one status to another is a *token transition*.

The status of the token impacts whether a key should be recovered from the KRA or reissued, whether new tokens will be blocked because there are already active existing tokens, and whether to issue or revoke temporary tokens. Administrators need to be able to control how statuses can be applied. For example, a token which is temporarily lost needs to be moved back to an active state once it is found. However, a token which is marked permanently lost or damaged (meaning it should be revoked) should never be allowed to be moved back into an active state.

This administrative control over status transitions is configured in the **CS.cfg** file. The allowed transitions — what status a token in a given statues is allowed to transition to — is defined in two different ways, depending on what is changing the token:

- *Agent-initiated token transitions* are when the agent manually changes the status of the token through the TPS's agent UI. These transitions are defined in the ***tokendb.allowedTransitions*** parameter.
- *Operation-initiated token transitions* are when a token operation (formatting or enrolling) changes the status of the token. An operation almost always moves the token from an uninitialized state to another state (by default, from uninitialized to active) and back. These transitions are defined in the ***tps.operations.allowedTransitions*** parameter.

The allowed transitions are set in number pairs, the first showing the original status and the second showing the status it is allowed to move to. For example, this setting allows a token with a status of temporarily lost (3) to move to a status of active/found (4):

```
tokendb.allowedTransitions=3:4
```

The allowed transitions setting identifies the starting status and then what other statuses cards in the starting state are allowed to be changed to. If a token status is not listed as a starting state, then it cannot be moved from its current state.

Multiple status transitions are entered as a comma-separated list.

```
tokendb.allowedTransitions=0:1,0:2,0:3,0:4,0:5,0:6,3:4,3:5,3:6,4:1,4:2,4
:3,4:6
```

5.7.1. Setting Token Transitions for Agent-Initiated Status Changes (UI)

Essentially, the token status is a way for agents to suspend or terminate tokens, similar to certificates being revoked. Agents can change the status of the token. The possble agent-set token statuses are listed in Table 5.9, “Token Statuses”.

The allowed transitions setting identifies the starting status and then what other statuses cards in the starting state are allowed to be changed to. If a token status is not listed as a starting state, then it cannot be moved from its current state. By default, the TPS configuration has three starting states: uninitialized, temporarily lost, and found. These default state changes are illustrated in Figure 5.1, “Default Token Status Transitions”.

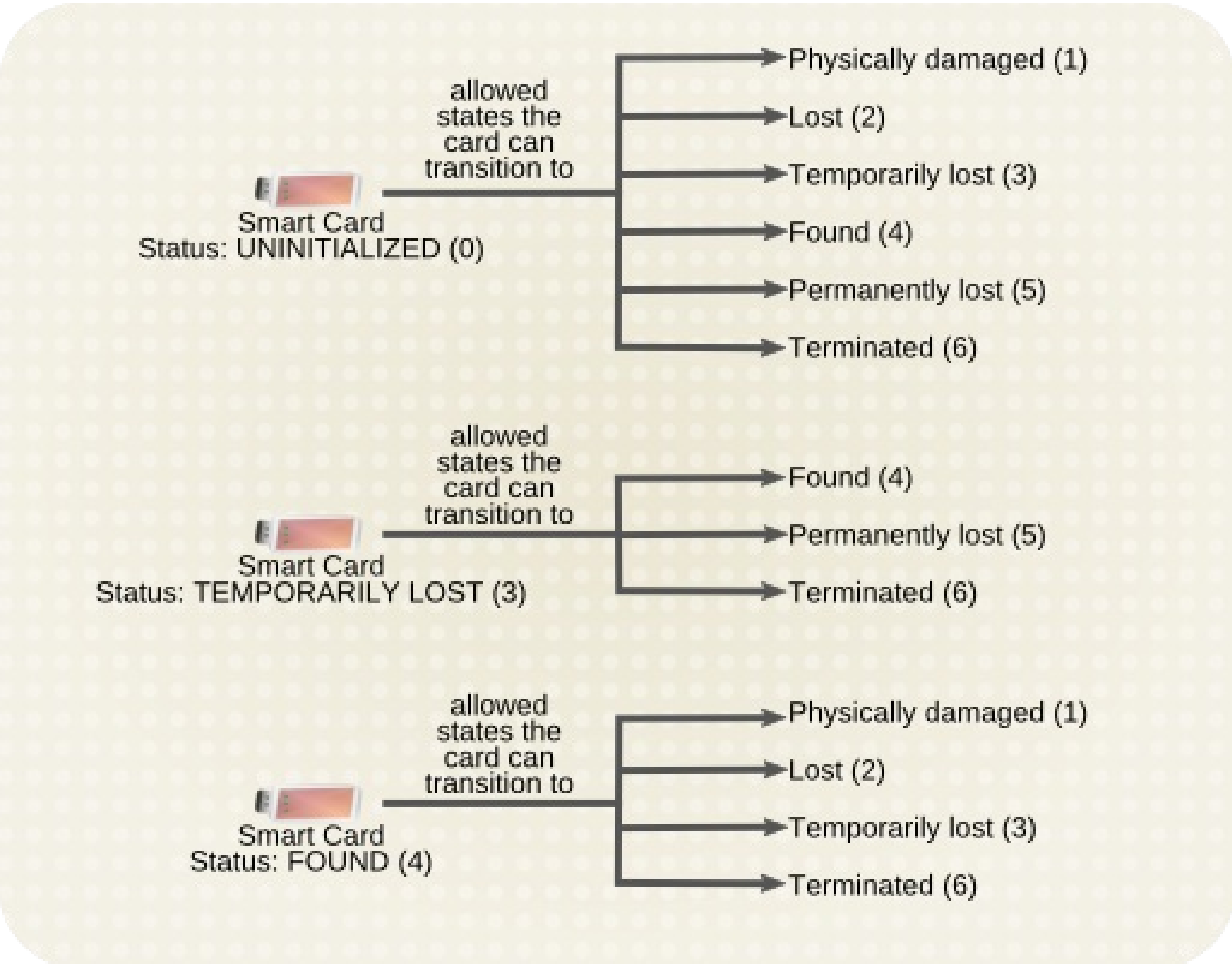


Figure 5.1. Default Token Status Transitions

The default value essentially allows all logical transitions and prohibits permanently lost or damaged tokens from being marked as found.

Note

If the ***tokendb.allowedTransitions*** parameter is missing or not set, then all transitions are allowed (even transitions for lost or damaged tokens to another status). If the parameter is set, then only transitions that are explicitly set are allowed.

Important

If no transitions are given *from* a particular token state (for instance, a transition is given to go *to* permanently lost, but there is no transition from permanently lost to another state), then the token status cannot be edited. The token will permanently remain in that final state and the **Edit Token** area in the TPS agent's page will be grayed out.

To change the allowed transition states:

1. Stop the TPS subsystem.

   ```
   systemctl stop pki-tomcatd@instance_name.service
   ```

2. Open the TPS's configuration directory.

   ```
   cd /etc/pki-tps
   ```

3. Open the **CS.cfg** file.

   ```
   vim CS.cfg
   ```

4. Add or edit the ***tokendb.allowedTransitions*** parameter at the end of the file. The available token statuses are listed in Table 5.9, “Token Statuses”.

   ```
   tokendb.allowedTransitions=0:1,0:2,0:3,0:4,0:5,0:6,3:4,3:5,3:6,4:1
   ,4:2,4:3,4:6
   ```

5. Restart the TPS subsystem.

   ```
   systemctl start pki-tomcatd@instance_name.service
   ```

Table 5.9. Token Statuses

Status	Meaning	Numeric Value
The token is uninitialized.	The token has not been enrolled.	0

Status	Meaning	Numeric Value
The token is physically damaged.	The TPS revokes the user certificates and marks the token lost.	1
The token has been permanently lost.	The TPS revokes the user certificates and marks the token lost.	2
The token is temporarily lost or unavailable.	The TPS puts the user certificates on hold and marks the token inactive.	3
The lost token has been found.	The TPS takes the certificates off hold and marks the token active.	4
The lost token cannot be found (permanently lost).	The TPS revokes both the temporary and the original certificates and marks the token lost.	5
This token has been terminated.	The TPS terminates the token. Terminating a token terminates the certificates and keys on the token and breaks the association between the token and the user in the token database. The physical token can still be formatted and reused afterward, but this change of status will mark a record of the termination event.	6

5.7.2. Setting Token Transitions for Token Operations

Enroll and format operations generally deal with uninitialized tokens, either taking an uninitialized token and setting them up for use or taking a previously active token and returning it to uninitialized so that it can be reused. Unlike agent-initiated status changes, operational status changes have a much simpler path, and the default value only defines transitions between uninitialized (0) and active (4) statuses.

```
tps.operations.allowedTransitions=0:0,0:4,4:0
```

Both format and enroll operations refer to the ***tps.operations.allowedTransitions*** parameter for their allowed transitions.

```
0:0 uninitialized --> uninitialized (format)
0:4 uninitialized --> active (enroll)
4:0 active --> uninitialized (format)
```

By the nature of these operations, there are very few logical transition paths. An enrollment operation only ever moves from an uninitialized to an active state or an active state to an active state (re-enrollment). No other defined transition ever applies to an enrollment operation. Likewise, a format operation only ever *ends* in an uninitialized token, regardless of its starting state.

> **Note**
>
> Some transition paths are explicitly *not* allowed by the TPS itself. For example, the TPS prevents any lost token (2) from moving to an active state (4). Even if that transition is allowed in the configuration parameter, the parameter value is overridden by the operation definition in the TPS itself.

If the ***tps.operations.allowedTransitions*** parameter is missing or not set, then all transitions defined in the ***tokendballowedTransitions*** parameter are allowed. If the parameter is set, then only transitions that are explicitly set are allowed.

> **Note**
>
> In some environments, it may be beneficial to add other allowed transitions for format operations, such as allowing a terminated token to be reformatted (6:0).

To change the allowed transition states:

1. Stop the TPS subsystem.

   ```
   systemctl stop pki-tomcatd@instance_name.service
   ```

2. Open the TPS's configuration directory.

   ```
   cd /etc/pki-tps
   ```

3. Open the **CS.cfg** file.

   ```
   vim CS.cfg
   ```

4. Add or edit the ***tps.operations.allowedTransitions*** parameter at the end of the file. The available token statuses are listed in Table 5.10, “Token Statuses”.

   ```
   tps.operations.allowedTransitions=0:0,0:4,4:0
   ```

5. Restart the TPS subsystem.

   ```
   systemctl start pki-tomcatd@instance_name.service
   ```

Table 5.10. Token Statuses

Status	Meaning	Numeric Value
The token is uninitialized.	The token has not been enrolled.	0
The token is physically damaged.	The TPS revokes the user certificates and marks the token lost.	1

Status	Meaning	Numeric Value
The token has been permanently lost.	The TPS revokes the user certificates and marks the token lost.	2
The token is temporarily lost or unavailable.	The TPS puts the user certificates on hold and marks the token inactive.	3
- The token is active. - The token is formatted. - The lost token has been found.	The certificates are valid and the token is active. When transitioning to this state (such as lost to found), the TPS takes the certificates off hold and marks the token active.	4
This token has been terminated.	The TPS terminates the token. Terminating a token terminates the certificates and keys on the token and breaks the association between the token and the user in the token database. The physical token can still be formatted and reused afterward, but this change of status will mark a record of the termination event.	6

5.8. Automating Encryption Key Recovery

The Certificate System allows for a semi-automated recovery if a user loses, destroys, or misplaces a token. The TPS automatically recovers the appropriate encryption keys and certificates for a permanently or temporarily lost token, depending on the circumstances of the token loss. To prevent misuse of the recovery feature, the TPS requires that a user must have a single active token.

When a user loses a token, the user must first get a replacement token. If a new enrollment is attempted with this new token, the TPS blocks the enrollment since the user already has an active token.

The token status in the database must be changed to `lost`. This action is performed through the TPS agent services page. The TPS agent, after affirmatively identifying the user, can search for the user's ID in the **Search tokens** link. The TPS agent select the active token and update the status, with the appropriate reason to recover the key.

Table 5.11. Lost Token Statuses

Agent Status Option	Configuration Parameter	Default Recovery Scheme
This token has been physically damaged.	reason=0	RecoverLast
This token has been permanently lost.	reason=1	GenerateNewKey
This token has been temporarily lost.	reason=6	GenerateNewKey

There are three different schemes for recovery:

- *GenerateNewKey* creates a new signing key and certificate.
- *RecoverLast* recovers the last encryption key and associated certificate.
- *GenerateNewKeyAndRecoverLast* generates a new signing key and recovers the last encryption key.

5.8.1. Configuring Enrollment for Replacement Tokens

The user can enroll for a replacement token. It is preferred that signing keys be generated on the smart card and not archived so that if the smart card is lost, new signing keys and certificates must be regenerated on the token, and temporary certificates created.

There is a different policy set for all three lost states, and each policy sets independently the rules for generating keys. Each policy set is part of the enrollment configuration.

```
op.enroll.userKey.keyGen.recovery.lost_type
```

For damaged tokens, the *lost_type* is **destroyed.**. For permanently lost tokens, it is **keyCompromised**. For temporarily lost tokens, it is **onHold**.

The policy describing which keys should be regenerated and which keys should be recovered is defined in the following TPS **CS.cfg** parameters. For example:

```
op.enroll.userKey.keyGen.recovery.destroyed.keyType.num=2
op.enroll.userKey.keyGen.recovery.destroyed.keyType.value.0=signing
op.enroll.userKey.keyGen.recovery.destroyed.keyType.value.1=encryption

op.enroll.userKey.keyGen.signing.recovery.destroyed.revokeCert=true
op.enroll.userKey.keyGen.signing.recovery.destroyed.revokeCert.reason=0
op.enroll.userKey.keyGen.signing.recovery.destroyed.scheme=GenerateNewKe
y

op.enroll.userKey.keyGen.encryption.recovery.destroyed.revokeCert=false
op.enroll.userKey.keyGen.encryption.recovery.destroyed.revokeCert.reason
=0
op.enroll.userKey.keyGen.encryption.recovery.destroyed.scheme=RecoverLas
t
```

Set **revokeCert=true** to revoke certificates if a token's certificates are replaced after being lost.

```
... for the signing key ...
 op.enroll.userKey.keyGen.signing.recovery.destroyed.revokeCert=true
 op.enroll.userKey.keyGen.signing.recovery.destroyed.revokeCert.reason=0

 op.enroll.userKey.keyGen.signing.recovery.keyCompromise.revokeCert=true
 op.enroll.userKey.keyGen.signing.recovery.keyCompromise.revokeCert.reas
on=1

 op.enroll.userKey.keyGen.signing.recovery.onHold.revokeCert=true
 op.enroll.userKey.keyGen.signing.recovery.onHold.revokeCert.reason=6
```

```
 op.enroll.userKey.keyGen.signing.revokeCert=true

 ... for the encryption key ...
 op.enroll.userKey.keyGen.encryption.recovery.destroyed.revokeCert=false
 op.enroll.userKey.keyGen.encryption.recovery.destroyed.revokeCert.reaso
n=0

 op.enroll.userKey.keyGen.encryption.recovery.keyCompromise.revokeCert=t
rue
 op.enroll.userKey.keyGen.encryption.recovery.keyCompromise.revokeCert.r
eason=1

 op.enroll.userKey.keyGen.encryption.recovery.onHold.revokeCert=true
 op.enroll.userKey.keyGen.encryption.recovery.onHold.revokeCert.reason=6

 op.enroll.userKey.keyGen.encryption.revokeCert=true
```

5.8.2. Configuring Key Generation for Temporary Tokens

If the smart card loss is temporary, the user can be enrolled for a temporary replacement. The profile for the replacement smart card is defined in the **userKeyTemporary** parameter in the TPS **CS.cfg** file. The certificate used through this profile is valid for seven days by default.

```
... snip ...
op.enroll.userKeyTemporary.keyGen.encryption.ca.conn=ca1
op.enroll.userKeyTemporary.keyGen.encryption.ca.profileId=caTempTokenUse
rEncryptionKeyEnrollment
op.enroll.userKeyTemporary.keyGen.encryption.certAttrId=c2
op.enroll.userKeyTemporary.keyGen.encryption.certId=C2
op.enroll.userKeyTemporary.keyGen.encryption.cuid_label=$cuid$
op.enroll.userKeyTemporary.keyGen.encryption.keySize=1024
op.enroll.userKeyTemporary.keyGen.encryption.keyUsage=0
op.enroll.userKeyTemporary.keyGen.encryption.keyUser=0
op.enroll.userKeyTemporary.keyGen.encryption.label=encryption key for
$userid$
op.enroll.userKeyTemporary.keyGen.encryption.overwrite=true
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.dec
rypt=true
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.der
ive=false
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.enc
rypt=false
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.pri
vate=true
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.sen
sitive=true
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.sig
n=false
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.sig
nRecover=false
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.tok
en=true
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.unw
rap=true
```

```
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.ver
ify=false
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.ver
ifyRecover=false
op.enroll.userKeyTemporary.keyGen.encryption.private.keyCapabilities.wra
p=false
op.enroll.userKeyTemporary.keyGen.encryption.privateKeyAttrId=k4
op.enroll.userKeyTemporary.keyGen.encryption.privateKeyNumber=4
... snip ...
```

5.9. Routing Revocation Requests to Different CAs

The only CA which can revoke a certificate is the CA which issued the certificate. When a CA is retired, it is possible to route revocation requests for tokens to that CA, while still routing enrollment and other requests to the new, active CA.

> **Note**
>
> A retired CA can revoke certificates which it has issued. However, it cannot issue new certificates, including renewing certificates. When a CA is retired, revocation requests can be routed to it. Renewal requests cannot be processed; instead, the token should be re-enrolled.

5.9.1. How Revocation Requests Are Sent to the CA

Each TPS profile has configuration for each available CA to use for different token operations such as enrollments and formatting. As covered in Section 5.12, “Configuring Connections to Other Subsystems”, each profile contains a section for the connection parameters of the CA (***conn.ca#***), and then that CA is specified in operation in the ***op.****operation.token.****ca.conn*** parameters.

The TPS is only aware of the CAs within its own configuration, not the larger PKI infrastructure. Additional CA instances must be added manually to the TPS profile for failover.

As the PKI infrastructure changes, those changes must also be accounted for manually in the TPS profile configuration.

Specifically, when a CA is retired, that CA is prevented from issuing new certificates or renewing existing certificates — including as part of enrollment operations for a token. However, **when a CA issues a certificate, only that CA can be used to revoke the certificate.**

The way that the TPS can route revocation requests for a profile is by running through a list of possible CAs. The ***conn.ca.list*** sets a list of CAs in the profile configuration to check for revocation requests. Each CA configuration section has a parameter for the CA certificate nickname (***conn.ca1.caNickname***) and the subject key identifier of the CA (***conn.ca1.caSKI***). When a revocation request is submitted, the TPS determine the CA certificate nickname and the subject key identifier from the certificate DN. It then derives the authority key identifier and iterates through its list of CAs defined for revocation until it finds a match. This way, new CAs can be set in the operation configuration while still using retired CAs for revocation requests.

> **Note**
>
> This also allows different CAs to be used for different types of token operations within the same profile. The appropriate CA is contacted for revocations.

When using revocation routing, two criteria must be met for the retired CA:

- The host and port information (at a minimum) must be available in the CA connection configuration. The CA configuration cannot be removed from the profile, even if it is no longer referenced in the configuration for the operations.
- The CA signing certificate must be stored in the TPS's internal security database. If the CA was previously used for enrollment operations, then it will already be present.

5.9.2. Setting the List of CAs for Revocation Routing

1. Stop the TPS subsystem.

   ```
   [root@server ~]# systemctl stop pki-tomcatd@instance_name.service
   ```

2. Edit the **CS.cfg** file.

   ```
   [root@server ~]# vim /etc/pki-tps/CS.cfg
   ```

3. If necessary, add the certificate nickname for each CA in the TPS configuration. For example:

   ```
   conn.ca1.clientNickname=subsystemCert cert-pki-tps-final,
   conn.ca1.hostadminport=server.example.com:9972
   conn.ca1.hostagentport=server.example.com:9970
   conn.ca1.hostport=server.example.com:9971
   conn.ca1.keepAlive=true
   conn.ca1.retryConnect=3
   conn.ca1.servlet.enrollment=/ca/ee/ca/profileSubmitSSLClient
   conn.ca1.servlet.renewal=/ca/ee/ca/profileSubmitSSLClient
   conn.ca1.servlet.revoke=/ca/ee/subsystem/ca/doRevoke
   conn.ca1.servlet.unrevoke=/ca/ee/subsystem/ca/doUnrevoke
   conn.ca1.timeout=100
   conn.ca1.caSKI=
   conn.ca1.caNickname=CA Signing Certificate
   ```

   The subject key identifier is automatically calculated from the certificate DN and stored by the TPS when a revocation request comes in. This parameter does not need to be added.

   > **Note**
   >
   > The CA connection information for retired CAs must remain in the TPS profile.

4. Add every CA in the configuration to the list of CAs available for revocation, including both active and retired CAs. For example:

```
conn.ca.list=ca1,ca2,ca3
```

5. Restart the TPS subsystem.

```
[root@server ~]# systemctl start pki-tomcatd@instance_name.service
```

5.10. Managing Shared Keys

The Token Key Service (TKS) *derives* keys for the TPS to use. TKS keys process key material sent from the user, the token CUID, an agreed on algorithm, and a public key to recombine a key that exists on the token (that is why the keys are *derived* rather than generated). These derived keys both encrypt sessions between the TPS and the Enterprise Security Client and generate keys for the token enrollment.

Part of the way that the TKS derives these keys is by using a common *master key* that is known to the TKS and existent on each of the smart cards or tokens. New master keys can be generated, stored in the TKS, and transported to the smart cards or additional HSM key stores to be used for token management operations using the **tkstool** command.

Managing master keys is described in this section.

- Section 5.10.1, “Generating Master Keys”
- Section 5.10.2, “Generating and Transporting Wrapped Master Keys”
- Section 5.10.3, “Using HSM for Generating Keys”
- Section 5.10.4, “Updating Master Key Versions and Associating the Master Key with Its Version”
- Section 5.10.5, “Configuring Symmetric Key Changeover”

5.10.1. Generating Master Keys

A master key is used as part of the algorithm to derive other keys on tokens and smart cards. New master keys can be generated on the TKS using the **tkstool** utility.

1. Get the PIN to use to access the TKS's security databases. The **internal** PIN is the one used for the security databases.

```
cat /var/lib/pki/pki-tomcat/tks/conf//password.conf

internal=649713464822
internaldb=secret12
replicationdb=-752230707
```

2. Open the TKS instance **alias/** directory.

```
cd /var/lib/pki/pki-tomcat/alias
```

3. Generate the new master key. For example:

```
tkstool -M -n new_master -d /var/lib/pki/pki-tomcat/alias -h
token_name
```

```
Enter Password or Pin for "NSS Certificate DB":

Generating and storing the master key on the specified token . . .

Naming the master key "new_master" . . .

Computing and displaying KCV of the master key on the specified
token . . .

    new_master key KCV:  CA5E 1764


Successfully generated, stored, and named the master key
including computing and displaying its KCV!
```

4. Verify that the keys have been added properly to the database.

```
tkstool -L -d .


 slot:  NSS User Private Key and Certificate Services
token:  NSS Certificate DB

Enter Password or Pin for "NSS Certificate DB":
        <0> new_master
```

Using the **tkstool** is explained in more detail in the *Certificate System Command-Line Tools Guide*.

5.10.2. Generating and Transporting Wrapped Master Keys

If a master key is going to be used on an external token or in multiple locations, then that key must be wrapped so that it can be safely transported to the hardware tokens. The **tkstool** utility can be used to generate both new master and transport keys. The transport key is used to send the master key securely to the facility where the tokens are generated.

> **Note**
>
> Tokens that are generated with a particular master key can only be used with that master key.

1. Get the PIN to use to access the TKS's security databases. The **internal** PIN is the one used for the security databases.

```
cat /var/lib/pki/pki-tomcat/tks/conf//password.conf

internal=649713464822
internaldb=secret12
replicationdb=-752230707
```

2. Open the TKS instance **alias/** directory.

```
cd /var/lib/pki/pki-tomcat/alias
```

3. Create a transport key called **transport**.

```
tkstool -T -d . -n transport
```

> **Note**
>
> The **tkstool** utility prints out the key shares and KCV values for each of the three session keys that are generated. Save them to file since these are all necessary to regenerate the transport key in the new databases in step 7 or to regenerate the key if it is lost.

When prompted, fill in the database password, then type in some noise to seed the random number generator.

```
Enter Password or Pin for "NSS Certificate DB":
sh: tput: command not found

A random seed must be generated that will be used in the
creation of your key.  One of the easiest ways to create a
random seed is to use the timing of keystrokes on a keyboard.

To begin, type keys on the keyboard until this progress meter
is full.  DO NOT USE THE AUTOREPEAT FUNCTION ON YOUR KEYBOARD!


Continue typing until the progress meter is full:

|************************************************************|

Finished.


Type the word "proceed" and press enter
```

The next prompts generate a series of session keys. For example:

```
The next screen generates the first session key share . . .


Type the word "proceed" and press enter to continue (or ^C to
break):  proceed
sh: tput: command not found

Generating the first session key share . . .


    first session key share:      8979 975D 6867 FB07
                                  5107 08B6 E625 01FD
```

```
    first session key share KCV:  0420 54F0


(1) Write down and save the value for this first session key
share.

(2) Write down and save the KCV value for this first session key
share.


Type the word "proceed" and press enter to continue (or ^C to
break):  proceed

.... snip ....

Generating first symmetric key . . .

Generating second symmetric key . . .

Generating third symmetric key . . .

Extracting transport key from operational token . . .

    transport key KCV:  444F D5C2


Storing transport key on final specified token . . .

Naming transport key "transport" . . .

Successfully generated, stored, and named the transport key!
```

4. Use the transport key to generate and wrap a master key and store it in a file called **file**.

```
tkstool -W -d . -n new_master -t transport -o file

Enter Password or Pin for "NSS Certificate DB":
Retrieving the transport key (for wrapping) from the specified
token . . .
Generating and storing the master key on the specified token . . .
Naming the master key "new_master" . . .
Successfully generated, stored, and named the master key!
Using the transport key to wrap and store the master key . . .
Writing the wrapped data (and resident master key KCV) into the
 file called "file" . . .

       wrapped data:   47C0 06DB 7D3F D9ED
                       FE91 7E6F A7E5 91B9
       master key KCV: CED9 4A7B
       (computed KCV of the master key residing inside the wrapped
data)
```

5. Copy the wrapped master key over to the appropriate locations or facility.

6. If necessary, generate new security databases on the HSM or at the facility.

```
tkstool -N -d directory
```

7. Run the **tkstool** command with the **-I** option to produce an identical transport key in the new database that was originally generated in the original database. Regenerating the transport key requires that you input the session key share and KCV for each of the three session keys generated in step 3.

```
# tkstool -I -d directory -n verify_transport
Enter Password or Pin for "NSS Certificate DB":

Use the next screen to input the first session key share . . .


Type the word "proceed" and press enter to continue (or ^C to
break):  proceed
sh: tput: command not found

Enter the first session key share . . .


Type in the first session key share (or ^C to break):

[8979]  [975D]  [6867]  [FB07]  [5107]  [08B6]  [E625]  [01FD]

Type in the corresponding KCV for the first session key share (or
^C to break):

[0420]  [54F/]

 ... [snip] ...
```

8. Use the transport key to unwrap the master key stored in the file.

```
tkstool -U -d directory -n new_master -t verify_transport -i file

Enter Password or Pin for "NSS Certificate DB":
Retrieving the transport key from the specified token (for
 unwrapping) . . .
Reading in the wrapped data (and resident master key KCV) from
 the file called "file" . . .

     wrapped data:   47C0 06DB 7D3F D9ED
                     FE91 7E6F A7E5 91B9
     master key KCV: CED9 4A7B
     (pre-computed KCV of the master key residing inside the
wrapped data)

Using the transport key to temporarily unwrap the master key to
recompute its KCV value to check against its pre-computed KCV
value . . .
     master key KCV: CED9 4A7B
     (computed KCV of the master key residing inside the wrapped
data)
     master key KCV: CED9 4A7B
     (pre-computed KCV of the master key residing inside the
```

```
wrapped data)

Using the transport key to unwrap and store the master key on the
 specified token . . .
Naming the master key "new_master" . . .
Successfully unwrapped, stored, and named the master key!
```

9. Verify that the keys have been added properly to the database.

```
tkstool -L -d .



 slot:  NSS User Private Key and Certificate Services
token:  NSS Certificate DB

Enter Password or Pin for "NSS Certificate DB":
        <0> transport
        <1> new_master
```

Using the **tkstool** is explained in more detail in the *Certificate System Command-Line Tools Guide*.

5.10.3. Using HSM for Generating Keys

By default the TKS is configured to use the internal software token to generate and store its master keys, but some deployments may require using a hardware security module (HSM) instead of the software token.

To generate keys on HSMs:

1. Install and configure the TKS subsystem.

2. Get the PIN to use to access the TKS's security databases. The **internal** PIN is the one used for the security databases.

```
cat /var/lib/pki/pki-tomcat/tks/conf//password.conf

internal=649713464822
internaldb=secret12
replicationdb=-752230707
```

3. Generate the TKS master key on the HSM using the **tkstool**. (By default during installation, the TKS master key is generated on the software token.) For example:

```
tkstool -M -n new_master -d /var/lib/pki/pki-tomcat/alias -h
nethsm
```

This generates a master key named **new_master** on the **nethsm** token for the **pki-tks** instance.

For more information on using the **tkstool**, see the *Certificate System Command-Line Tools Guide*.

4. Verify that the keys for the HSM have been added properly to the TKS database.

```
tkstool -L -d . -h nethsm


 slot:  NSS User Private Key and Certificate Services
token:  NSS Certificate DB

Enter Password or Pin for "NSS Certificate DB":
        <0> new_master
```

5. Update the TKS instance's **CS.cfg** to contain the following values:

```
 # useSoftToken tells whether to use software token or no. by
default it's true,
 # even if it's not settks.useSoftToken=false
 # mk_mappings maps key version to key name on token name
 # in this example, #02 is the version number, nethsm is the token
name,
 # and new_master is the key name
 tks.mk_mappings.#02#01=nethsm:new_master
```

   It is not necessary to change the **defaultSlot** value; it can remain the default value for the software database:

```
tks.defaultSlot=Internal Key Storage Token
```

6. Restart the TKS instance.

```
service pki-tks restart
```

7. Update the **CS.cfg** for every Token Processing System (TPS) which uses the edited TKS instance. Set the **requiredVersion** parameter and enable key upgrade in all profiles with the parameters **update.symmetricKeys.enable** and **update.symmetricKeys.requiredVersion** in the parameter name. For example:

```
 # note that the "requiredVersion" needs to map with the version
number
 # specified in the mk_mappings parameter of TKS's CS.cfg
 op.enroll.userKey.update.symmetricKeys.enable=true
 op.enroll.userKey.update.symmetricKeys.requiredVersion=2
```

8. Restart the TPS instance.

```
systemctl restart pki-tomcatd@instance_name.service
```

5.10.4. Updating Master Key Versions and Associating the Master Key with Its Version

The master keys stored in the TKS are accessed by the TPS to perform token operations. Some default keys are built into the TKS, but these can be replaced by generating new masters keys. The new master keys should be mapped to the TKS keyset configuration in the TKS **CS.cfg** file.

The default master key on a token is the first version, set by the smart card manufacturer. This has the value **#01** in its key mapping in the TKS **CS.cfg** file:

```
tks.mk_mappings.#01#01=tokenname:masterKeyId
```

Master keys have a numeric identifier such as 01. The TKS maps these IDs to PKCS #11 object nicknames specified in the *masterKeyId* part of the mapping. Therefore, the first number is updated as the master key version is updated; the second number stays consistent.

Note

Smart cards from the Axalto Web Store come with a default developer key set where all keys are set to **404142434445464748494a4b4c4d4e4f**. The TKS has this key built in, and it is referred to with the master key set #01. The TKS uses key set #01 by default.

Note

Always stop a subsystem instance before editing the configuration file.

1. Stop the TKS.

   ```
   service pki-tks stop
   ```

2. Generate a new master key, as described in Section 5.10.1, “Generating Master Keys”.

3. To map to the new version of the key, add a mapping parameter, **tks.mk_mappings**, to the TKS's **CS.cfg** file. This associates the new master key with the PKCS #11 object. For example, for a key named **new_master** on a **nethsm** token:

   ```
   tks.mk_mappings.#02#01=nethsm:new_master
   ```

   To reference the security database, set the *tokenname* to **internal**. The *masterKeyId* is the name given to the master key when it was generated.

   All numeric key identifiers in mapping configurations must be suffixed with **#01**. **#02** represents the latest master key version.

4. Each TKS configured in the TPS **CS.cfg** has a defined keyset that is associated with it:

   ```
   conn.tks1.keySet=defKeySet
   ```

   The new master key must be associated with the TKS keyset definition so that it can be used by the TPS. This keyset also requires a mapping parameter for the new master key version in the TPS **CS.cfg** file.

   ```
    tks.defKeySet._000=##
   ```

```
 tks.defKeySet._001=## Axalto default key set:
 tks.defKeySet._002=##
 tks.defKeySet._003=## tks.defKeySet.mk_mappings.#02#01=
<tokenname>:<nickname>
 tks.defKeySet._004=##
 tks.defKeySet.auth_key=#40#41#42#43#44#45#46#47#48#49#4a#4b#4c#4d
#4e#4f
 tks.defKeySet.kek_key=#40#41#42#43#44#45#46#47#48#49#4a#4b#4c#4d#
4e#4f
 tks.defKeySet.mac_key=#40#41#42#43#44#45#46#47#48#49#4a#4b#4c#4d#
4e#4f
 tks.defKeySet.nistSP800-108KdfOnKeyVersion=00
 tks.defKeySet.nistSP800-108KdfUseCuidAsKdd=false
 tks.defKeySet.mk_mappings.#02#01=nethsm:new_master
```

The two settings related to NIST SP 800 are parameters that control the TKS to determine whether to use the old Visa key derivation method or the newer NistSP800-108 method of deriving session keys, which are used in establishing a secure channel with the token. Both of these values are derived by TPS when first contacting the token.

tks.defKeySet.nistSP800-108KdfOnKeyVersion=00

This setting determines if the requested key version should result in the use of the NistSP800-108 Key Derivation Function (KDF) or the legacy KDF. If the requested token key version is greater or equal to the value of this setting, then the new Nist KDF will be used, otherwise the older one will function.

tks.defKeySet.nistSP800-108KdfUseCuidAsKdd=false

This setting decides which value is to be used as the *diversification data* identifying the token in use. This data is used in various calculations when deriving session keys.

If the setting is true, the KDD value will be used for the token, otherwise the older CUID value will be utilized. As of the current release, both of these values are sent to the TKS.

Note

When using the new NistSP800-108 *along* with a hardware security module (HSM), special instructions are needed to generate the master key *on* the HSM instead of using the **tkstool** utility. This utility does not support the special kind of key that is need when using NistSP800-1008.

5.10.5. Configuring Symmetric Key Changeover

When global platform-compliant smart cards are made, the manufacturer burns a set of symmetric keys onto the token. The smart card user shares a master symmetric key with the manufacturer. The smart card TKS is configured to use these symmetric keys. However, during enrollment, it is desirable to replace these symmetric keys with a set that is not shared by the manufacturer to restrict the set of entities that can manipulate the token.

Warning

Changing the symmetric keys can render the smart cards unusable if the master key is lost. Use key changeover in controlled conditions, and be aware of the implications of erasing a TKS instance. This section contains information on returning the keys to the factory state.

The TKS and TPS are configured for key changeover by enabling the appropriate parameters in the **CS.cfg** file for both the enroll and format operations.

1. Stop the TKS instance. For example:

   ```
   service pki-tks stop
   ```

2. Get the PIN to use to access the TKS's security databases. The **internal** PIN is the one used for the security databases.

   ```
   cat /var/lib/pki/pki-tomcat/tks/conf//password.conf

   internal=649713464822
   internaldb=secret12
   replicationdb=-752230707
   ```

3. On the TKS instance, generate new keys to use for token-client communications. For example:

   ```
   tkstool -M -n new_master -d /var/lib/pki/pki-tomcat/alias
   ```

   Note

   If this is being generated on an HSM or other external token, then use the **-h** option with the command to give the token name.

   Generating a new master key on the TKS is described in more detail in Section 5.10.1, “Generating Master Keys”.

4. Open the TKS's configuration file.

   ```
   vi /etc/pki-tks/CS.cfg
   ```

5. Map the new master key's identifier, **02**, to its PKCS #11 object nickname in the TKS's **CS.cfg** file by adding the ***tks.mk_mappings.#02#01*** and ***tks.defKeySet.mk_mappings.#02#01*** parameters.

   ```
   tks.mk_mappings.#02#01=token_name:nickname
   tks.defKeySet.mk_mappings.#02#01=token_name:nickname
   ```

   Mapping master keys in the TKS configuration is described in more detail in Section 5.10.4, “Updating Master Key Versions and Associating the Master Key with Its Version”.

6. Start the TKS instance.

```
service pki-tks start
```

7. Stop the TPS instance to edit its configuration.

```
systemctl stop pki-tomcatd@instance_name.service
```

8. Edit the TPS's configuration file.

```
vi /etc/pki-tps/CS.cfg
```

9. Change the ***symmetricKeys.enable*** and ***requiredVersion*** parameters to use the newly-generated master keys on the TKS. For example:

```
op.operation_type.update.symmetricKeys.enable=true
op.operation_type.profile_name.update.symmetricKeys.requiredVersio
n=2
```

   - For the enroll operation, the lines begin with **op.enroll**. For example, for the **userKey** profile:

   ```
   op.enroll.userKey.update.symmetricKeys.enable=true
   op.enroll.userKey.update.symmetricKeys.requiredVersion=2
   ```

   - For the format operation, the lines begin with **op.format**. For example, for the **userKey** profile:

   ```
   op.format.tokenKey.update.symmetricKeys.enable=true
   op.format.tokenKey.update.symmetricKeys.requiredVersion=2
   ```

   requiredVersion is the numeric key set identifier required for the operation to proceed. If the smart card does not have the key set specified by the **requiredVersion** parameter, key changeover will occur, and the operation process continues.

The TPS audit log shows whether the key changeover worked successfully.

Note

With an Axalto Web Store smart card, change the smart card back to the original static **4041..** key set. To do this, change the **requiredVersion** parameter back to **1** and set a new format. Do this before removing a TKS instance, or else the smart card cannot be managed.

5.10.6. Troubleshooting Master Key and HSM Problems

With an nfast NetHSM, a key changeover operation may fail with master key-related errors. Check the **/var/lib/pki/pki-tomcat/tks/logs/catalina.out** log for errors related to the master key:

```
2011-10-27 16:27:18 [32084] t40b90e4600000000: pkcs11-sam: 000008d5
Application
error: Key type CKK_DES2 label "new_master"
2011-10-27 16:27:18 [32084] t40b90e4600000000: pkcs11-sam: 000008d5
Application
error: Insecure key being used too long after creation; set
CKNFAST_OVERRIDE_SECURITY_ASSURANCES=longterm to allow
```

The errors mean that the NetHSM device thinks the master key is too old and is refusing the operation. To resolve this:

1. Open a terminal, and run all commands from this same terminal session.
2. Set the environment variable to allow the nfast NetHSM to use old master keys:

   ```
   export CKNFAST_OVERRIDE_SECURITY_ASSURANCES=longterm
   ```

3. Stop the TKS.

   ```
   service pki-tks stop
   ```

4. Restart the nfast NetHSM.

   ```
   /opt/nfast/sbin/init.d-ncipher restart
   ```

5. Restart the TKS.

   ```
   service pki-tks start
   ```

6. Perform the key changeover, as in Section 5.10.5, “Configuring Symmetric Key Changeover”.

5.11. Configuring the TPS

There are several parameters relating to smart card certificate enrollment — such as enabling SSL — which are not configured when the TPS is first set up. The TPS is fully operational without any further customization, but setting these extra parameters allows more flexibility to using the TPS with the Enterprise Security Client.

5.11.1. Enabling SSL for TPS-Enterprise Security Client Connections

By default, the TPS communicates with the Enterprise Security Client over standard HTTP, but it is configured to listen over two different secure (SSL) ports, for regular users of the Enterprise Security Client to connect over SSL. The Enterprise Security Client can be configured to connect over these SSL ports.

5.11.1.1. Default TPS SSL Configuration

Each secure authentication port is configured in a **<VirtualHost>** entry in the **/var/lib/pki/pki-tomcat/tps/conf/nss.conf** file with the SSL configuration. There are two ports configured:

```
Listen 7889
Listen 7890
```

Port 7889 is used for client (certificate-based) authentication to the Enterprise Security Client. Port 7890 is used for normal SSL connections, so it is mainly used by regular user mode for the Enterprise Security Client.

> **Note**
>
> The **nss.conf** directives are described in more detail in the [Configuration Directives](#) section of the **mod_nss** documentation.

The SSL configuration for port 7889 defines the allowed SSL/TLS protocols, cipher suites, and certificates used by the connection. The most important configuration attribute for the TPS-Enterprise Security Client connection is **NSSVerifyClient**, which is set to **require**. This means that client authentication is required to connect to that port.

Example 5.4. Excerpt SSL Configuration for Port 7889

```
<VirtualHost _default_:7889>

#   Enable/Disable SSL for this virtual host.
NSSEngine on

#   List the ciphers that the client is permitted to negotiate.
NSSCipherSuite -des,-desede3,-rc2,-rc2export,-rc4,-
rc4export,+rsa_3des_sha,-rsa_des_56_sha,+rsa_des_sha,-rsa_null_md5,-
rsa_null_sha,-rsa_rc2_40_md5,+rsa_rc4_128_md5,-rsa_rc4_128_sha,-
rsa_rc4_40_md5,-rsa_rc4_56_sha,-fortezza,-fortezza_rc4_128_sha,-
fortezza_null,-fips_des_sha,+fips_3des_sha,-rsa_aes_128_sha,-
rsa_aes_256_sha,+ecdhe_ecdsa_aes_256_sha

NSSProtocol SSLv3,TLSv1

#   SSL Certificate Nickname:
NSSNickname "Server-Cert cert-pki-tps"

#   Server Certificate Database:
NSSCertificateDatabase  /var/lib/pki-tps/alias

#   Client Authentication (Type):
NSSVerifyClient require

</VirtualHost>
```

The SSL configuration for port 7890 is the same as that for port 7889, with one exception: the **NSSVerifyClient** directive is set to **none**. This means that client authentication is *not* required to connect to that port.

Example 5.5. Excerpt SSL Configuration for Port 7890

```
<VirtualHost _default_:7890>

#   SSL Engine Switch:
NSSEngine on

#   SSL Cipher Suite:
NSSCipherSuite -des,-desede3,-rc2,-rc2export,-rc4,-
rc4export,+rsa_3des_sha,-rsa_des_56_sha,+rsa_des_sha,-rsa_null_md5,-
rsa_null_sha,-rsa_rc2_40_md5,+rsa_rc4_128_md5,-rsa_rc4_128_sha,-
rsa_rc4_40_md5,-rsa_rc4_56_sha,-fortezza,-fortezza_rc4_128_sha,-
fortezza_null,-fips_des_sha,+fips_3des_sha,-rsa_aes_128_sha,-
rsa_aes_256_sha,+ecdhe_ecdsa_aes_256_sha

NSSProtocol SSLv3,TLSv1

#   SSL Certificate Nickname:
NSSNickname "Server-Cert cert-pki-tps"

#   Server Certificate Database:
NSSCertificateDatabase  /var/lib/pki-tps/alias

#   Client Authentication (Type):
NSSVerifyClient none

</VirtualHost>
```

5.11.1.2. Configuring the Enterprise Security Client to Use SSL

While the TPS listens by default over secure ports, the Enterprise Security Client uses standard ports. The Enterprise Security Client configuration must be updated to use the secure ports.

First, the Enterprise Security Client has to have the CA certificate for the CA which issued the TPS's certificates in order to trust the TPS connection.

1. Open the CA's end user pages in a web browser.

   ```
   https://server.example.com:8443/ca/ee/ca
   ```

2. Click the **Retrieval** tab at the top.

3. In the left menu, click the **Import CA Certificate Chain** link.

4. Choose the radio button to download the chain as a file, and remember the location and name of the downloaded file.

5. Open the Enterprise Security Client. For example:

   ```
   /usr/lib/esc-1.1.0/esc
   ```

6. Click the **View Certificates** button.

7. Click the **Authorities** tab.

8. Click **Import**, and navigate to the CA certificate chain file.

9. When prompted, confirm that you want to trust the CA.

The Enterprise Security Client needs to be configured to communicate with the TPS over SSL; this is done by setting the *Phone Home URL*, which is the default URL the Enterprise Security Client uses to connect to the TPS.

Resetting the Enterprise Security Client's Phone Home URL is described in more detail in *Managing Smart Cards with the Enterprise Security Client*.

1. Open the Enterprise Security Client. For example:

   ```
   /usr/lib/esc-1.1.0/esc
   ```

2. Insert a new, blank token into the machine.

   Blank tokens are unformatted, so they do not have an existing Phone Home URL, and the URL must be set manually. Formatted tokens (and tokens can be formatted by the manufacturer or by your IT department) already have the URL set, and thus do not prompt to set the Phone Home URL.

3. Fill in the new TPS URL with the SSL port information. For example:

   ```
   https://server.example.com:8443/tps/phoneHome
   ```

4. Edit the Phone Home XML file to provide SSL ports for Enterprise Security Client in the **<UI>** and **<Operation>** elements. The default file is **cgi-bin/home/index.cgi**.

   ```
   <ServiceInfo>
   <IssuerName>FedoraProject</IssuerName>
   <Services>
   <Operation>https://server.example.com:8443/tps</Operation>
   <UI/>
   <EnrolledTokenBrowserURL>http://fedoraproject.org</EnrolledTokenBr
   owserURL>
   <EnrolledTokenURL/>
   <TokenType>userKey</TokenType>
   </Services>
   </ServiceInfo>
   ```

5.11.2. Configuring the Channels between the TPS and Tokens

The TPS communicates with a token through the user interface, the Enterprise Security Client. This channel can be configured for four attributes:

- Its size
- Encryption
- The encryption key version and type

Example 5.6. Default TPS-Token Channel Configuration

```
channel.blocksize=248
channel.defKeyIndex=0
channel.defKeyVersion=0
channel.encryption=true
```

The **defKeyIndex** and **defKeyVersion** parameters should remain the default value, as in Example 5.6, “Default TPS-Token Channel Configuration”.

The ***channel.encryption*** configuration parameter sets whether to use an encrypted channel between the TPS and tokens managed by the Enterprise Security Client.

```
channel.encryptionchannel.encryption=true
```

For security, the **channel.encryptionchannel.encryption** parameter should always be set to **true**, the default.

5.11.3. Configuring or Disabling LDAP Authentication

The TPS, by default, requires a user to authenticate to an LDAP directory when a smart card operation request is received. There are three parameters for this which can be set for each separate token operation:

```
op.operation.key_type.auth.enable=true|false
op.operation.key_type.auth.id=ldap_db_config_entry
op.operation.key_type.loginRequest.enable=true|false
```

Setting these parameters determines whether LDAP authentication is required, which the LDAP directory to use for the authentication (by referencing its entry in the TPS **CS.cfg** file), and whether to send the login request to the smart card client program.

> **Note**
>
> The user must have an existing LDAP user entry in the LDAP server instance specified in the TPS's **CS.cfg** file in order to complete the operation.

5.11.3.1. Configuring LDAP Authentication in CS.cfg

1. Stop the TPS subsystem.

   ```
   [root@server ~]# systemctl stop pki-tomcatd@instance_name.service
   ```

2. Open the TPS's configuration directory.

   ```
   [root@server ~]# cd /etc/pki-tps
   ```

3. Edit the **CS.cfg** file.

   ```
   [root@server ~]# vim CS.cfg
   ```

4. Set the authentication parameters.

```
op.operation_type.token_type.loginRequest.enable=false|true
op.operation_type.token_type.auth.id=ldap_db_config_entry
op.operation_type.token_type.auth.enable=false|true
```

The *operation_type* is the token operation for which LDAP authentication is being disabled, such as **enroll**, **format**, or **pinreset**. Disabling authentication for one operation type does not disable it for any other operation types.

The *token_type* is the token profile. There are default profiles for regular users. There can also be custom token types for other kinds of users or certificates.

For example:

```
op.enroll.userKey.loginRequest.enable=true
op.enroll.userKey.auth.id=ldap1
op.enroll.userKey.pinReset.enable=true
```

5. Restart the TPS subsystem.

```
[root@server ~]# systemctl start pki-tomcatd@instance_name.service
```

Like configuring multiple subsystem instances, there can be multiple LDAP directories configured. Additional LDAP parameters, such as the base DN under which to search for entries and the Directory Server hostname and port, are listed in Table 5.12, “LDAP Authentication”.

Table 5.12. LDAP Authentication

Parameter	Description
auth.instance.#.attributes	The LDAP attributes of the user entry to be retrieved, if attributes are present, such as **auth.instance.0.attributes=mail,cn,uid**. Once retrieved, these attributes can be used in other parameter entries as **$auth.***attr name***$**. For example, **op.enroll.userKey.keyGen.tokenName=$userid$ [$auth.cn$]**.
auth.instance.#.type	The authentication type to use. This must be **LDAP_Authentication**.
auth.instance.#.libraryName	The library to use for LDAP authentication. Provide the full path to the library. The filename must be **libldapauth.so**.
auth.instance.#.libraryFactory	The function name to use for LDAP authentication. This must be **GetAuthentication**.
auth.instance.#.authId	Specifies this authentication instance ID to use to define operations. For example, **ldap1**.
auth.instance.#.hostport	The LDAP hostname and port number. The format is *ldap-hostname:ldap-port*.

Parameter	Description
auth.instance.#.SSLOn	Sets whether SSL should be turned on. The valid values are **true|false**.
auth.instance.#.retries	The number of times authentication is tried after failure. The valid values are integers. For example, **1**.
auth.instance.#.retryConnect	The number of times the TPS tries to reconnect to the LDAP server after a connection attempt fails. The valid values are integers. For example, **3**.
auth.instance.#.baseDN	The base DN from which to start the LDAP search. For example, **o=example.com**.
auth.instance.#.ui.title.en	The title of the LDAP authentication plug-in. For example, **LDAP Authentication**.
auth.instance.#.ui.description.en	The description of the LDAP authentication activity. This is displayed to the user in the Enterprise Security Client authentication dialog box. For example, **This authenticates the user against the LDAP dev directory**.
auth.instance.#.ui.id.UID.name.en	The UID parameter name. This is displayed to the user in the Enterprise Security Client authentication dialog box. For example, **LDAP User ID**.
auth.instance.#.ui.id.PASSWORD.name.en	The password parameter name. This is displayed to the user in the Enterprise Security Client authentication dialog box. For example, **LDAP Password**.
auth.instance.#.ui.id.UID.description.en	The description of the UID parameter. This is displayed to the user in the Enterprise Security Client authentication dialog box.
auth.instance.#.ui.id.PASSWORD.description.en	The description of the password parameter. This is displayed to the user in the Enterprise Security Client authentication dialog box.

5.11.4. Configuring the Token Database

The TPS uses an LDAP database called the *token database* or *tokenDB* to keep specific information for each registered token. It also associates tokens with certificates and users.

The token database is viewed or edited through the **Administrator** tab of the TPS HTML services page. The agent/admin services page is used to add tokens, check token status, edit token information, and view token information, like certificates and past operations.

The parameters used to configure the token database in the TPS are listed in Table 5.13, “Token Database Preferences”.

Table 5.13. Token Database Preferences

Parameter	Description

Parameter	Description
tokendb.auditLog	The full path to the audit log file. For example, **/var/lib/pki/*instance_name*/logs/tokendb-audit.log**.
tokendb.hostport	The token database (LDAP) hostname and port number. The format is *hostname:port*.
tokendb.bindDN	The bind DN to bind to the token database. The default value is **cn=directory manager**.
tokendb.bindPassPath	The path to a local password file which contains the subsystem passwords. The default file is **/etc/pki-tps/password.conf**.
tokendb.templateDir	The directory where the templates for the TPS agent page are located.
tokendb.userBaseDN	The LDAP suffix where the user entries are.
tokendb.baseDN	The LDAP suffix where the token entries should be added and modified by the TPS. The default value is **ou=Tokens,***baseDN*.
tokendb.activityBaseDN	The LDAP suffix where the token-based activities should be recorded by the TPS. The default value is **ou=Activities,***baseDN*.
tokendb.certBaseDN	The LDAP suffix where the certificate entries should be added by the TPS. The default value is **ou=certificates,***baseDN*.

Parameter	Description
	Change these templates only to change the appearance of the TPS agent page » tokendb.indexTemplate » tokendb.indexAdminTemplate » tokendb.newTemplate » tokendb.showTemplate » tokendb.showCertTemplate » tokendb.errorTemplate » tokendb.searchTemplate » tokendb.searchResultTemplate » tokendb.searchCertificateResultTemplate » tokendb.editTemplate » tokendb.editResultTemplate » tokendb.addResultTemplate » tokendb.deleteTemplate » tokendb.deleteResultTemplate » tokendb.searchActivityTemplate » tokendb.searchActivityResultTemplate » tokendb.showAdminTemplate » tokendb.doTokenTemplate » tokendb.doTokenConfirmTemplate » tokendb.revokeTemplate » tokendb.editAdminTemplate » tokendb.editAdminResultTemplate » tokendb.searchAdminTemplate » tokendb.searchAdminResultTemplate
tokendb.defaultPolicy	The default policy to use. The valid values are **PIN_RESET=YES|NO;** and **RE_ENROLL=YES|NO;**.

5.11.5. Configuring Server-Side Key Generation and Archival of Encryption Keys

Note

There is the option when the TPS instance is configured to set up a KRA to perform server-side key generation and key archival and recovery. If this was enabled when the TPS instance as configured, then it is not necessary to configure it manually in the **CS.cfg**. If, however, the KRA information has changed or the KRA was not configured during the installation process, then the procedure described in this section can be used to set up the KRA.

The global platform environment prevents removing private keys from the smart card. For encryption keys, it is often necessary to back up the key material for later recovery, which means the keys should be generated outside the smart card and then imported. The keys are generated in the KRA subsystem, where the keys can also be archived. The TPS, TKS, and KRA must all be configured to support server-side generation and archival for encryption keys.

To configure server-side key generation for tokens enrolled through the token management system:

1. Configure the KRA to perform server-side key generation for the appropriate kinds of tokens.
2. Add the TPS to the KRA as a key recovery agent.
3. Import the KRA transport key into the TKS.
4. Configure the TPS to generate and archive keys.

5.11.5.1. Step 1: Configuring the KRA to Perform Server-Side Key Generation for Tokens

The Key Recovery Authority (KRA) has different configuration settings to enable server-side key generation for different types of hardware security modules (HSM). If the KRA is not configured to perform key generation for the specific HSM type, the enrollment process on the TPS could fail.

1. Open the KRA's configuration directory.

   ```
   cd /var/lib/pki/pki-tomcat/kra/conf/
   ```

2. Edit the **CS.cfg** file.

   ```
   vim CS.cfg
   ```

3. Add the appropriate parameters for token key generation.

   For nCipher netHSM tokens, use:

   ```
   kra.keygen.temporaryPairs = true
   ```

   For LunaSA2 tokens, use:

   ```
   kra.keygen.temporaryPairs == true
   kra.keygen.sensitivePairs == true
   kra.keygen.extractablePairs == true
   ```

If none of these parameters are set, the default value is **kra.keygen.temporaryPairs = true**, which allows netHSM tokens to be enrolled with server-side key generation and archival.

5.11.5.2. Step 2: Configuring the TPS to Generate and Archive Keys

1. Stop the TPS.

   ```
   systemctl stop pki-tomcatd@instance_name.service
   ```

2. Edit the following parameters in the TPS **CS.cfg** file to use the appropriate KRA connection information:

   ```
    conn.kra.totalConns=1
    conn.kra1.hostport=KRA_HOST:KRA_SSLPORT
   ```

```
conn.kra1.clientNickname=Subsystem-Cert
conn.kra1.servlet.GenerateKeyPair=/kra/GenerateKeyPair
conn.kra1.servlet.TokenKeyRecovery=/kra/TokenKeyRecovery
conn.kra1.retryConnect=3
conn.kra1.SSLOn=true
conn.kra1.keepAlive=false
```

3. Also edit the smart card profiles in the TPS **CS.cfg** file.

   The TPS **CS.cfg** file has a section defining each type of smart card profile to maintain. In the default configuration, the **userKey** is defined under the **op.enroll.userKey** subsection. The **keyGen** subsection of the **userKey** profile defines each type of key/certificate pair allowed for that type of smart card. In the default configuration, one of the key/certificate pairs is **encryption**. Set the following parameters to enable server-side key generation and to archive keys:

   ```
   op.enroll.userKey.keyGen.encryption.serverKeygen.enable=true
   op.enroll.userKey.keyGen.encryption.serverKeygen.kra.conn=kra1
   op.enroll.userKey.keyGen.encryption.serverKeygen.archive=true
   ```

4. Restart the TPS subsystem.

   ```
   systemctl start pki-tomcatd@instance_name.service
   ```

5.11.6. Setting TPS Server Password Lengths

The TPS can set a minimum required length for TPS passwords used for users (which are stored in the backend LDAP databases).

```
general.pwlength.min=16
```

These settings can be edited in the **CS.cfg** file.

> **Note**
>
> Whenever the TPS configuration is changed, the TPS must be restarted to load the changes.
>
> ```
> systemctl restart pki-tomcatd@instance_name.service
> ```

5.11.7. Setting TPS Server Search Configuration

Since the TPS uses Red Hat Directory Server instances for its token database, internal database, and authentication directory, limits can be placed on LDAP searches to improve the TPS performance.

- The default and maximum number of entries returned
- The maximum search time, in seconds

Additionally, there is a parameter to set the minimum required length for TPS passwords.

Example 5.7. Default TPS Server General Configuration

```
general.pwlength.min=16
general.search.sizelimit.default=100
general.search.sizelimit.max=2000
general.search.timelimit.default=10
general.search.timelimit.max=10
```

These settings can be edited in the **CS.cfg** file.

Note

Whenever the TPS configuration is changed the TPS must be restarted to load the changes.

```
systemctl restart pki-tomcatd@instance_name.service
```

All of the searches are performed against the LDAP backend instance which is used for the TPS subsystem. If users are performing searches against a database with a high number of token or activities entries, then the searches on the Directory Server may hit a configured limit, the *ID list scan limit*. This means that the number of matching entries is so high that the server treats the search as an unindexed search. Unindexed searches are resource-intensive, so this can affect both Directory Server and TPS performance. To improve performance, consider setting the ID list scan limit on the Directory Server so that it is higher than the number of tokens or the number of activities. The default value of the ID scan limit parameter, ***nsslapd-idlistscanlimit***, is 4000. For example:

```
/usr/lib[64]/mozldap/ldapmodify -D "cn=directory manager" -w secret -p
389 -h server.example.com
changetype: modify
replace: nsslapd-idlistscanlimit
nsslapd-idlistscanlimit: 100000
^D
```

The ID list scan limit can impact Directory Server memory usage if it is set too high. For information on indexing performance and the ID list scan limit, see the Directory Server Administrator's Guide.

5.12. Configuring Connections to Other Subsystems

Every TPS has connections configured to at least one CA and one TKS instance, and optionally a KRA instance. These default connections can be edited and additional connections can be added for failover tolerance or for load balancing.

5.12.1. Editing Subsystem Connections in the TPS UI

Each connection — meaning each CA, TKS, and KRA that the TPS uses — has a separate entry in the **CS.cfg** file. The configuration is exactly the same in the TPS UI and the **CS.cfg** file, but the UI shows the changelog before saving changes and provides a layer of validation before accepting changes.

> **Note**
>
> Every configuration change performed through the TPS web UI is automatically recorded to the TPS audit logs. For change tracking, it is very useful to make configuration changes only in the TPS admin UI.

To edit a subsystem connection:

1. Open the TPS web UI.

   ```
   https://server.example.com:7889/tus/
   ```

2. Go to top level tabs at the top of the UI, select **System** → **Subsystem Connections**.

3. Choose a subsystem to edit the link.

4. Click **Disable** for the link, so the value can be edited.

5. Click **Edit** to start editing the values.

6. Click **Save** when done.

7. Restart the TPS to load the new subsystem connection information.

   ```
   systemctl restart pki-tomcatd@instance_name.service
   ```

A new subsystem connection can be added in the same way: give it a name, paste in the new configuration, and validate the settings.

5.13. Potential Token Operation Errors

Errors that are returned by smart cards are listed in Section 15.3, “Smart Card Error Codes”. These errors are specifically related to the function or behavior of the smart cards themselves, not necessarily the TPS or token management system in Certificate System.

When managing the TPS itself, it is important to know that token operations can cause a large number of unindexed searches to be returned in the instance's internal Directory Server logs. (An unindexed search shows up in Red Hat Directory Server access logs as **notes=U**.) Unindexed searches are resource-intensive and can affect performance for the Directory Server. However, many of the unindexed searches returned for Certificate System token operations are improperly labeled index searches when they are really indexed VLV searches. The remainder of the unindexed searches still had very low etimes for the searches and should not significantly affect Certificate System performance.

[2] The token type can also be determined by the server by checking the Phone Home URL for the token.

Chapter 6. Revoking Certificates and Issuing CRLs

The Certificate System provides methods for revoking certificates and for producing lists of revoked certificates, called certificate revocation lists (CRLs). This chapter describes the methods for revoking a certificate, describes CMC revocation, and provides details about CRLs and setting up CRLs.

6.1. About Revoking Certificates

Certificates can be revoked by an end user (the original owner of the certificate) or by a Certificate Manager agent. End users can revoke certificates by using the revocation form provided in the end-entities page. Agents can revoke end-entity certificates by using the appropriate form in the agent services interface. Certificate-based (SSL/TLS client authentication) is required in both cases.

An end user can revoke only certificates that contain the same subject name as the certificate presented for authentication. After successful authentication, the server lists the certificates belonging to the end user. The end user can then select the certificate to be revoked or can revoke all certificates in the list. The end user can also specify additional details, such as the date of revocation and revocation reason for each certificate or for the list as a whole.

Agents can revoke certificates based on a range of serial numbers or based on subject name components. When the revocation request is submitted, agents receive a list of certificates from which they can pick the ones to be revoked. For instructions on how agents revoke end-entity certificates, see the *Certificate System Agents Guide*.

When revocation requests are approved, the Certificate Manager marks the corresponding certificate records in its internal database as revoked, and, if configured to do so, removes the revoked certificates from the publishing directory. These changes are reflected in the next CRL which the CA issues.

Server and client applications that use public-key certificates as ID tokens need access to information about the validity of a certificate. Because one of the factors that determines the validity of a certificate is its revocation status, these applications need to know whether the certificate being validated has been revoked. The CA has a responsibility to do the following:

- Revoke the certificate if a revocation request is received by the CA and approved.
- Make the revoked certificate status available to parties or applications that need to verify its validity status.

Whenever a certificate is revoked, the Certificate Manager automatically updates the status of the certificate in its internal database, it marks the copy of the certificate in its internal database as revoked and removes the revoked certificate from the publishing directory, if the Certificate Manager is configured to remove the certificate from the database.

One of the standard methods for conveying the revocation status of certificates is by publishing a list of revoked certificates, known a certificate revocation list (CRL). A CRL is a publicly available list of certificates that have been revoked.

The Certificate Manager can be configured to generate CRLs. These CRLs can be created to conform to X.509 standards by enabling extension-specific modules in the CRL configuration. The server supports standard CRL extensions through its CRL issuing points framework; see Section 6.3.3, “Setting CRL Extensions” for more information on setting up CRL extensions for issuing points. The Certificate Manager can generate a CRL every time a certificate is revoked and at periodic intervals. If publishing is set up, the CRLs can be published to a file, an LDAP directory, or an OCSP responder.

A CRL is issued and digitally signed by the CA that issued the certificates listed in the CRL or by an entity that has been authorized by that CA to issue CRLs. The CA may use a single key pair to sign both the certificates and CRLs it issues or two separate key pairs, one for signing certificates and another one for signing CRLs.

By default, the Certificate Manager uses a single key pair for signing the certificates it issues and CRLs it generates. To create another key pair for the Certificate Manager and use it exclusively for signing CRLs, see Section 6.3.4, “Setting a CA to Use a Different Certificate to Sign CRLs”.

CRLs are generated when issuing points are defined and configured and when CRL generation is enabled.

When CRLs are enabled, the server collects revocation information as certificates are revoked. The server attempts to match the revoked certificate against all issuing points that are set up. A given certificate can match none of the issuing points, one of the issuing points, several of the issuing points, or all of the issuing points. When a certificate that has been revoked matches an issuing point, the server stores the information about the certificate in the cache for that issuing point.

The cache is copied to the internal directory at the intervals set for copying the cache. When the interval for creating a CRL is reached, a CRL is created from the cache. If a delta CRL has been set up for this issuing point, a delta CRL is also created at this time. The full CRL contains all revoked certificate information since the Certificate Manager began collecting this information. The delta CRL contains all revoked certificate information since the last update of the full CRL.

The full CRLs are numbered sequentially, as are delta CRLs. A full CRL and a delta CRL can have the same number; in that case, the delta CRL has the same number as the *next* full CRL. For example, if the full CRL is the first CRL, it is CRL 1. The delta CRL is Delta CRL 2. The data combined in CRL 1 and Delta CRL 2 is equivalent to the next full CRL, which is CRL 2.

Note

When changes are made to the extensions for an issuing point, no delta CRL is created with the next full CRL for that issuing point. A delta CRL is created with the *second* full CRL that is created, and then all subsequent full CRLs.

The internal database stores only the latest CRL and delta CRL. As each new CRL is created, the old one is overwritten.

When CRLs are published, each update to the CRL and delta CRL is published to the locations specified in the publishing set up. The method of publishing determines how many CRLs are stored. For file publishing, each CRL that is published to a file using the number for the CRL, so no file is overwritten. For LDAP publishing, each CRL that is published replaces the old CRL in the attribute containing the CRL in the directory entry.

By default, CRLs do not contain information about revoked expired certificates. The server can include revoked expired certificates by enabling that option for the issuing point. If expired certificates are included, information about revoked certificates is not removed from the CRL when the certificate expires. If expired certificates are not included, information about revoked certificates is removed from the CRL when the certificate expires.

6.1.1. User-Initiated Revocation

When an end user submits a certificate revocation request, the first step in the revocation process is for the Certificate Manager to identify and authenticate the end user to verify that the user is attempting to revoke his own certificate, not a certificate belonging to someone else.

In SSL/TSL client authentication, the server expects the end user to present a certificate that has the same subject name as the one to be revoked and uses that for authentication purposes. The server verifies the authenticity of a revocation request by mapping the subject name in the certificate presented for client authentication to certificates in its internal database. The server revokes the certificate only if the certificate maps successfully to one or more valid or expired certificates in its internal database.

After successful authentication, the server lists the valid or expired certificates that match the subject name of the certificate presented for client authentication. The user can then either select the certificates to be revoked or revoke all certificates in the list.

6.1.2. Reasons for Revoking a Certificate

A Certificate Manager can revoke any certificate it has issued. There are generally accepted reason codes for revoking a certificate that are often included in the CRL, such as the following:

- **0**. Unspecified; no particular reason is given.
- **1**. The private key associated with the certificate was compromised.
- **2**. The private key associated with the CA that issued the certificate was compromised.
- **3**. The owner of the certificate is no longer affiliated with the issuer of the certificate and either no longer has rights to the access gained with the certificate or no longer needs it.
- **4**. Another certificate replaces this one.
- **5**. The CA that issued the certificate has ceased to operate.
- **6**. The certificate is on hold pending further action. It is treated as revoked but may be taken off hold in the future so that the certificate is active and valid again.
- **8**. The certificate is going to be *removed* from the CRL because it was removed from hold. This only occurs in delta CRLs.
- **9**. The certificate is revoked because the privilege of the owner of the certificate has been withdrawn.

A certificate can be revoked by administrators, agents, and end entities. Agents and administrators with agent privileges can revoke certificates using the forms in the agent services page. End users can revoke certificates using the forms in the **Revocation** tab of the end-entity interface. End users can revoke only their own certificates, whereas agents and administrators can revoke any certificates issued by the server. End users are also required to authenticate to the server in order to revoke a certificate.

Whenever a certificate is revoked, the Certificate Manager updates the status of the certificate in its internal database. The server uses the entries in the internal database to track of all revoked certificates, and, when configured, it makes the CRLs public by publishing it to a central repository to notify other users that the certificates in the list are no longer valid.

6.1.3. CRL Issuing Points

Because CRLs can grow very large, there are several methods to minimize the overhead of retrieving and delivering large CRLs. One of these methods partitions the entire certificate space and associates a separate CRL with every partition. This partition is called a *CRL issuing point*, the location where a subset of all the revoked certificates is maintained. Partitioning can be based on whether the revoked certificate is a CA certificate, whether it was revoked for a specific reason, or whether it was issued using a specific profile. Each issuing point is identified by its name.

By default, the Certificate Manager generates and publishes a single CRL, the *master CRL*. An issuing point can generate CRLs for all certificates, for only CA signing certificates, or for all certificates including expired certificates.

Once the issuing points have been defined, they can be included in certificates so that an application that needs to check the revocation status of a certificate can access the CRL issuing points specified in the certificate instead of the master or main CRL. Since the CRL maintained at the issuing point is smaller than the master CRL, checking the revocation status is much faster.

CRL distribution points can be associated with certificates by setting the **CRLDistributionPoint** extension.

6.1.4. Delta CRLs

Delta CRLs can be issued for any defined issuing point. A delta CRL contains information about any certificates revoked since the last update to the full CRL. Delta CRLs for an issuing point are created by enabling the **DeltaCRLIndicator** extension.

6.1.5. Publishing CRLs

The Certificate Manager can publish the CRL to a file, an LDAP-compliant directory, or to an OCSP responder. Where and how frequently CRLs are published are configured in the Certificate Manager, as described in Chapter 7, *Publishing Certificates and CRLs*.

Because CRLs can be very large, publishing CRLs can take a very long time, and it is possible for the process to be interrupted. Special publishers can be configured to publish CRLs to a file over HTTP1.1, and, if the process is interrupted, the CA subsystem's web server can resume publishing at the point it was interrupted, instead of having to begin again. This is described in Section 7.8, “Setting up Resumable CRL Downloads”.

6.1.6. Certificate Revocation Pages

The end-entities page of the Certificate Manager includes default HTML forms for revocation authenticated by an SSL/TLS client. The forms are accessible from the **Revocation** tab. You can see the form for such a revocation by clicking the **User Certificatae** link.

To change the form appearance to suit organization's requirements, edit the **UserRevocation.html**, the form that allows the SSL/TSL client authenticated revocation of client or personal certificates. The file is in the **/var/lib/*instance_name*/webapps/*subsystem_type*/ee/*subsystem_type*** directory.

6.2. Performing a CMC Revocation

CMC revocation allows users to set up a revocation client, sign the revocation request with an agent certificate, and then send the signed request to the Certificate Manager. When this method is used, the Certificate Manager automatically issues certificates when a valid certificate request signed with the agent's certificate is received and automatically revokes a certificate when a valid revocation request signed with the agent's certificate is received.

6.2.1. Setting up CMC Revocation

To use CMC to revoke certificates, do the following:

- Set up an instance of the CMCAuth Authentication plug-in module. An instance is enabled and configured by default.
- Use the agent certificate to sign revocation requests.

The CMC revocation utility, **CMCRevoke**, is used to sign a revocation request with an agent's certificate. This utility simply passes the required information — certificate serial number, issuer name, and revocation reason — to identify the certificate to revoke, and then the require information to identify the CA agent performing the revocation (certificate nickname and the database with the certificate).

The reason the certificate is being revoked can be any of the following (with the number being the value passed to the **CMCRevoke** utility):

- **0** — unspecified
- **1** — the key was compromised
- **2** — the CA key was compromised
- **3** — the employee's affiliation changed
- **4** — the certificate has been superseded
- **5** — cessation of operation
- **6** — the certificate is on hold

The available tool arguments are described in detail in the *Command-Line Tools Guide*.

6.2.2. Testing CMCRevoke

1. Create a CMC revocation request for an existing certificate.

   ```
   CMCRevoke -d/path/to/agent-cert-db -nnickname -iissuerName -
   sserialName -mreason -ccomment
   ```

   For example, if the directory containing the agent certificate is **~jsmith/.mozilla/firefox/**, the nickname of the certificate is **AgentCert**, and the serial number of the certificate is **22**, the command is as shown:

```
CMCRevoke -d"~jsmith/.mozilla/firefox/" -n"ManagerAgentCert" -
i"cn=agentAuthMgr" -s22 -m0 -c"test comment"
```

> **Note**
>
> Surround values that include spaces in quotation marks.

> **Important**
>
> Do not have a space between the argument and its value. For example, giving a serial number of 26 is **-s26**, not **-s 26**.

2. Open the end-entities page.

   ```
   https://server.example.com:8443/ca/ee/ca
   ```

3. Select the **Revocation** tab.

4. Select the **CMC Revoke** link on the menu.

5. Paste the output from the **CMCRevoke** into the text area.

6. Remove **-----BEGIN NEW CERTIFICATE REQUEST-----** and **----END NEW CERTIFICATE REQUEST-----** from the pasted content.

7. Click **Submit**.

8. The returned page should confirm that correct certificate has been revoked.

6.3. Issuing CRLs

1. The Certificate Manager uses its OCSP signing key to sign CRLs. To use a separate signing key pair for CRLs, set up a CRL signing key and change the Certificate Manager configuration to use this key to sign CRLs. See Section 6.3.4, "Setting a CA to Use a Different Certificate to Sign CRLs" for more information.

2. Set up CRL issuing points. An issuing point is already set up and enabled for a master CRL.

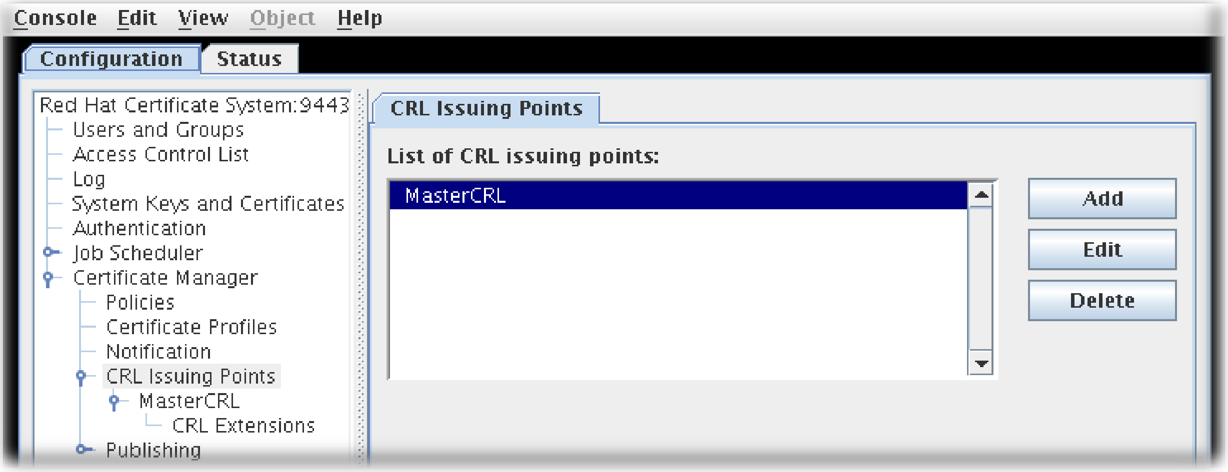


Figure 6.1. Default CRL Issuing Point

Additional issuing points for the CRLs can be created. See Section 6.3.1, "Configuring Issuing Points" for details.

There are five types of CRLs the issuing points can create, depending on the options set when configuring the issuing point to define what the CRL will list:

- *Master CRL* contains the list of revoked certificates from the entire CA.
- *ARL* is an Authority Revocation List containing only revoked CA certificates.
- *CRL with expired certificates* includes revoked certificates that have expired in the CRL.
- *CRL from certificate profiles* determines the revoked certificates to include based on the profiles used to create the certificates originally.
- *CRLs by reason code* determines the revoked certificates to include based on the revocation reason code.

3. Configure the CRLs for each issuing point. See Section 6.3.2, "Configuring CRLs for Each Issuing Point" for details.

4. Set up the CRL extensions which are configured for the issuing point. See Section 6.3.3, "Setting CRL Extensions" for details.

5. Set up the delta CRL for an issuing point by enabling extensions for that issuing point, **DeltaCRLIndicator** or **CRLNumber**.

6. Set up the **CRLDistributionPoint** extension to include information about the issuing point.

7. Set up publishing CRLs to files, an LDAP directory, or an OCSP responder. See Chapter 7, *Publishing Certificates and CRLs* for details about setting up publishing.

6.3.1. Configuring Issuing Points

Issuing points define which certificates are included in a new CRL. A master CRL issuing point is created by default for a master CRL containing a list of all revoked certificates for the Certificate Manager.

To create a new issuing point, do the following:

1. Open the Certificate System Console.

```
pkiconsole https://server.example.com:8443/ca
```

2. In the **`Configuration`** tab, expand **`Certificate Manager`** from the left navigation menu. Then select **`CRL Issuing Points`**.

3. To edit an issuing point, select the issuing point, and click **`Edit`**. The only parameters which can be edited are the name of the issuing point and whether the issuing point is enabled or disabled.

   To add an issuing point, click **`Add`**. The CRL Issuing Point Editor window opens.

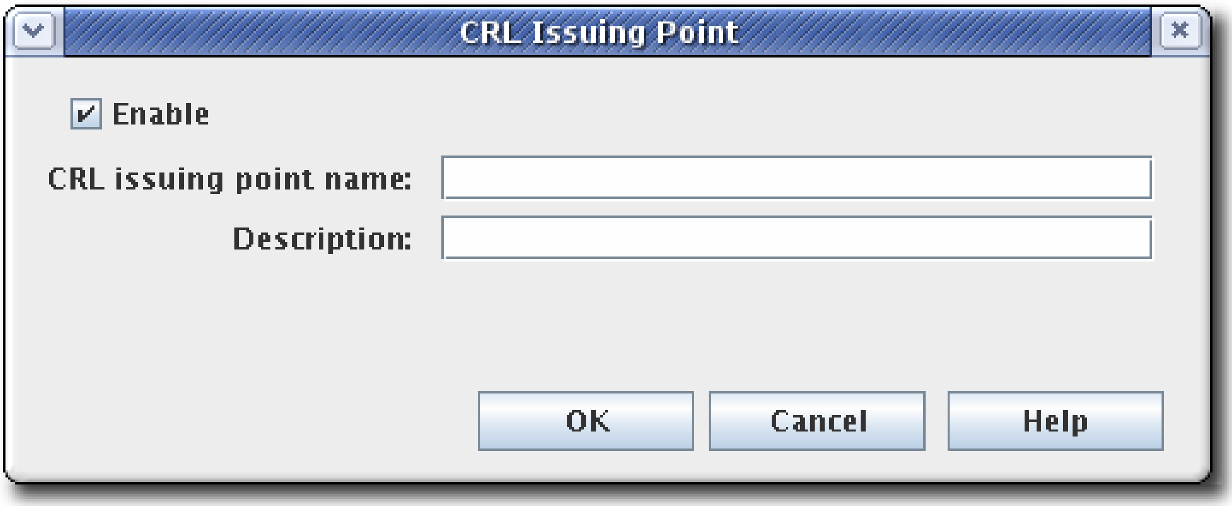
   

   Figure 6.2. CRL Issuing Point Editor

   > **Note**
   >
   > If some fields do not appear large enough to read the content, expand the window by dragging one of the corners.

   Fill in the following fields:

   - **`Enable`**. Enables the issuing point if selected; deselect to disable.
   - **`CRL Issuing Point name`**. Gives the name for the issuing point; spaces are not allowed.
   - **`Description`**. Describes the issuing point.

4. Click **`OK`**.

To view and configure a new issuing point, close the CA Console, then open the Console again. The new issuing point is listed below the **`CRL Issuing Points`** entry in the navigation tree.

Configure CRLs for the new issuing point, and set up any CRL extensions that will be used with the CRL. See Section 6.3.2, “Configuring CRLs for Each Issuing Point” for details on configuring an issuing point. See Section 6.3.3, “Setting CRL Extensions” for details on setting up the CRL extensions. All the CRLs created appear on the **Update Revocation List** page of the agent services pages.

6.3.2. Configuring CRLs for Each Issuing Point

Information, such as the generation interval, the CRL version, CRL extensions, and the signing algorithm, can all be configured for the CRLs for the issuing point. The CRLs must be configured for each issuing point.

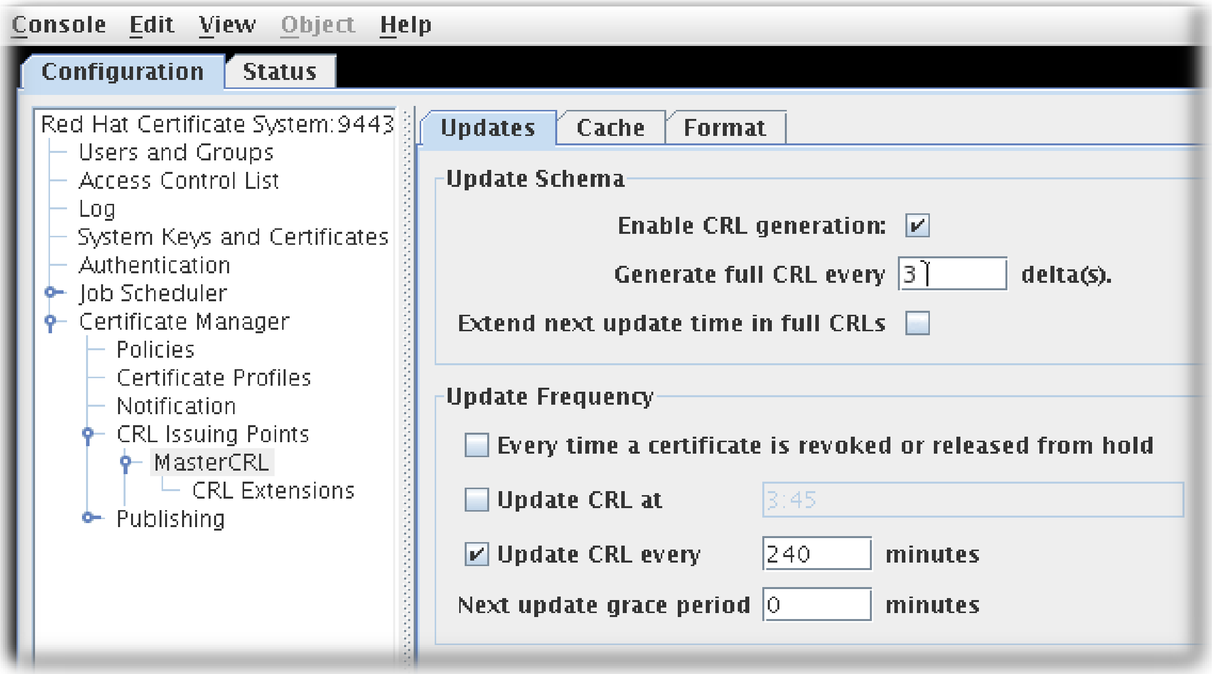
1. Open the CA console.

```
pkiconsole https://server.example.com:8443/ca
```

2. In the navigation tree, select **Certificate Manager**, and then select **CRL Issuing Points**.

3. Select the issuing point name below the **Issuing Points** entry.

4. Configure how and how often the CRLs are updated by supplying information in the **Update** tab for the issuing point. This tab has two sections, **Update Schema** and **Update Frequency**.



- The **Update Schema** section has the following options:

  - **Enable CRL generation**. This checkbox sets whether CRLs are generated for that issuing point.

  - **Generate full CRL every # delta(s)**. This field sets how frequently CRLs are created in relation to the number of changes.

  - **Extend next update time in full CRLs**. This provides an option to set the **nextUpdate** field in the generated CRLs. The ***nextUpdate*** parameter shows the date when the next CRL is issued, regardless of whether it is a full or delta CRL. When using a combination of full and delta CRLs, enabling ***Extend***

next update time in full CRLs will make the ***nextUpdate*** parameter in a full CRL show when the next *full* CRL will be issued. Otherwise, the ***nextUpdate*** parameter in the full CRL will show when the next *delta* CRL will be issued, since the delta will be the next CRL to be issued.

- The **Update Frequency** section sets the different intervals when the CRLs are generated and issued to the directory.

  - **Every time a certificate is revoked or released from hold**. This sets the Certificate Manager to generate the CRL every time it revokes a certificate. The Certificate Manager attempts to issue the CRL to the configured directory whenever it is generated. Generating a CRL can be time consuming if the CRL is large. Configuring the Certificate Manager to generate CRLs every time a certificate is revoked may engage the server for a considerable amount of time; during this time, the server will not be able to update the directory with any changes it receives.

    This setting is not recommended for a standard installation. This option should be selected to test revocation immediately, such as testing whether the server issues the CRL to a flat file.

  - **Update the CRL at**. This field sets a daily time when the CRL should be updated. To specify multiple times, enter a comma-separate list of times, such as **01:50,04:55,06:55**. To enter a schedule for multiple days, enter a comma-separated list to set the times within the same day, and then a semicolon separated list to identify times for different days. For example, this sets revocation on Day 1 of the cycle at 1:50am, 4:55am, and 6:55am and then Day 2 at 2am, 5am, and 5pm:

    ```
    01:50,04:55,06:55;02:00,05:00,17:00
    ```

  - **Update the CRL every**. This checkbox enables generating CRLs at the interval set in the field. For example, to issue CRLs every day, select the checkbox, and enter **1440** in this field.

  - **Next update grace period**. If the Certificate Manager updates the CRL at a specific frequency, the server can be configured to have a grace period to the next update time to allow time to create the CRL and issue it. For example, if the server is configured to update the CRL every 20 minutes with a grace period of 2 minutes, and if the CRL is updated at 16:00, the CRL is updated again at 16:18.

5. The **Cache** tab sets whether caching is enabled and the cache frequency.

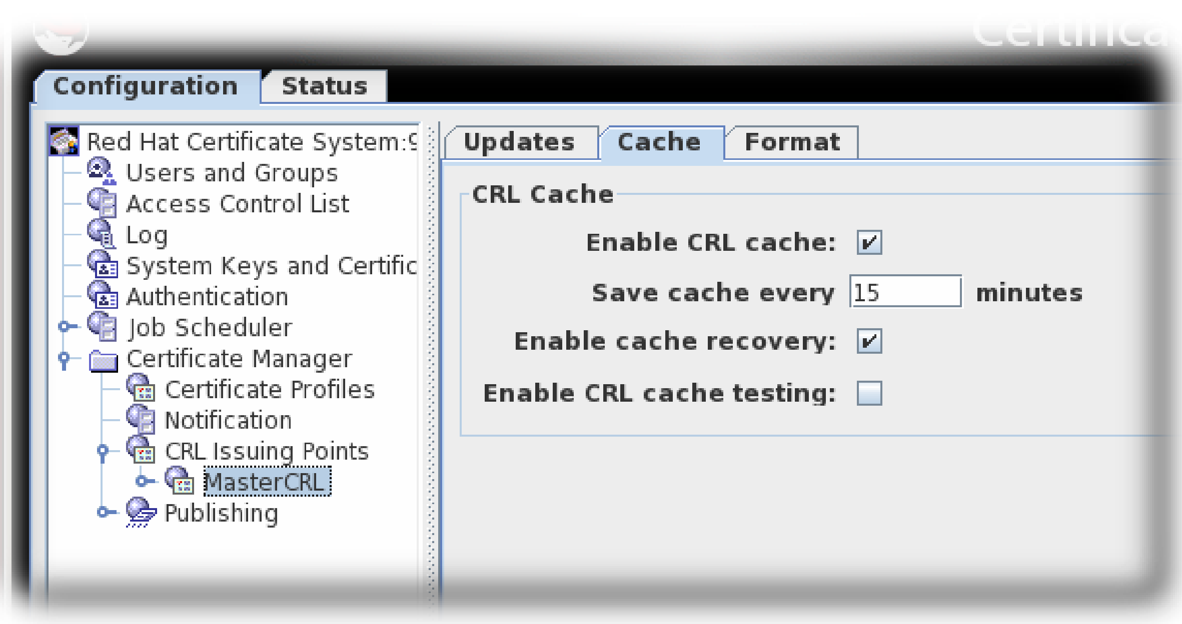


Figure 6.3. CRL Cache Tab

- **`Enable CRL cache`**. This checkbox enables the cache, which is used to create delta CRLs. If the cache is disabled, delta CRLs will not be created. For more information about the cache, see Section 6.1, “About Revoking Certificates”.

- **`Update cache every`**. This field sets how frequently the cache is written to the internal database. Set to **`0`** to have the cache written to the database every time a certificate is revoked.

- **`Enable cache recovery`**. This checkbox allows the cache to be restored.

- **`Enable CRL cache testing`**. This checkbox enables CRL performance testing for specific CRL issuing points. CRLs generated with this option should not be used in deployed CAs, as CRLs issued for testing purposed contain data generated solely for the purpose of performance testing.

6. The **`Format`** tab sets the formatting and contents of the CRLs that are created. There are two sections, **`CRL Format`** and **`CRL Contents`**.

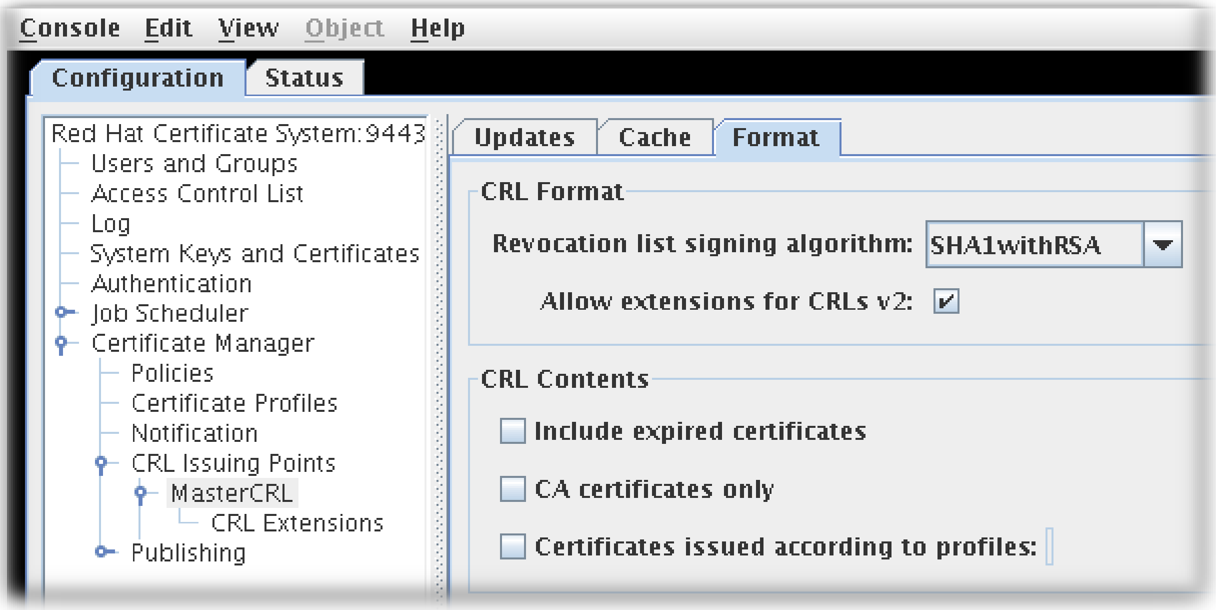


Figure 6.4. CRL Format Tab

- The **`CRL Format`** section has two options:
  - **`Revocation list signing algorithm`** is a drop down list of allowed ciphers to encrypt the CRL.
  - **`Allow extensions for CRL v2`** is a checkbox which enabled CRL v2 extensions for the issuing point. If this is enabled, set the required CRL extensions described in Section 6.3.3, “Setting CRL Extensions”.

> **Note**
>
> Extensions must be turned on to create delta CRLs.

- The **`CRL Contents`** section has three checkboxes which set what types of certificates to include in the CRL:
  - **`Include expired certificates`**. This includes revoked certificates that have expired. If this is enabled, information about revoked certificates remains in the CRL after the certificate expires. If this is not enabled, information about revoked certificates is removed when the certificate expires.
  - **`CA certificates only`**. This includes only CA certificates in the CRL. Selecting this option creates an Authority Revocation List (ARL), which lists only revoked CA certificates.
  - **`Certificates issued according to profiles`**. This only includes certificates that were issued according to the listed profiles; to specify multiple profiles, enter a comma-separated list.

7. Click **Save**.

8. Extensions are allowed for this issuing point and can be configured. See Section 6.3.3, “Setting CRL Extensions” for details.

6.3.3. Setting CRL Extensions

> **Note**
>
> Extensions only need configured for an issuing point if the **`Allow extensions for CRLs v2`** checkbox is selected for that issuing point.

When the issuing point is created, three extensions are automatically enabled: **`CRLReason`**, **`InvalidityDate`**, and **`CRLNumber`**. Other extensions are available but are disabled by default. These can be enabled and modified. For more information about the available CRL extensions, see Section B.4.2, "Standard X.509 v3 CRL Extensions Reference".

To configure CRL extensions, do the following:

1. Open the CA console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

2. In the navigation tree, select **`Certificate Manager`**, and then select **`CRL Issuing Points`**.

3. Select the issuing point name below the **`Issuing Points`** entry, and select the **`CRL Extension`** entry below the issuing point.

   The right pane shows the **`CRL Extensions Management`** tab, which lists configured extensions.

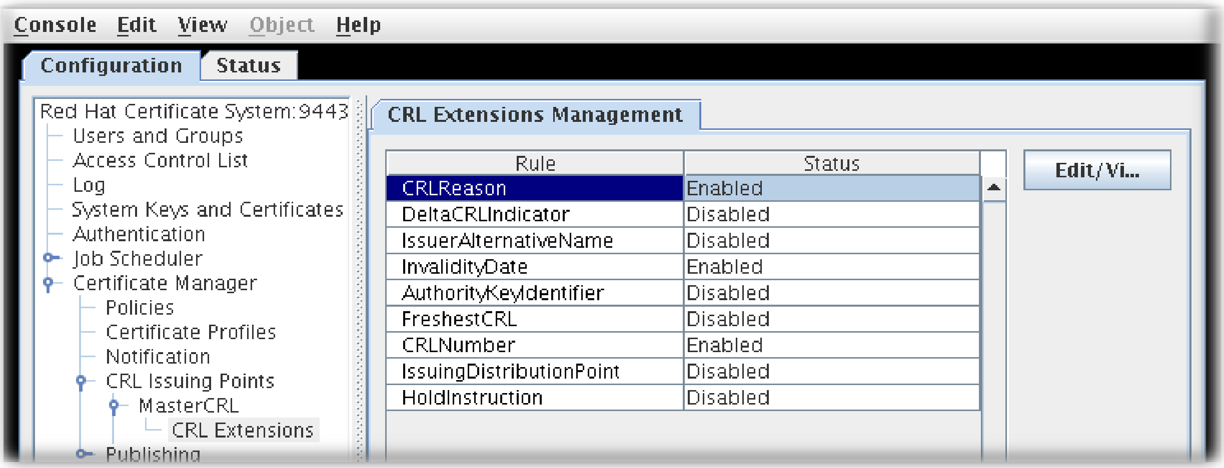


Figure 6.5. CRL Extensions

4. To modify a rule, select it, and click **`Edit/View`**.

5. Most extensions have two options, enabling them and setting whether they are critical. Some require more information. Supply all required values. See Section B.4.2, "Standard X.509 v3 CRL Extensions Reference" for complete information about each extension and the parameters for those extensions.

6. Click **`OK`**.

7. Click **Refresh** to see the updated status of all the rules.

6.3.4. Setting a CA to Use a Different Certificate to Sign CRLs

A Certificate Manager uses the key pair corresponding to its OCSP signing certificate for signing certificates and certificate revocation lists (CRLs). To use a different key pair to sign the CRLs that the Certificate Manager generates, then a CRL signing certificate can be created. The Certificate Manager's CRL signing certificate must be signed or issued by itself.

To enable a Certificate Manager to sign CRLs with a different key pair, do the following:

1. Request and install a CRL signing certificate for the Certificate Manager.

   This can be done through the certificate wizard in **System Keys and Certificates** in the console. Use the wizard to request a certificate of the "other" type, and specify "crlSigning" as the certificate type.

   Alternatively, use the **certutil** tool to generate a key pair, request a certificate for the key pair, and install the certificate in the Certificate Manager's certificate database. For more information about the **certutil** tool, see http://www.mozilla.org/projects/security/pki/nss/tools/.

2. When the certificate request has been created, submit it through the Certificate Manager end-entities page. The page has a URL in the following format:

   ```
   https://hostname:port/ca/ee/ca
   ```

3. After the request is submitted, log into the agent services page.

4. Check the request for required extensions. The CRL signing certificate must contain the **Key Usage** extension with the **crlSigning** bit set.

5. Approve the request.

6. After the CRL signing certificate is generated, install the certificate in the Certificate Manager's database through **System Keys and Certificates** in the console.

7. Stop the Certificate Manager.

   ```
   ]# systemctl stop pki-tomcatd@instance_name.service
   ```

8. Update the Certificate Manager's configuration to recognize the new key pair and certificate.

   a. Change to the Certificate Manager instance configuration directory.

      ```
      ]# cd /var/lib/pki/instance-name/ca/conf/
      ```

   b. Open the **CS.cfg** file and add the following lines:

      ```
      ca.crl_signing.cacertnickname=nickname cert-instance_ID
      ca.crl_signing.defaultSigningAlgorithm=signing_algorithm
      ca.crl_signing.tokenname=token_name
      ```

      nickname is the name assigned to the CRL signing certificate; *instance_ID* is the name of the Certificate Manager instance; *signing_algorithm* is **MD5withRSA**, **MD2withRSA**, or **SHA1withRSA**, if the key type is RSA; and *token_name* is the name of the token used for generating the key pair and the certificate. If the internal/software token is used, use **Internal Key Storage Token** as the value.

For example, the entries might look like this:

```
ca.crl_signing.cacertnickname=crlSigningCert cert-pki-ca
ca.crl_signing.defaultSigningAlgorithm=MD5withRSA
ca.crl_signing.tokenname=Internal Key Storage Token
```

c. Save the changes, and close the file.

9. Restart the Certificate Manager.

```
]# systemctl restart pki-tomcatd@instance_name.service
```

Now the Certificate Manager is ready to use the CRL signing certificate to sign the CRLs it generates.

6.3.5. Generating CRLs from Cache

By default, CRLs are generated from the CA's internal database. However, revocation information can be collected as the certificates are revoked and kept in memory. This revocation information can then be used to update CRLs from memory. Bypassing the database searches that are required to generate the CRL from the internal database significantly improves performance.

Note

Because of the performance enhancement from generating CRLs from cache, enable the ***enableCRLCache*** parameter in most environments. However, the ***Enable CRL cache testing*** parameter *should not* be enabled in a production environment.

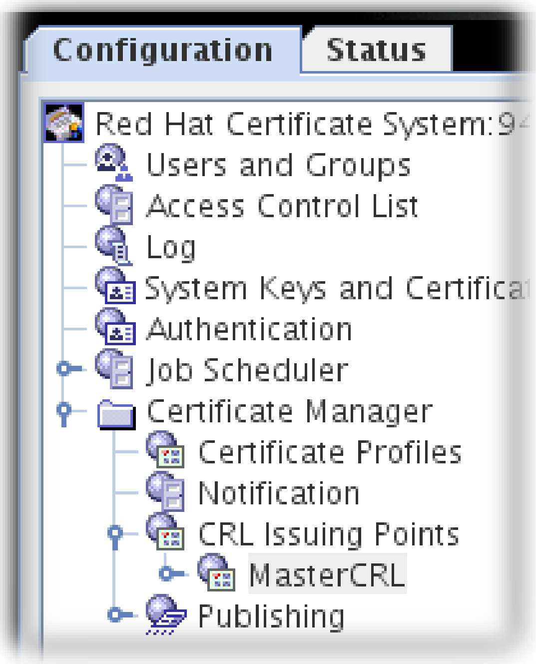
6.3.5.1. Configuring CRL Generation from Cache in the Console

1. Open the console.

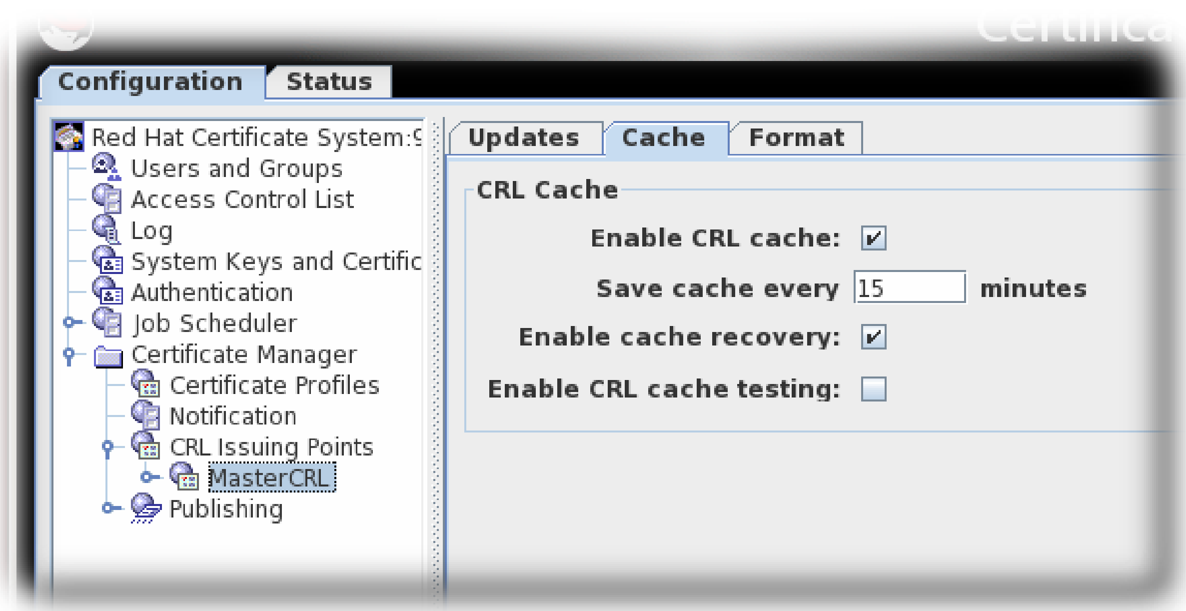
```
pkiconsole https://server.example.com:8443/ca
```

2. In the **Configuration** tab, expand the **Certificate Manager** folder and the **CRL Issuing Points** subfolder.

3. Select the **MasterCRL** node.



4. Select **Enable CRL cache**.



5. Save the changes.

6.3.5.2. Configuring CRL Generation from Cache in CS.cfg

1. Stop the CA server.

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Open the CA configuration directory.

```
]# cd /var/lib/instance_name/conf/
```

3. Edit the **CS.cfg** file, setting the ***enableCRLCache*** and ***enableCacheRecovery*** parameters to true:

```
ca.crl.MasterCRL.enableCRLCache=true
ca.crl.MasterCRL.enableCacheRecovery=true
```

4. Start the CA server.

```
]# systemctl start pki-tomcatd@instance_name.service
```

6.4. Setting Full and Delta CRL Schedules

CRLs are generated periodically. Setting that period is touched on in the configuration in Section 6.3.2, "Configuring CRLs for Each Issuing Point".

CRLs are issued according to a time-based schedule. CRLs can be issued every single time a certificate is revoked, at a specific time of day, or once every so-many minutes.

Time-based CRL generation schedules apply to every CRL that is generated. There are two kinds of CRLs, full CRLs and delta CRLs. A full CRL has a record of every single revoked certificate, whereas delta CRLs contain only the certificates that have been revoked since the last CRL (delta or full) was generated.

By default, full CRLs are generated at every specified interval in the schedule. It is possible space out the time between generating full CRLs by generating interim *delta* CRLs. The generation interval is configured in the *CRL schema*, which sets the scheme for generating delta and full CRLs.

If the interval is set to 3, for example, then the first CRL generated will be both a full and delta CRL, then the next two generation updates are delta CRLs only, and then the fourth interval is both a full and delta CRL again. In other words, every third generation interval has both a full CRL and a delta CRL.

```
Interval   1, 2, 3, 4, 5, 6, 7 ...
Full CRL   1        4        7 ...
Delta CRL  1, 2, 3, 4, 5, 6, 7 ...
```

Note

For delta CRLs to be generated in addition to full CRLs, the CRL cache must be enabled.

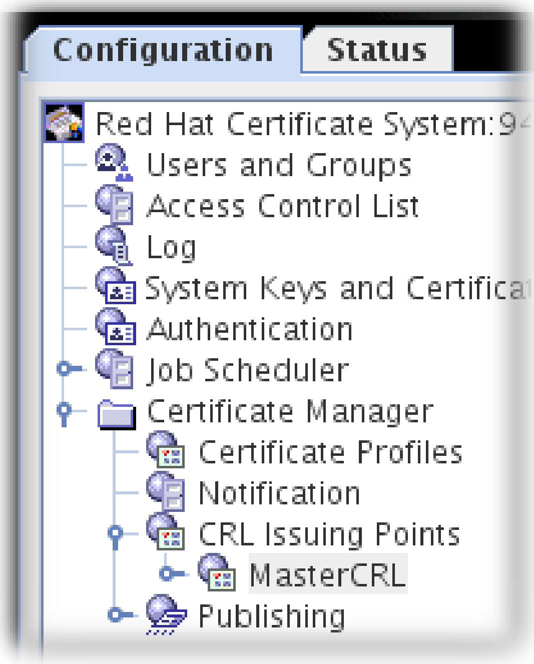
6.4.1. Configuring CRL Update Intervals in the Console

1. Open the console.

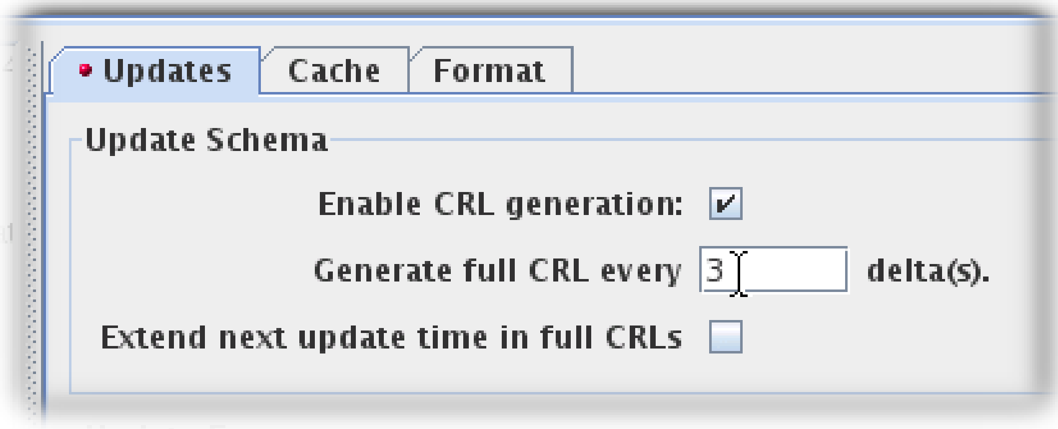
```
pkiconsole https://server.example.com:8443/ca
```

2. In the **Configuration** tab, expand the **Certificate Manager** folder and the **CRL Issuing Points** subfolder.

3. Select the **MasterCRL** node.

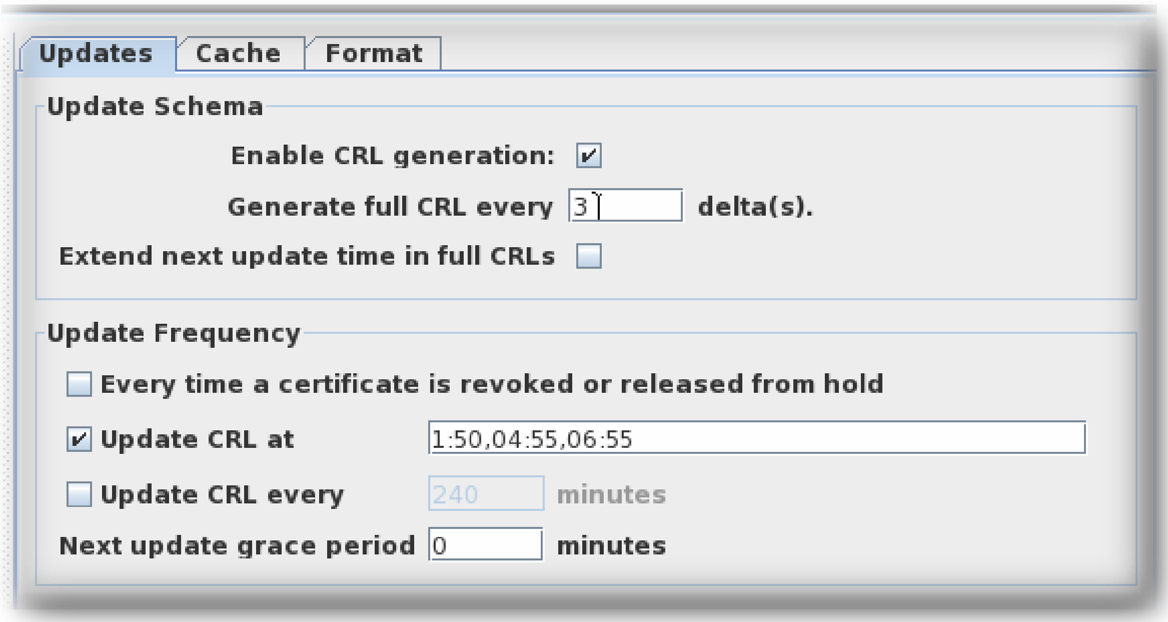


4. Enter the required interval in the **`Generate full CRL every # delta(s)`** field.

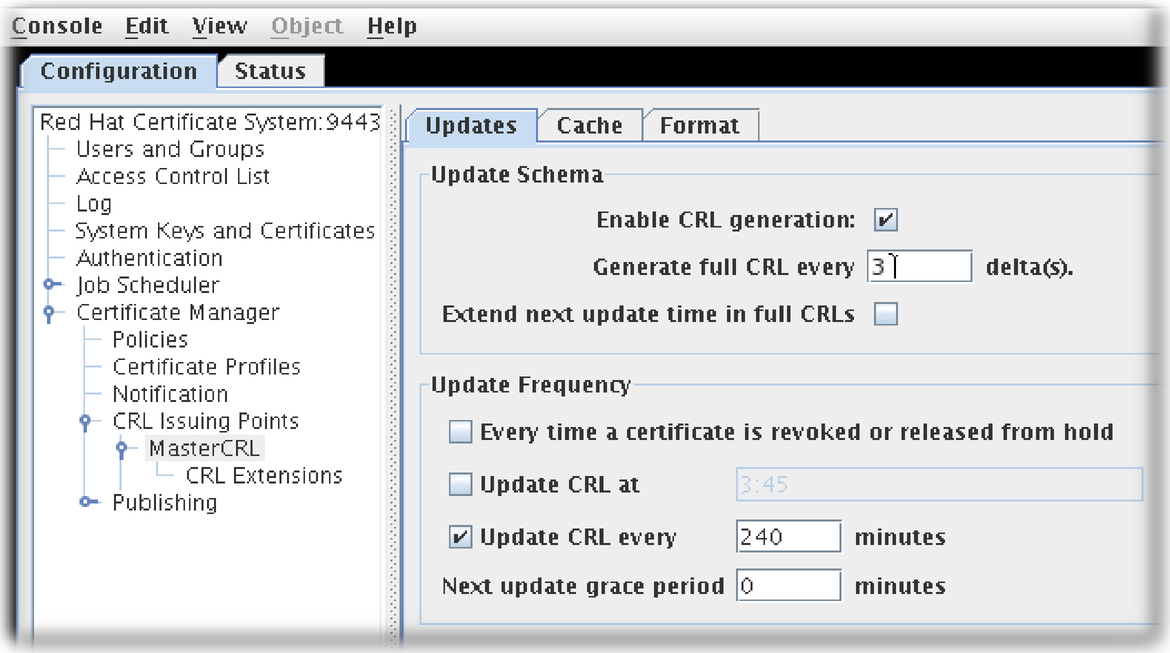


5. Set the update frequency, either by specifying a cyclical interval or set times for the updates to occur:

   » Select the **`Update CRL at`** checkbox and enter specific times separated by commas, such as **`01:50,04:55,06:55`**.



- Select **Update CRL every** checkbox and enter the required interval, such as **240**.

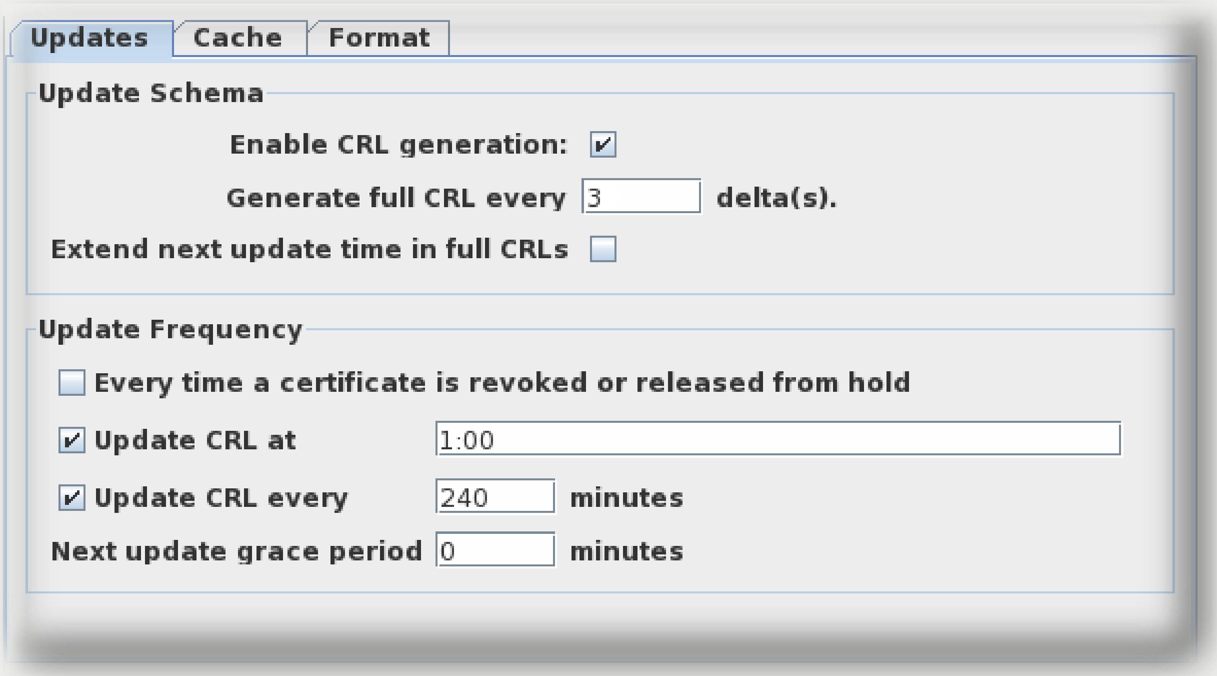


6. Save the changes.

Note

Schedule drift can occur when updating CRLs by interval. Typically, drift occurs as a result of manual updates and CA restarts.

To prevent schedule drift, select the **`Update CRL at`** checkbox and enter a value. The interval updates will resynchronize with the **`Update CRL at`** value every 24 hours.



Only one **`Update CRL at`** value will be accepted when updating CRLs by interval.

6.4.2. Configuring Update Intervals for CRLs in CS.cfg

Configuring the settings for full and delta CRLs in the **`CS.cfg`** file involves editing parameters.

Table 6.1. CRL Extended Interval Parameters

Parameter	Description	Accepted Values
updateSchema	Sets the ratio for how amny delta CRLs are generated per full CRL.	An integer value
enableDailyUpdates	Enables and disables setting CRL updates based on set times.	true or false
enableUpdateInterval	Enables and disables setting CRL updates based on set intervals.	true or false
dailyUpdates	Sets the times the CRLs should be updated	A comma delimited list of times.

Parameter	Description	Accepted Values
autoUpdateInterval	Sets the interval in minutes to update the CRLs.	An integer value.

1. Stop the CA server.

```
]#  systemctl stop pki-tomcatd@instance_name.service
```

2. Change to the CA configuration directory.

```
]# cd /var/lib/instance_name/conf/
```

3. Edit the **CS.cfg** file, and add the following line to set the update interval:

```
ca.crl.MasterCRL.updateSchema=3
```

   The default interval is 1, meaning a full CRL is generated every time a CRL is generated. The ***updateSchema*** interval can be set to any integer.

4. Set the update frequency, either by specifying a cyclical interval or set times for the updates to occur:

   - Specify set times by enabling the ***enableDailyUpdates*** parameter, and add the desired times to the ***dailyUpdates*** parameter:

```
ca.crl.MasterCRL.enableDailyUpdates=true
ca.crl.MasterCRL.enableUpdateInterval=false
ca.crl.MasterCRL.dailyUpdates=0:50,04:55,06:55
```

     Specify intervals by enabling the ***enableUpdateInterval*** parameter, and add the required interval in minutes to the ***autoUpdateInterval*** parameter:

```
ca.crl.MasterCRL.enableDailyUpdates=false
ca.crl.MasterCRL.enableUpdateInterval=true
ca.crl.MasterCRL.autoUpdateInterval=240
```

5. Restart the CA server.

```
systemctl start pki-tomcatd@instance_name.service
```

> **Note**
>
> Schedule drift can occur when updating CRLs by interval. Typically, drift occurs as a result of manual updates and CA restarts.
>
> To prevent schedule drift, set both ***enableDailyUpdates*** and ***enableUpdateInterval*** parameters to true, and add the required values to ***autoUpdateInterval*** and ***dailyUpdates***:
>
> ```
> ca.crl.MasterCRL.enableDailyUpdates=true
> ca.crl.MasterCRL.enableUpdateInterval=true
> ca.crl.MasterCRL.autoUpdateInterval=240
> ca.crl.MasterCRL.dailyUpdates=1:00
> ```
>
> Only one ***dailyUpdates*** value will be accepted when updating CRLs by interval.
>
> The interval updates will resynchronize with the ***dailyUpdates*** value every 24 hours preventing schedule drift.

6.4.3. Configuring CRL Generation Schedules over Multiple Days

By default, CRL generaton schedules cover 24 hours. Also, by default, when full and delta CRLs are enabled full CRLs occur at specific intervals in place of one or all delta CRLs, i.e., every third update.

To set CRL generation schedules across multiple days, the list of times uses commas to separate times within the same day and a semicolon to delimit days:

```
ca.crl.MasterCRL.dailyUpdates=01:00,03:00,18:00;02:00,05:00,17:00
```

This example updates CRLs on day one of the schedule at 01:00, 03:00, and 18:00, and on day two of the schedule at 02:00, 05:00, and 17:00. On day three the cycle starts again.

> **Note**
>
> The semicolon indicates a new day. Starting the list with a semicolon results in an initial day where no CRLs are generated. Likewise, ending the list with a semicolon adds a final day to the schedule where no CRLs are generated. Two semicolons together result in a day with no CRL generation.

To set full CRL updates independent of delta updates, the list of times accepts time values prepended with an asterisk to indicate when full CRL updates should occur:

```
ca.crl.MasterCRL.dailyUpdates=01:00,03:00,18:00,*23:00;02:00,05:00,21:00
,*23:30
```

This example generates delta CRL updates on day one at 01:00, 03:00, and 18:00, with a full and delta CRL update at 23:00. On day two, delta CRLs are updated at 02:00, 05:00, and 21:00, with a full and delta CRL update at 23:30. On day three, the cycle starts again.

Note

The semicolon and asterisk syntax works in both the console and when manually editing the **CS.cfg** file.

6.5. Enabling Revocation Checking

Revocation checking means that a Certificate System subsystem verifies that a certificate is both valid and not revoked when an agent or administrator attempts to access the instance's secure interfaces. This leverages a local OCSP service (either a CA's internal OCSP service or a separate OCSP responder) to check the revocation status of the certificate.

OCSP configuration is covered in Section 6.6, “Using the Online Certificate Status Protocol (OCSP) Responder”.

6.5.1. Enabling Automatic Revocation Checking on the CA

The CA can be configured to check the revocation status of any certificate (including agent, administrator, and enrollment) the server receives during authentication of an SSL/TLS client. This means that when the CA receives any client authentication request, it automatically checks an OCSP. (For information about setting up an OCSP responder, see Section 6.6, “Using the Online Certificate Status Protocol (OCSP) Responder”.)

As part of revocation checking, the CA has the ability to cache client authentication so that it keeps a list of verified certificates. This allows the CA to check its cached results before checking its internal database or an OCSP, which improves the overall operation performance. Automatic revocation checking is enabled in the ***revocationChecking.enabled*** parameter.

The revocation status results are only valid for a certain, specified period of time (***revocationChecking.validityInterval***). If the CA has no way to re-verify a certificate status that is in cache, then there is a grace interval (***revocationChecking.unknownStateInterval***) where the previously-cached status is still considered valid, even if it is outside the validity interval.

Note

The cached certificates are kept in a buffer (***revocationChecking.bufferSize***). If the buffer setting is missing or is set to zero, then no buffer is kept, which means that the results of revocation checks are not cached. In that case, all revocation checks are performed directly against the CA's internal database.

> **Note**
>
> The subsystem **CS.cfg** configuration file includes a parameter, **jss.ocspcheck.enable**, which sets whether a Certificate Manager should use an OCSP to verify the revocation status of the certificate it receives as a part of SSL/TLS client or server authentication. Changing the value of this parameter to **true** means the Certificate Manager reads the Authority Information Access extension in the certificate and verifies the revocation status of the certificate from the OCSP responder specified in the extension.

1. Stop the subsystem instance.

   ```
   ]# systemctl stop pki-tomcatd@instance_name.service
   ```

2. Open the **CS.cfg** file.

   ```
   vim /var/lib/pki/instance-name/ca/conf/CS.cfg
   ```

3. Edit the revocation-related parameters.

   ```
   auths.revocationChecking.bufferSize=50
   auths.revocationChecking.ca=ca
   auths.revocationChecking.enabled=true
   auths.revocationChecking.unknownStateInterval=0
   auths.revocationChecking.validityInterval=120
   ```

   - ***revocationChecking.ca***. Sets which service is providing the OCSP respsonse, a CA or an OCSP responder.
   - ***revocationChecking.enabled***. Sets revocation checking. **true** enables checking; **false** disables checking. By default, the feature is enabled.
   - ***revocationChecking.bufferSize***. Sets the total number of last-checked certificates the server should maintain in its cache. For example, if the buffer size is 2, the server retains the last two certificates checked in its cache. By default, the server caches the last 50 certificates.
   - ***revocationChecking.unknownStateInterval***. Sets how frequently the server checks the revocation status. The default interval is 0 seconds. unknownStateInterval is a grace period in which cache result will be assumed to be true if CA has no means (no access to information allowing) to verify certificate status
   - ***revocationChecking.validityInterval***. Sets how long the cached certificates are considered valid. Be judicious when choosing the interval. For example, if the validity period is 60 seconds, the server discards the certificates in its cache every minute and attempts to retrieve them from their source. The Certificate Manager uses its internal database to retrieve and verify the revocation status of the certificates. The default validity period is 120 seconds (2 minutes).

4. Start the Certificate System instance.

   ```
   ]# systemctl start pki-tomcatd@instance_name.service
   ```

6.5.2. Enabling Certificate Revocation Checking for Subsystems

The Certified System subsystems do not have OCSP checking enabled, by default, to validate subsystem certificates. This means it is possible for someone to log into the administrative or agent interfaces with a revoked certificate.

OCSP checking can be enabled for all subsystems by editing the **server.xml** file. The agent interface and the admin interface are configured separately, so both sections in the configuration should be edited.

> **Note**
>
> If the subsystem has been configured to use an SSL/TLS connection with its internal database, then the SSL/TLS server certificate of the LDAP internal database must be recognized by the OCSP responder. If the OCSP responder does not recognize the LDAP server certificate, then the subsystem will not start properly. This configuration is covered in the *Certificate System Planning, Installation, and Deployment Guide*, since subsystem-LDAP SSL/TLS server connections are configured as part of the subsystem setup.

1. Get the name of the OCSP signing certificate for the OCSP or CA which will be used to check certificate status. For example:

   ```
   ]# certutil -L -d /etc/pki/instance-name/alias

   Certificate Nickname                                          Trust
   Attributes

   SSL,S/MIME,JAR/XPI

   Certificate Authority - Example Domain                        CT,c,
   ocspSigningCert cert-pki-ocsp CTu,Cu,Cu
   subsystemCert cert-pki-ocsp                                   u,u,u
   Server-Cert cert-pki-ocsp                                     u,u,u
   auditSigningCert cert-pki-ocsp
   u,u,Pu
   ```

2. Open the **server.xml** file for the subsystem. For example:

   ```
   vim /etc/pki/instance-name/server.xml
   ```

3. If the OCSP signing certificate is not present in the instance's security database, import it:

   ```
   ]# certutil -d /etc/pki/instance-name/alias -A -n "ocspSigningCert
   cert-pki-ca" -t "C,," -a -i ocspCert.b64
   ```

4. There are three critical parameters to enable OCSP checking:

   - ***enableOCSP***, which must be set to **true** to enable OCSP checking.

This is a global setting; if it is set for one interface, then it applies to every interface for the instance. However, it must be set on the first interface listed in the **server.xml** file, which is usually the agent interface. Any setting on another interface is ignored.

- ***ocspResponderURL***, which gives the URL of the OCSP responder to send the OCSP requests.

  For an OCSP Manager, this can be its own internal service or another OCSP service in another OCSP or in a CA. For other subsystems, this always points to an external OCSP service in an OCSP or a CA.

- ***ocspResponderCertNickname***, which gives the signing certificate to use to sign the response; for a CA OCSP service, this is the CA's OCSP signing certificate, and for an OCSP responder, it is an OCSP signing certificate.

Other parameters can be used to define the OCSP communication. All of the OCSP checking parameters are listed in Table 6.2, “OCSP Parameters for server.xml”.

There are two different sections in the file for the agent and administrator interfaces. The OCSP parameters need to be added to both sections to enable and configure OCSP checking. For example:

Example 6.1. OCSP Settings for an Agent Interface

```
<Connector name="Agent" port="8443" maxHttpHeaderSize="8192"
        maxThreads="150" minSpareThreads="25"
maxSpareThreads="75"
        enableLookups="false" disableUploadTimeout="true"
        acceptCount="100" scheme="https" secure="true"
        clientAuth="true" sslProtocol="SSL"
        sslOptions="ssl2=true,ssl3=true,tls=true"

ssl2Ciphers="-SSL2_RC4_128_WITH_MD5, ..."

ssl3Ciphers="-SSL3_FORTEZZA_DMS_WITH_NULL_SHA, ..."

tls3Ciphers="-SSL3_FORTEZZA_DMS_WITH_NULL_SHA, ..."

SSLImplementation="org.apache.tomcat.util.net.jss.JSSImplementat
ion"
        enableOCSP="true"

ocspResponderURL="http://server.example.com:8443/ca/ocsp"
        ocspResponderCertNickname="ocspSigningCert cert-pki-ca
102409a"
        ocspCacheSize="1000"
        ocspMinCacheEntryDuration="60"
        ocspMaxCacheEntryDuration="120"
        ocspTimeout="10"
        debug="true"
        serverCertNickFile="/etc/pki/instance-
name/serverCertNick.conf"
```

```
          passwordFile="/etc/pki/instance-name/password.conf"

passwordClass="org.apache.tomcat.util.net.jss.PlainPasswordFile"
          certdbDir="/etc/pki/instance-name/alias"/>
```

5. If the given OCSP service is not the CA, then the OCSP service's signing certificate must be imported into the subsystem's NSS database. This can be done in the console or using **certutil**; both options are covered in Section 16.6.1, “Installing Certificates in the Certificate System Database”.

6. Restart the subsystem.

```
]# systemctl restart pki-tomcatd@instance_name.service
```

Table 6.2. OCSP Parameters for server.xml

Parameter	Description
enableOCSP	Enables (or disables) OCSP checking for the subsystem.
ocspResponderURL	Sets the URL where the OCSP requests are sent. For an OCSP Manager, this can be its own internal service or another OCSP service in another OCSP or in a CA. For a TKS or KRA, this always points to an external OCSP service in an OCSP or a CA.
ocspResponderCertNickname	Sets the nickname of the signing certificate for the responder, either the OCSP signing certificate or the CA's OCSP signing certificate. The certificate must be imported into the subsystem's NSS database and have the appropriate trust settings set.
ocspCacheSize	Sets the maximum number of cache entries.
ocspMinCacheEntryDuration	Sets minimum seconds before another fetch attempt can be made. For example, if this is set to 120, then the validity of a certificate cannot be checked again until at least 2 minutes after the last validity check.
ocspMaxCacheEntryDuration	Sets the maximum number of seconds to wait before making the next fetch attempt. This prevents having too large a window between validity checks.
ocspTimeout	Sets the timeout period, in seconds, for the OCSP request.

6.6. Using the Online Certificate Status Protocol (OCSP) Responder

6.6.1. Setting up the OCSP Responder

If a CA within the security domain is selected when the Online Certificate Status Manager is configured, there is no extra step required to configure the OCSP service. The CA's CRL publishing is set up automatically, and its signing certificate is automatically added and trusted in the Online Certificate Status Manager's certificate database. However, if a non-security domain CA is selected, then the OCSP service must be manually configured after the Online Certificate Status Manager is configured.

Note

Not every CA within the security domain to which the OCSP Manager belongs is automatically trusted by the OCSP Manager when it is configured. Every CA in the certificate chain of the CA configured in the CA panel is trusted automatically by the OCSP Manager. Other CAs within the security domain but not in the certificate chain must be trusted manually.

To set up the Online Certificate Status Manager for a Certificate Manager outside the security domain:

1. Configure the CRLs for every CA that will publish to an OCSP responder.
2. Enable publishing, set up a publisher, and set publishing rules in every CA that the OCSP service will handle (Chapter 7, *Publishing Certificates and CRLs*). This is not necessary if the Certificate Managers publish to an LDAP directory and the Online Certificated Status Manager is set up to read from that directory.
3. The certificate profiles must be configured to include the Authority Information Access extension, pointing to the location at which the Certificate Manager listens for OCSP service requests (Section 6.6.4, “Enabling the Certificate Manager's Internal OCSP Service”).
4. Configure the OCSP Responder.
   - Configure the Revocation Info store (Section 6.6.2.2, “Configure the Revocation Info Stores: Internal Database” and Section 6.6.2.3, “Configure the Revocation Info Stores: LDAP Directory”).
   - Identify every publishing Certificate Manager to the OCSP responder (Section 6.6.2, “Identifying the CA to the OCSP Responder”).
   - If necessary, configure the trust settings for the CA which signed the OCSP signing certificate (Section 16.7, “Changing the Trust Settings of a CA Certificate”).
5. Restart both subsystems after configuring them.
6. Verify that the CA is properly connected to the OCSP responder (Section 6.6.2.1, “Verify Certificate Manager and Online Certificate Status Manager Connection”).

6.6.2. Identifying the CA to the OCSP Responder

Before a CA is configured to publish CRLs to the Online Certificate Status Manager, the CA must be identified to the Online Certificate Status Manager by storing the CA signing certificate in the internal database of the Online Certificate Status Manager. The Certificate Manager signs CRLs with the key pair associated with this certificate; the Online Certificate Status Manager verifies the signature against the stored certificate.

Note

If a CA within the security domain is selected when the Online Certificate Status Manager is configured, there is no extra step required to configure the Online Certificate Status Manager to recognize the CA; the CA signing certificate is automatically added and trusted in the Online Certificate Status Manager's certificate database. However, if a non-security domain CA is selected, then the CA signing certificate must be manually added to the certificate database after the Online Certificate Status Manager is configured.

It is not necessary to import the certificate chain for a CA which will publish its CRL to the Online Certificate Status Manager. The only time a certificate chain is needed for the OCSP service is if the CA connects to the Online Certificate Status Manager through SSL/TLS authentication when it publishes its CRL. Otherwise, the Online Certificate Status Manager does not need to have the complete certificate chain.

However, the Online Certificate Status Manager must have the certificate which signed the CRL, either a CA signing certificate or a separate CRL signing certificate, in its certificate database. The OCSP service verifies the CRL by comparing the certificate which signed the CRL against the certificates in its database, not against a certificate chain. If both a root CA and one of its subordinate CAs publish CRLs to the Online Certificate Status Manager, the Online Certificate Status Manager needs the CA signing certificate of both CAs.

To import the CA or CRL signing certificate which is used to sign the certificates the CA is publishing to the Online Certificate Status Manager, do the following:

1. Get the Certificate Manager's base-64 CA signing certificate from the end-entities page of the CA.

2. Open the Online Certificate Status Manager agent page. The URL has the format **`https://`***hostname:SSLport***`/ocsp/agent/ocsp`**.

3. In the left frame, click **`Add Certificate Authority`**.

4. In the form, paste the encoded CA signing certificate inside the text area labeled **`Base 64 encoded certificate (including the header and footer)`**.

5. To verify that the certificate is added successfully, in the left frame, click **`List Certificate Authorities`**.

The resulting form should show information about the new CA. The **`This Update`**, **`Next Update`**, and **`Requests Served Since Startup`** fields should show a value of zero (0).

6.6.2.1. Verify Certificate Manager and Online Certificate Status Manager Connection

When the Certificate Manager is restarted, it tries to connect to the Online Certificate Status Manager's SSL/TLS port. To verify that the Certificate Manager did indeed communicate with the Online Certificate Status Manager, check the **`This Update`** and **`Next Update`** fields, which should be updated with the appropriate timestamps of the CA's last communication with the Online Certificate Status Manager. The **`Requests Served Since Startup`** field should still show a value of zero (0) since no client has tried to query the OCSP service for certificate revocation status.

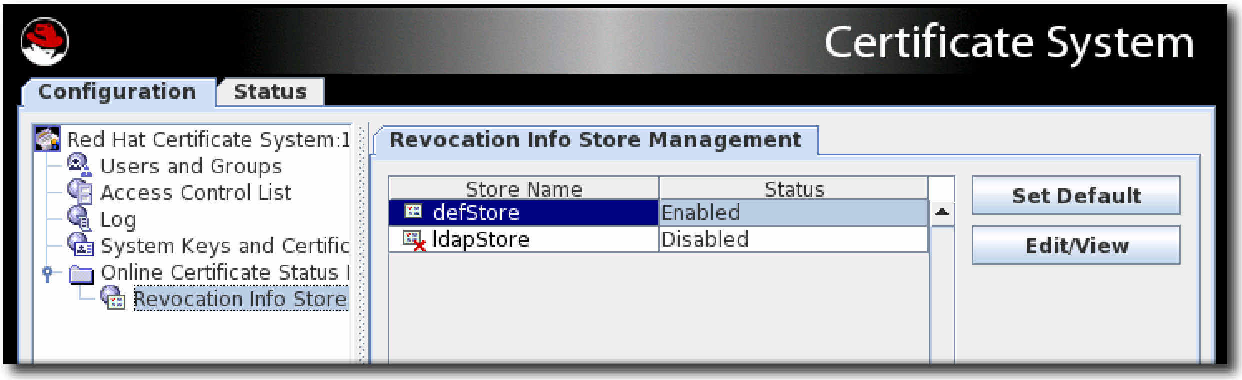
6.6.2.2. Configure the Revocation Info Stores: Internal Database

The Online Certificate Status Manager stores each Certificate Manager's CRL in its internal database and uses it as the CRL store for verifying the revocation status of certificates. To change the configuration that the Online Certificate Status Manager uses for storing the CRLs in its internal database:

1. Open the Online Certificate Status Manager Console.

```
pkiconsole https://server.example.com:8443/ocsp
```

2. In the **Configuration** tab, select **Online Certificate Status Manager**, and then select **Revocation Info Stores**.



The right pane shows the two repositories the Online Certificate Status Manager can use; by default, it uses the CRL in its internal database.

3. Select the **defStore**, and click **Edit/View**.

4. Edit the **defStore** values.

- **`notFoundAsGood`.** Sets the OCSP service to return an OCSP response of GOOD if the certificate in question cannot be found in any of the CRLs. If this is not selected, the response is UNKNOWN, which, when encountered by a client, results in an error message.
- **`byName`.** The OCSP Responder only supports the basic response type, which includes the ID of the OCSP Responder making the response. The ResponderID field within the basic response type is determined by the value of the ***`ocsp.store.defStore.byName`*** parameter. If ***`byName`*** parameter is true or is missing, the OCSP authority signing certificate subject name is used as the ResponderID field of the OCSP response. If ***`byName`*** parameter is false, the OCSP authority signing certificate key hash will be the ResponderID field of the OCSP response.
- **`includeNextUpdate`.** Includes the timestamp of the next CRL update time.

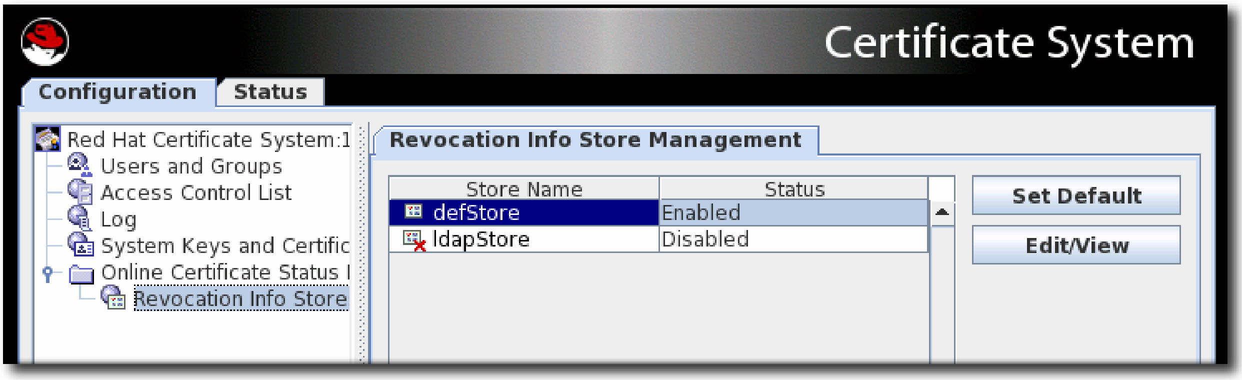
6.6.2.3. Configure the Revocation Info Stores: LDAP Directory

Although the OCSP Manager stores the CA CRLs in its internal database by default, it can be configured to use a CRL published to an LDAP directory instead. To configure the Online Certificate Status Manager to use an LDAP directory:

1. Open the Online Certificate Status Manager Console.

```
pkiconsole https://server.example.com:8443/ocsp
```

2. In the **Configuration** tab, select **Online Certificate Status Manager**, and then select **Revocation Info Stores**.

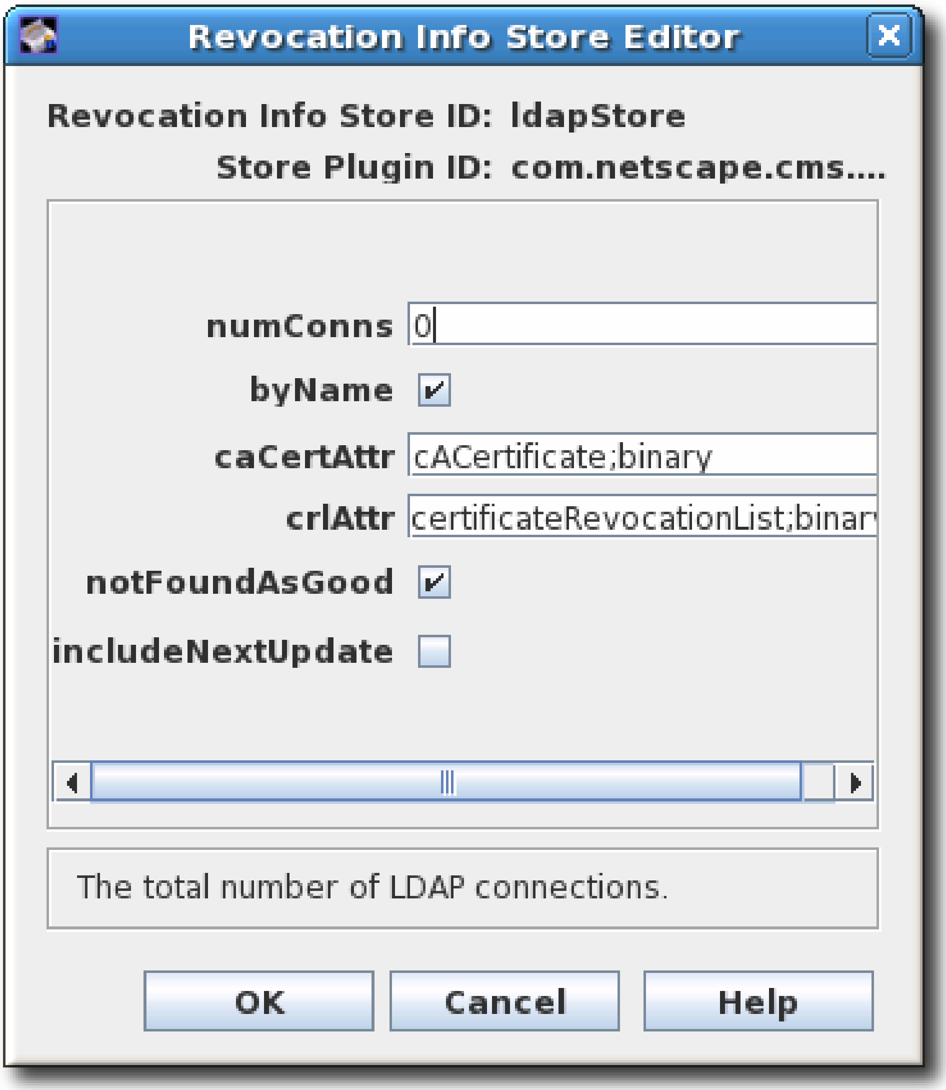


   The right pane shows the two repositories the Online Certificate Status Manager can use; by default, it uses the CRL in its internal database.

3. To use the CRLs in LDAP directories, click **Set Default** to enable the **ldapStore** option.

4. Select **ldapStore**, and click **Edit/View**.

5. Set the **ldapStore** parameters.



- **numConns.** The total number of LDAP directories the OCSP service should check. By default, this is set to 0. Setting this value shows the corresponding number of **host**, **port**, **baseDN**, and **refreshInSec** fields.
- **host.** The fully-qualified DNS hostname of the LDAP directory.
- **port.** The non-SSL/TLS port of the LDAP directory.
- **baseDN.** The DN to start searching for the CRL. For example, **O=example.com**.
- **refreshInSec.** How often the connection is refreshed. The default is 86400 seconds (daily).
- **caCertAttr.** Leave the default value, **cACertificate;binary**, as it is. It is the attribute to which the Certificate Manager publishes its CA signing certificate.
- **crlAttr.** Leave the default value, **certificateRevocationList;binary**, as it is. It is the attribute to which the Certificate Manager publishes CRLs.
- **notFoundAsGood.** Sets the OCSP service to return an OCSP response of GOOD if the certificate in question cannot be found in any of the CRLs. If this is not selected, the response is UNKNOWN, which, when encountered by a client, results in an error message.
- **byName.** The OCSP Responder only supports the basic response type, which includes the ID of the OCSP Responder making the response. The ResponderID field within the basic response type is determined by the value of the ***ocsp.store.defStore.byName*** parameter. If ***byName*** parameter is true or is missing, the OCSP authority signing certificate subject name is used as the ResponderID field of the OCSP response. If ***byName*** parameter is false, the OCSP authority signing certificate key hash will be the ResponderID field of the OCSP response.
- **includeNextUpdate.** The Online Certificate Status Manager can include the timestamp of the next CRL update time.

6.6.2.4. Testing the OCSP Service Setup

Test whether the Certificate Manager can service OCSP requests properly by doing the following:

1. Turn on revocation checking in the browser or client.
2. Request a certificate from the CA that has been enabled for OCSP services.
3. Approve the request.
4. Download the certificate to the browser or client.
5. Make sure the CA is trusted by the browser or client.
6. Check the status of Certificate Manager's internal OCSP service.

   Open the CA agent services page, and select the **OCSP Services** link.
7. Test the independent Online Certificate Status Manager subsystem.

   Open the Online Certificate Status Manager agent services page, and click the **List Certificate Authorities** link.

The page should show information about the Certificate Manager configured to publish CRLs to the Online Certificate Status Manager. The page also summarizes the Online Certificate Status Manager's activity since it was last started.

8. Revoke the certificate.

9. Verify the certificate in the browser or client. The server should return that the certificate has been revoked.

10. Check the Certificate Manager's OCSP-service status again to verify that these things happened:

    - The browser sent an OCSP query to the Certificate Manager.
    - The Certificate Manager sent an OCSP response to the browser.
    - The browser used that response to validate the certificate and returned its status, that the certificate could not be verified.

11. Check the independent OCSP service subsystem again to verify that these things happened:

    - The Certificate Manager published the CRL to the Online Certificate Status Manager.
    - The browser sent an OCSP response to the Online Certificate Status Manager.
    - The Online Certificate Status Manager sent an OCSP response to the browser.
    - The browser used that response to validate the certificate and returned its status, that the certificate could not be verified.

6.6.3. Setting the Response for Bad Serial Numbers

OCSP responders check the revocation status and expiration date of a certificate before determining whether the certificate is valid; by default, the OCSP does not validate other information on the certificate.

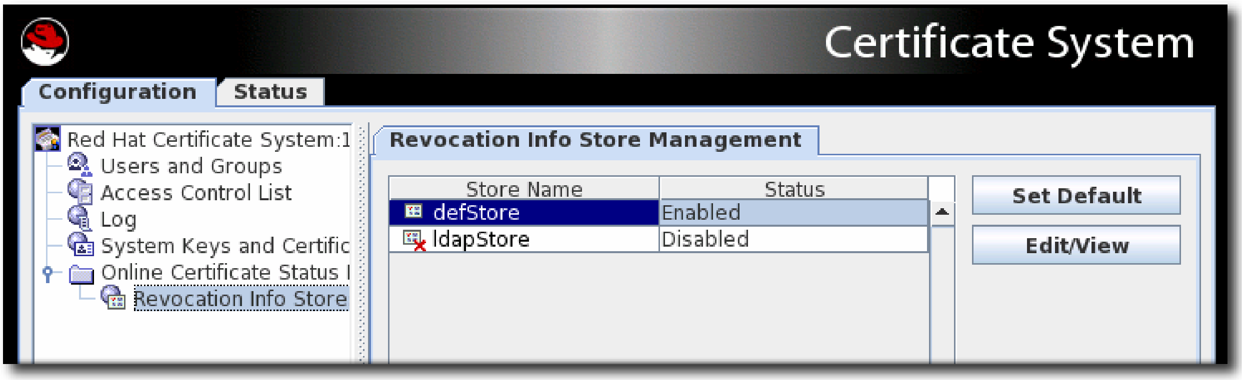
The ***notFoundAsGood*** parameter sets how the OCSP handles a certificate with an invalid serial number. This parameter is enabled by default, which means that if a certificate is present with a bad serial number but the certificate is otherwise valid, the OCSP returns a status of **GOOD** for the certificate.

To have the OCSP check and reject certificates based on bad serial numbers as well as revocation status, change the ***notFoundAsGood*** setting. In that case, the OCSP returns a status of **UNKNOWN** with a certificate with a bad serial number. The client interprets that as an error and can respond accordingly.

1. Open the Online Certificate Status Manager Console.

   ```
   pkiconsole https://server.example.com:8443/ocsp
   ```

2. In the **Configuration** tab, select **Online Certificate Status Manager**, and then select **Revocation Info Stores**.



3. Select the **defStore**, and click **Edit/View**.

4. Edit the ***notFoundAsGood*** value. Selecting the checkbox means that the OCSP returns a value of **GOOD** even if the serial number on the certificate is bad. Unselecting the checkbox means that the OCSP sends a value of **UNKNOWN**, which the client can intrepret as an error.

5. Restart the OCSP Manager.

```
]# systemctl restart pki-tomcatd@instance-name.service
```

6.6.4. Enabling the Certificate Manager's Internal OCSP Service

The Certificate Manager has a built-in OCSP service, which can be used by OCSP-compliant clients to query the Certificate Manager directly about the revocation status of the certificate. When the Certificate Manager is installed, an OCSP signing certificate is issued and the OCSP service is turned on by default. This OCSP signing certificate is used to sign all responses to OCSP service requests. Since the internal OCSP service checks the status of certificates stored in the Certificate Manager's internal database, publishing does not have to be configured to use this service.

Clients can query the OCSP service through the non-SSL/TLS end-entity port of the Certificate Manager. When queried for the revocation status of a certificate, the Certificate Manager searches its internal database for the certificate, checks its status, and responds to the client. Since the Certificate Manager has real-time status of all certificates it has issued, this method of revocation checking is the most accurate.

Every CA's built-in OCSP service is turned on at installation. However, to use this service, the CA needs to issue certificates with the Authority Information Access extension.

1. Go to the CA's end-entities page. For example:

   ```
   https://server.example.com:8443/ca/ee/ca
   ```

2. Find the CA signing certificate.

3. Look for the Authority Info Access extension in the certificate, and note the **Location URIName** value, such as **https://server.example.com:8443/ca/ocsp**.

4. Update the enrollment profiles to enable the Authority Information Access extension, and set the **Location** parameter to the Certificate Manager's URI. For information on editing the certificate profiles, see Section 2.2, “Setting up Certificate Profiles”.

5. Restart the CA instance.

   ```
   ]# systemctl restart pki-tomcatd@instance-name.service
   ```

To disable the Certificate Manager's internal OCSP service, edit the CA's **CS.cfg** file and change the value of the **ca.ocsp** parameter to **false**.

```
ca.ocsp=false
```

6.6.5. Submitting OCSP Requests Using the OCSPClient program

The **OCSPClient** program can be used for performing OCSP requests. For example:

```
]# OCSPClient -h server.example.com -p 8080 -d /etc/pki/pki-tomcat/alias
-c "caSigningCert cert-pki-ca" --serial 2
CertID.serialNumber=2
CertStatus=Good
```

The **OCSPClient** command can be used with the following command-line options:

Table 6.3. Available OCSPClient Options

Option	Description
-d *database*	Security database location (default: current directory)

Option	Description
-h *hostname*	OCSP server hostname (default: example.com)
-p *port*	OCSP server port number (default: 8080)
-t *path*	OCSP service path (default: /ocsp/ee/ocsp)
-c *nickname*	CA certificate nickname (defaut: CA Signing Certificate)
-n *times*	Number of submissions (default: 1)
--serial *serial_number*	Serial number of certificate to be checked
--input *input_file*	Input file containing DER-encoded OCSP request
--output *output_file*	Output file to store DER-encoded OCSP response
-v, --verbose	Run in verbose mode
--help	Show help message

6.6.6. Submitting OCSP Requests Using the GET Method

OCSP requests which are smaller than 255KB can be submitted to the Online Certificate Status Manager using a GET method, as described in RFC 6960. To submit OCSP requests over GET:

1. Generate an OCSP request for the certificate the status of which is being queried. For example:

   ```
   ]# openssl ocsp -CAfile ca.pem -issuer issuer.pem -serial
   serial_number -reqout - | base64

   MEIwQDA+MDww0jAJBgUrDgMCGgUABBT4cyABkyiCIhU4JpmIBewdDnn8ZgQUbyBZ44
   kgy35o7xW5BMzM8FTvyTwCAQE=
   ```

2. Paste the URL in the address bar of a web browser to return the status information. The browser must be able to handle OCSP requests.

   ```
   https://server.example.com:8443/ocsp/ee/ocsp/MEIwQDA+MDww0jAJBgUrD
   gMCGgUABBT4cyABkyiCIhU4JpmIBewdDnn8ZgQUbyBZ44kgy35o7xW5BMzM8FTvyTw
   CAQE=
   ```

3. The OCSP Manager responds with the certificate status which the browser can interpret. The possible statuses are GOOD, REVOKED, and UNKNOWN.

Alternatively, run the OCSP from the command line by using a tool such as **curl** to send the request and **openssl** to parse the response. For example:

1. Generate an OCSP request for the certificate the status of which is being queried. For example:

   ```
   ]# openssl ocsp -CAfile ca.pem -issuer issuer.pem -serial
   serial_number -reqout - | base64

   MEIwQDA+MDww0jAJBgUrDgMCGgUABBT4cyABkyiCIhU4JpmIBewdDnn8ZgQUbyBZ44
   kgy35o7xW5BMzM8FTvyTwCAQE=
   ```

2. Connect to the OCSP Manager using **curl** to send the OCSP request.

```
curl
https://server.example.com:8443/ocsp/ee/ocsp/MEIwQDA+MDwwOjAJBgUrD
gMCGgUABBT4cyABkyiCIhU4JpmIBewdDnn8ZgQUbyBZ44kgy35o7xW5BMzM8FTvyTw
CAQE= > ocspresp.der
```

3. Parse the response using **openssl**:

```
openssl ocsp -respin ocspresp.der -resp_text
```

For certificates issued by a 7.1 CA with the Authority Information Access extension to be sent to the OCSP with the GET method, a redirect needs to be created to forward the requests to the appropriate URL, as described in Section 6.6.7, “Setting up a Redirect for Certificates Issued in Certificate System 7.1 and Earlier”.

6.6.7. Setting up a Redirect for Certificates Issued in Certificate System 7.1 and Earlier

The location for the OCSP user pages, specified in the URL with the file root **/ocsp/ee/ocsp/**, is different in Certificate System 9 or Certificate System 8.1 than the location in Certificate System 7.1, which was simply **/ocsp/**. In order for certificates issued by a 7.1 or earlier CA with the Authority Information Access extension to be sent to the OCSP, create a redirect to forward the requests to the appropriate URL.

Note

Setting the redirect is only required to manage certificates issued by a 7.1 or earlier CA with the Authority Information Access extension. If the certificates are issued by a later version Certificate Manager or do not contain the Authority Information Access extension, then this configuration is not necessary.

1. Stop the OCSP Responder.

```
]# systemctl stop pki-tomcatd@instance-name.service
```

2. Change to the OCSP's end user web applications directory. For example:

```
]# cd /var/lib/pki-ocsp/webapps/ocsp
```

3. Change to the **ROOT/WEB-INF/** directory in the **ROOT** folder of the OCSP's web applications directory. For example:

```
]# cd /var/lib/pki-ocsp/webapps/ocsp/ROOT/WEB-INF/
```

4. Create and open the **lib/** directory in the **ROOT** folder of the OCSP's web applications directory.

```
]# mkdir lib
]# cd lib/
```

5. Create a symlink that links back to the **/usr/share/java/pki/cms.jar** JAR file. For example:

```
]# ln -s /usr/share/java/pki/cms.jar cms.jar
```

6. Move up to the main web application directory. For example:

```
]# cd /var/lib/pki-ocsp/webapps/ocsp/
```

7. Rename the current instance (**ocsp**) directory. For example:

```
]# mv /var/lib/pki-ocsp/webapps/ocsp/ocsp /var/lib/pki-
ocsp/webapps/ocsp/ocsp2
```

8. Change to the **WEB-INF/** directory in the original **ocsp/** directory. For example:

```
]# cd  /var/lib/pki-ocsp/webapps/ocsp/ocsp/WEB-INF
```

9. In original **ocsp/WEB-INF/** directory, edit the **web.xml** file and add lines mapping between the **eeocspAddCRL** and **csadmin-wizard** servlets.

```
    <servlet-mapping>
       <servlet-name>  ocspOCSP  </servlet-name>
       <url-pattern>   /ee/ocsp/*  </url-pattern>
    </servlet-mapping>
```

10. Create and install the **web.xml** file in the **ROOT** directory. For example:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<web-app>

  <display-name>Welcome to Tomcat</display-name>
  <description>
     Welcome to Tomcat
  </description>

  <servlet>
    <servlet-name>ocspProxy</servlet-name>
    <servlet-
class>com.netscape.cms.servlet.base.ProxyServlet</servlet-class>
    <init-param>
      <param-name>destContext</param-name>
      <param-value>/ocsp2</param-value>
    </init-param>
    <init-param>
      <param-name>destServlet</param-name>
      <param-value>/ee/ocsp</param-value>
    </init-param>
  </servlet>

  <servlet>
    <servlet-name>ocspOther</servlet-name>
    <servlet-
class>com.netscape.cms.servlet.base.ProxyServlet</servlet-class>
    <init-param>
      <param-name>destContext</param-name>
      <param-value>/ocsp2</param-value>
```

```
    </init-param>
    <init-param>
      <param-name>srcContext</param-name>
      <param-value>/ocsp</param-value>
    </init-param>
    <init-param>
      <param-name>destServlet</param-name>
      <param-value></param-value>
    </init-param>
    <init-param>
      <param-name>matchURIStrings</param-name>

<param-
value>/ocsp/registry,/ocsp/acl,/ocsp/jobsScheduler,/ocsp/ug,/ocsp/
server,/ocsp/log,

/ocsp/auths,/ocsp/start,/ocsp/ocsp,/ocsp/services,/ocsp/agent,/ocs
p/ee,
            /ocsp/admin</param-value>
    </init-param>
    <init-param>
      <param-name>destServletOnNoMatch</param-name>
      <param-value>/ee/ocsp</param-value>
    </init-param>
    <init-param>
      <param-name>appendPathInfoOnNoMatch</param-name>
      <param-value>/ocsp</param-value>
    </init-param>
  </servlet>

  <servlet-mapping>
    <servlet-name>ocspProxy</servlet-name>
    <url-pattern>/ocsp</url-pattern>
  </servlet-mapping>

  <servlet-mapping>
    <servlet-name>ocspOther</servlet-name>
    <url-pattern>/ocsp/*</url-pattern>
  </servlet-mapping>

</web-app>
```

11. Edit the **/var/lib/pki-ocsp/conf/context.xml** file, changing the following line:

```
<Context>
 to
<Context crossContext="true" >
```

12. Edit the **/var/lib/pki-ocsp/webapps/ocsp/ocsp2/services.template** file and change the following line:

```
result.recordSet[i].uri);
 to
result.recordSet[i].uri + "/");
```

13. Start the OCSP instance.

```
]# systemctl restart pki-tomcatd@instance-name.service
```

Part II. Additional Configuration to Manage CA Services

Chapter 7. Publishing Certificates and CRLs

Red Hat Certificate System includes a customizable publishing framework for the Certificate Manager, enabling certificate authorities to publish certificates, certificate revocation lists (CRLs), and other certificate-related objects to any of the supported repositories: an LDAP-compliant directory, a flat file, and an online validation authority. This chapter explains how to configure a Certificate Manager to publish certificates and CRLs to a file, to a directory, and to the Online Certificate Status Manager.

The general process to configure publishing is as follows:

1. Configure publishing to a file, LDAP directory, or OCSP responder.

   There can be a single publisher or multiple publishers, depending on how many locations will be used. The locations can be split by certificates and CRLs or narrower definitions, such as certificate type. Rules determine which type to publish and to what location by being associated with the publisher.

2. Set rules to determine what certificates are published to the locations. Any rule which a certificate or CRL matches is activated, so the same certificate can be published to a file and to an LDAP directory by matching a file-based rule and matching a directory-based rule.

   Rules can be set for each object type: CA certificates, CRLs, user certificates, and cross-pair certificates. Disable all rules that will not be used.

3. Configure CRLs. CRLs must be configured before they can be published. See Chapter 6, *Revoking Certificates and Issuing CRLs*.

4. Enable publishing after setting up publishers, mappers, and rules. Once publishing is enabled, the server starts publishing immediately. If the publishers, mappers, and rules are not completely configured, publishing may not work correctly or at all.

7.1. About Publishing

The Certificate System is capable of publishing certificates to a file or an LDAP directory and of publishing CRLs to a file, an LDAP directory, or to an OCSP responder.

For additional flexibility, specific types of certificates or CRLs can be published to a single format or all three. For example, CA certificates can be published only to a directory and not to a file, and user certificates can be published to both a file and a directory.

> **Note**
>
> An OCSP responder only provides information about CRLs; certificates are not published to an OCSP responder.

Different publishing locations can be set for certificates files and CRL files, as well as different publishing locations for different types of certificates files or different types of CRL files.

Similarly, different types of certificates and different types of CRLs can be published to different places in a directory. For example, certificates for users from the West Coast division of a company can be published in one branch of the directory, while certificates for users in the East Coast division can be published to another branch in the directory.

When publishing is enabled, every time a certificate or a CRL is issued, updated, or revoked, the publishing system is invoked. The certificate or CRL is evaluated by the rules to see if it matches the type and predicate set in the rule. The type specifies if the object is a CRL, CA certificate, or any other certificate. The predicate sets more criteria for the type of object being evaluated. For example, it can specify user certificates, or it can specify West Coast user certificates. To use predicates, a value needs to be entered in the predicate field of the publishing rule, and a corresponding value (although formatted somewhat differently) needs to be contained in the certificate or certificate request to match. The value in the certificate or certificate request may be derived from information in the certificate, such as the type of certificate, or may be derived from a hidden value that is placed in the request form. If no predicate is set, all certificates of that type are considered to match. For example, all CRLs match the rule if **CRL** is set as the type.

Every rule that is matched publishes the certificate or CRL according to the method and location specified in that rule. A given certificate or CRL can match no rules, one rule, more than one rule, or all rules. The publishing system attempts to match every certificate and CRL issued against all rules.

When a rule is matched, the certificate or CRL is published according to the method and location specified in the publisher associated with that rule. For example, if a rule matches all certificates issued to users, and the rule has a publisher that publishes to a file in the location **/etc/CS/certificates**, the certificate is published as a file to that location. If another rule matches all certificates issued to users, and the rule has a publisher that publishes to the LDAP attribute **userCertificate;binary** attribute, the certificate is published to the directory specified when LDAP publishing was enabled in this attribute in the user's entry.

For rules that specify to publish to a file, a new file is created when either a certificate or a CRL is issued in the stipulated directory.

For rules that specify to publish to an LDAP directory, the certificate or CRL is published to the entry specified in the directory, in the attribute specified. The CA overwrites the values for any published certificate or CRL attribute with any subsequent certificate or CRL. Simply put, any existing certificate or CRL that is already published is replaced by the next certificate or CRL.

For rules that specify to publish to an Online Certificate Status Manager, a CRL is published to this manager. Certificates are not published to an Online Certificate Status Manager.

For LDAP publishing, the location of the user's entry needs to be determined. Mappers are used to determine the entry to which to publish. The mappers can contain an exact DN for the entry, some variable that associates information that can be gotten from the certificate to create the DN, or enough information to search the directory for a unique attribute or set of attributes in the entry to ascertain the correct DN for the entry.

When a certificate is revoked, the server uses the publishing rules to locate and delete the corresponding certificate from the LDAP directory or from the filesystem.

When a certificate expires, the server can remove that certificate from the configured directory. The server does not do this automatically; the server must be configured to run the appropriate job. For details, see Chapter 11, *Setting Automated Jobs*.

Setting up publishing involves configuring publishers, mappers, and rules.

7.1.1. Publishers

Publishers specify the location to which certificates and CRLs are published. When publishing to a file, publishers specify the filesystem publishing directory. When publishing to an LDAP directory, publishers specify the attribute in the directory that stores the certificate or CRL; a mapper is used to determine the DN of the entry. For every DN, a different formula is set for deriving that DN. The location of the LDAP directory is specified when LDAP publishing is enabled. When publishing a CRL to an OCSP responder, publishers specify the hostname and URI of the Online Certificate Status Manager.

7.1.2. Mappers

Mappers are only used in LDAP publishing. Mappers construct the DN for an entry based on information from the certificate or the certificate request. The server has information from the subject name of the certificate and the certificate request and needs to know how to use this information to create a DN for that entry. The mapper provides a formula for converting the information available either to a DN or to some unique information that can be searched in the directory to obtain a DN for the entry.

7.1.3. Rules

Rules for file, LDAP, and OCSP publishing tell the server whether and how a certificate or CRL is to be published. A rule first defines what is to be published, a certificate or CRL matching certain characteristics, by setting a type and predicate for the rule. A rule then specifies the publishing method and location by being associated with a publisher and, for LDAP publishing, with a mapper.

Rules can be as simple or complex as necessary for the PKI deployment and are flexible enough to accommodate different scenarios.

7.1.4. Publishing to Files

The server can publish certificates and CRLs to flat files, which can then be imported into any repository, such as a relational database. When the server is configured to publish certificates and CRLs to file, the published files are DER-encoded binary blobs, base-64 encoded text blobs, or both.

- For each certificate the server issues, it creates a file that contains the certificate in either DER-encoded or base-64 encoded format. Each file is named either **cert-***serial_number***.der** or **cert-***serial_number***.b64**. The *serial_number* is the serial number of the certificate contained in the file. For example, the filename for a DER-encoded certificate with the serial number **1234** is **cert-1234.der**.

- Every time the server generates a CRL, it creates a file that contains the new CRL in either DER-encoded or base-64 encoded format. Each file is named either *issuing_point_name-this_update***.der** or *issuing_point_name-this_update***.b64**, depending on the format. The *issuing_point_name* identifies the CRL issuing point which published the CRL, and *this_update* specifies the value derived from the time-dependent update value for the CRL contained in the file. For example, the filename for a DER-encoded CRL with the value **This Update: Friday January 28 15:36:00 PST 2016**, is **MasterCRL-20160128-153600.der**.

7.1.5. OCSP Publishing

There are two forms of Certificate System OCSP services, an internal service for the

Certificate Manager and the Online Certificate Status Manager. The internal service checks the internal database of the Certificate Manager to report on the status of a certificate. The internal service is not set for publishing; it uses the certificates stored in its internal database to determine the status of a certificate. The Online Certificate Status Manager checks CRLs sent to it by Certificate Manager. A publisher is set for each location a CRL is sent and one rule for each type of CRL sent.

For detailed information on both OCSP services, see Section 6.6, “Using the Online Certificate Status Protocol (OCSP) Responder”.

7.1.6. LDAP Publishing

In *LDAP publishing*, the server publishes the certificates, CRLs, and other certificate-related objects to a directory using LDAP or LDAPS. The branch of the directory to which it publishes is called the *publishing directory*.

- For each certificate the server issues, it creates a blob that contains the certificate in its DER-encoded format in the specified attribute of the user's entry. The certificate is published as a DER encoded binary blob.

- Every time the server generates a CRL, it creates a blob that contains the new CRL in its DER-encoded format in the specified attribute of the entry for the CA.

The server can publish certificates and CRLs to an LDAP-compliant directory using the LDAP protocol or LDAP over SSL (LDAPS) protocol, and applications can retrieve the certificates and CRLs over HTTP. Support for retrieving certificates and CRLs over HTTP enables some browsers to import the latest CRL automatically from the directory that receives regular updates from the server. The browser can then use the CRL to check all certificates automatically to ensure that they have not been revoked.

For LDAP publishing to work, the user entry must be present in the LDAP directory.

If the server and publishing directory become out of sync for some reason, privileged users (administrators and agents) can also manually initiate the publishing process. For instructions, see Section 7.12.2, “Manually Updating the CRL in the Directory”.

7.2. Configuring Publishing to a File

The general process to configure publishing involves setting up a publisher to publish the certificates or CRLs to the specific location. There can be a single publisher or multiple publishers, depending on how many locations will be used. The locations can be split by certificates and CRLs or finer definitions, such as certificate type. Rules determine which type to publish and to what location by being associated with the publisher.

Publishing to file simply publishes the CRLs or certificates to text files on a given host.

Publishers must be created and configured for each publishing location; publishers are not automatically created for publishing to a file. To publish all files to a single location, create one publisher. To publish to different locations, create a publisher for each location. A location can either contain an object type, like user certificates, or a subset of an object type, like West Coast user certificates.

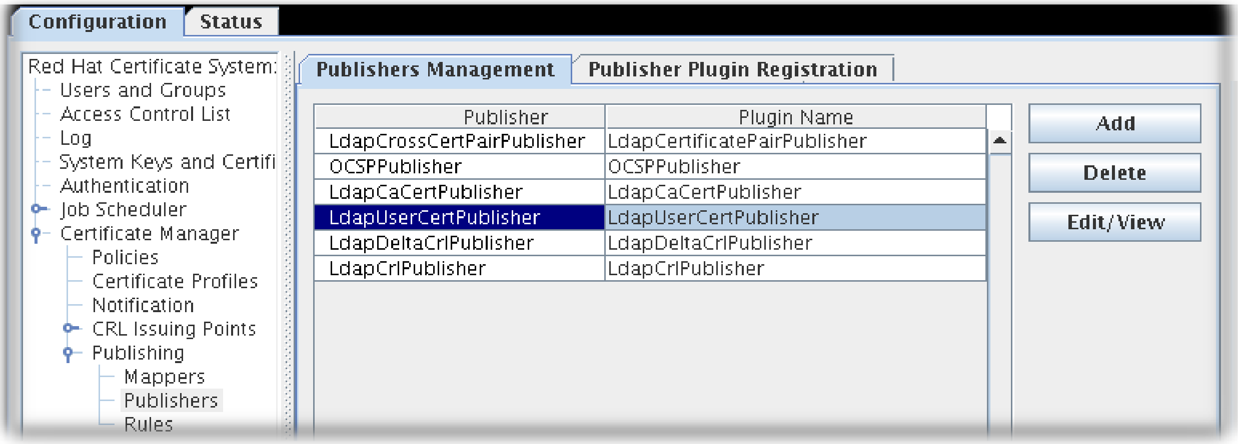
To create publishers for publishing to files:

1. Log into the Certificate Manager Console.

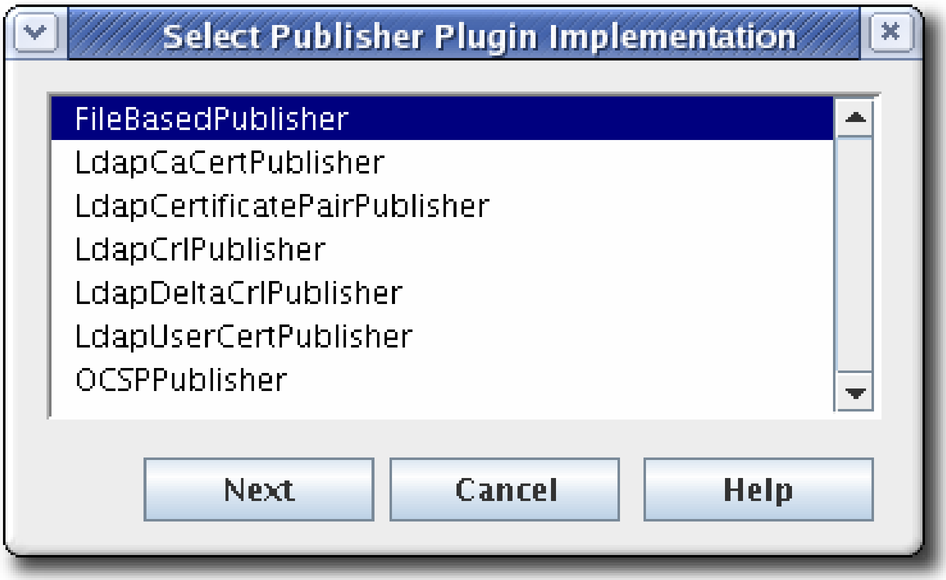
```
pkiconsole https://server.example.com:8443/ca
```

2. In the **Configuration** tab, select **Certificate Manager** from the navigation tree on the left. Select **Publishing**, and then **Publishers**.

   The **Publishers Management** tab, which lists configured publisher instances, opens on the right.

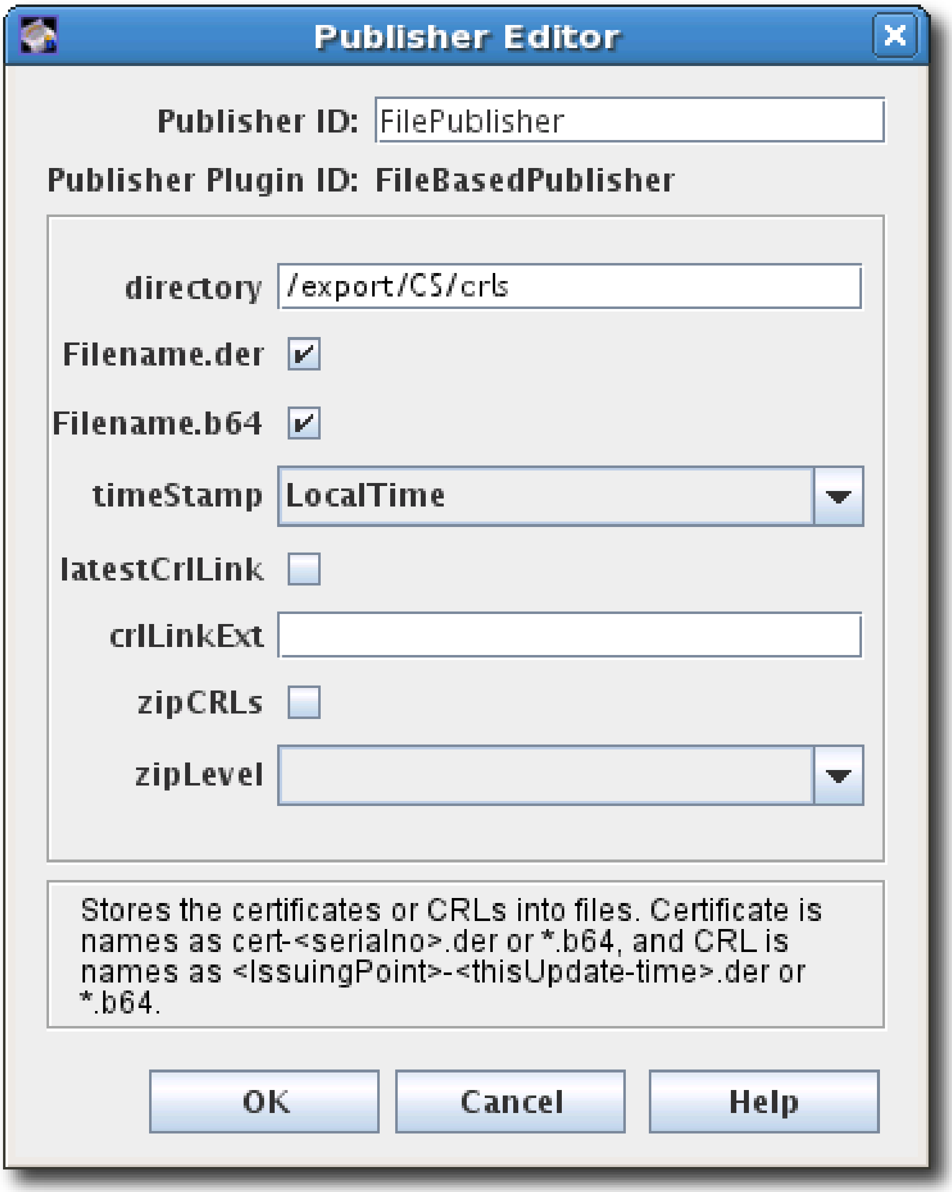


3. Click **Add** to open the **Select Publisher Plug-in Implementation** window, which lists registered publisher modules.



4. Select the **FileBasedPublisher** module, then open the editor window.

   This is the module that enables the Certificate Manager to publish certificates and CRLs to files.



5. Configure the information for publishing the certificate:

   - The publisher ID, an alphanumeric string with no spaces like **PublishCertsToFile**
   - The path to the directory in which the Certificate Manager should publish the files. The path can be an absolute path or can be relative to the Certificate System instance directory. For example, **/export/CS/certificates**.
   - The file type to publish, by selecting the checkboxes for DER-encoded files, base-64 encoded files, or both.
   - For CRLs, the format of the timestamp. Published certificates include serial numbers in their file names, while CRLs use timestamps.
   - For CRLs, whether to generate a link in the file to go to the latest CRL. If enabled, the link assumes that the name of the CRL issuing point to use with the extension will be supplied in the **crlLinkExt** field.
   - For CRLs, whether to compress (zip) CRLs and the compression level to use.

After configuring the publisher, configure the rules for the published certificates and CRLs, as described in Section 7.5, “Creating Rules”.

7.3. Configuring Publishing to an OCSP

The general process to configure publishing involves setting up a publisher to publish the certificates or CRLs to the specific location. There can be a single publisher or multiple publishers, depending on how many locations will be used. The locations can be split by certificates and CRLs or finer definitions, such as certificate type. Rules determine which type to publish and to what location by being associated with the publisher.

Publishing to an OCSP Manager is a way to publish CRLs to a specific location for client verification.

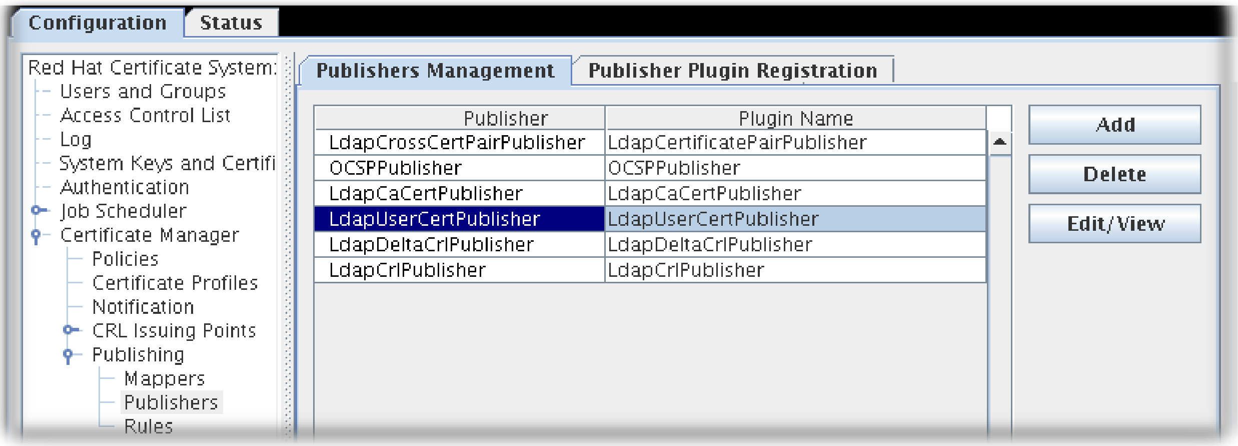
A publisher must be created and configured for each publishing location; publishers are not automatically created for publishing to the OCSP responder. Create a single publisher to publish everything to s single location, or create a publisher for every location to which CRLs will be published. Each location can contain a different kind of CRL.

7.3.1. Enabling Publishing to an OCSP with Client Authentication

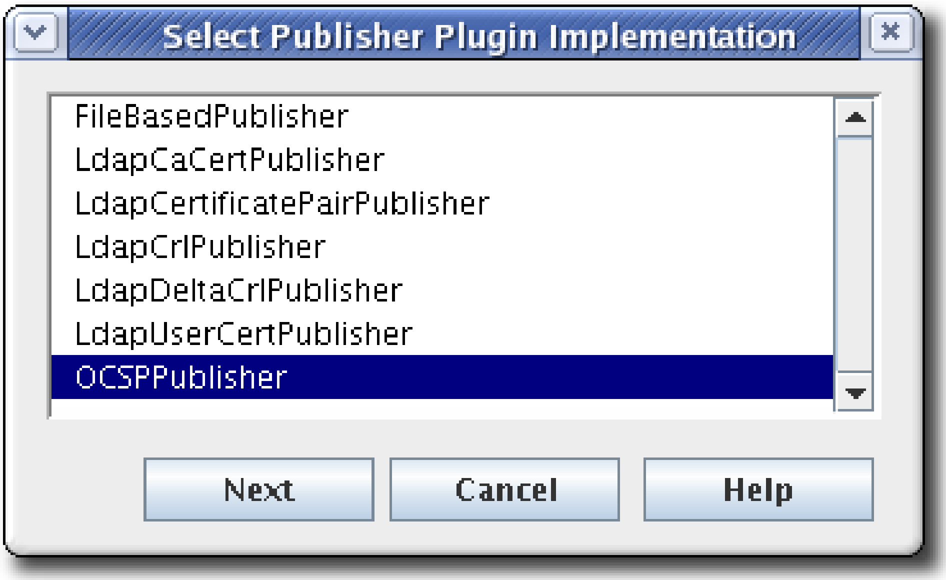
1. Log into the Certificate Manager Console.

```
pkiconsole https://server.example.com:8443/ca
```

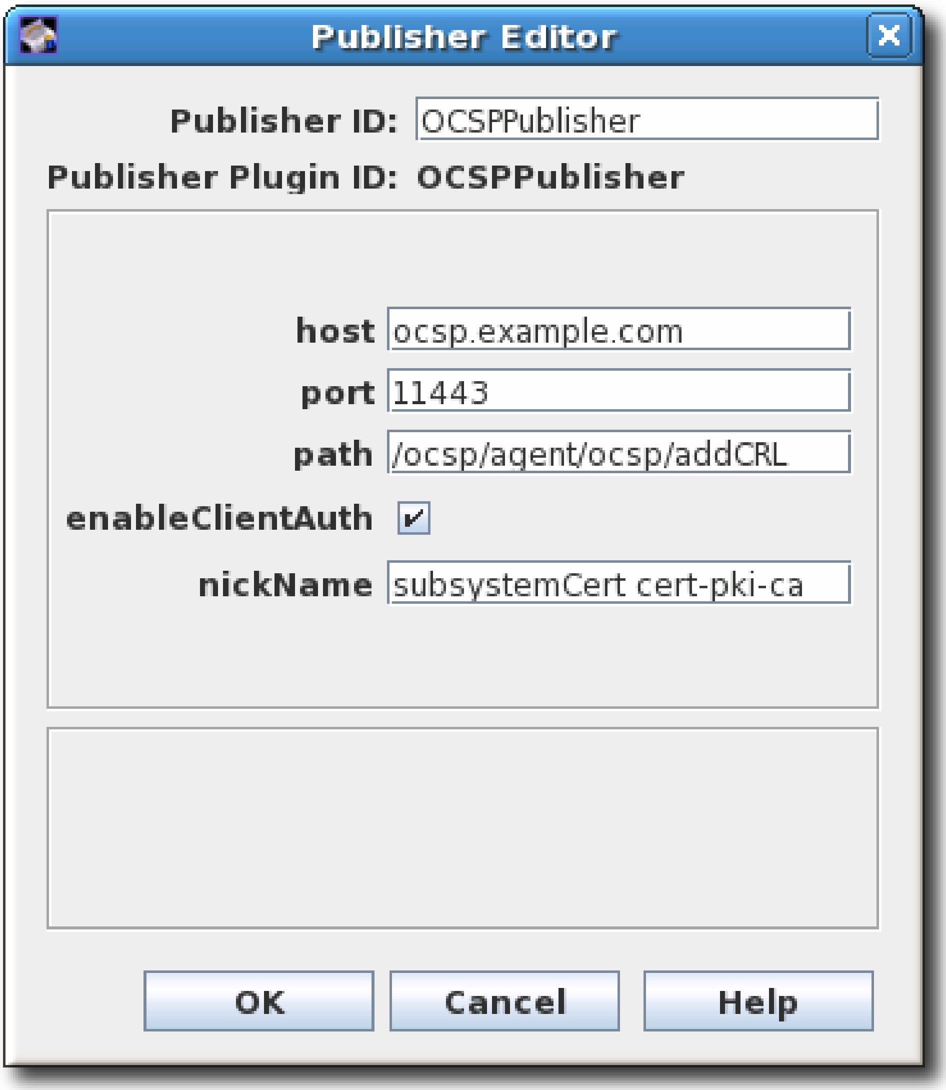
2. In the **Configuration** tab, select **Certificate Manager** from the navigation tree on the left. Select **Publishing**, and then **Publishers**.



3. Click **Add** to open the **Select Publisher Plug-in Implementation** window, which lists registered publisher modules.



4. Select the **OCSPPublisher** module, then open the editor window. This is the publisher module that enables the Certificate Manager to publish CRLs to the Online Certificate Status Manager.



- The publisher ID must be an alphanumeric string with no spaces, like **PublishCertsToOCSP**.

- The **host** can be the fully-qualified domain name, such as **ocspResponder.example.com**, or an IPv4 or IPv6 address.
- The default path is the directory to send the CRL to, like **/ocsp/agent/ocsp/addCRL**.
- If client authentication is used (**enableClientAuth** is checked), then the **nickname** field gives the nickname of the certificate to use for authentication. This certificate must already exist in the OCSP security database; this will usually be the CA subsystem certificate.

5. Create a user entry for the CA on the OCSP Manager. The user is used to authenticate to the OCSP when sending a new CRL. There are two things required:

   - Name the OCSP user entry after the CA server, like **CA-***hostname-EEport*.
   - Use whatever certificate was specified in the publisher configuration as the user certificate in the OCSP user account. This is usually the CA's subsystem certificate.

   Setting up subsystem users is covered in Section 14.4.2.1, “Creating Users”.

After configuring the publisher, configure the rules for the published certificates and CRLs, as described in Section 7.5, “Creating Rules”.

7.4. Configuring Publishing to an LDAP Directory

The general process to configure publishing involves setting up a publisher to publish the certificates or CRLs to the specific location. There can be a single publisher or multiple publishers, depending on how many locations will be used. The locations can be split by certificates and CRLs or finer definitions, such as certificate type. Rules determine which type to publish and to what location by being associated with the publisher.

Configuring LDAP publishing is similar to other publishing procedures, with additional steps to configure the directory:

1. Configure the Directory Server to which certificates will be published. Certain attributes have to be added to entries and bind identities and authentication methods have to be configured.

2. Configure a publisher for each type of object published: CA certificates, cross-pair certificates, CRLs, and user certificates. The publisher declares in which attribute to store the object. The attributes set by default are the X.500 standard attributes for storing each object type. This attribute can be changed in the publisher, but generally, it is not necessary to change the LDAP publishers.

3. Set up mappers to enable an entry's DN to be derived from the certificate's subject name. This generally does not need set for CA certificates, CRLs, and user certificates. There can be more than one mapper set for a type of certificate. This can be useful, for example, to publish certificates for two sets of users from different divisions of a company who are located in different parts of the directory tree. A mapper is created for each of the groups to specify a different branch of the tree.

   For details about setting up mappers, see Section 7.4.3, “Creating Mappers”.

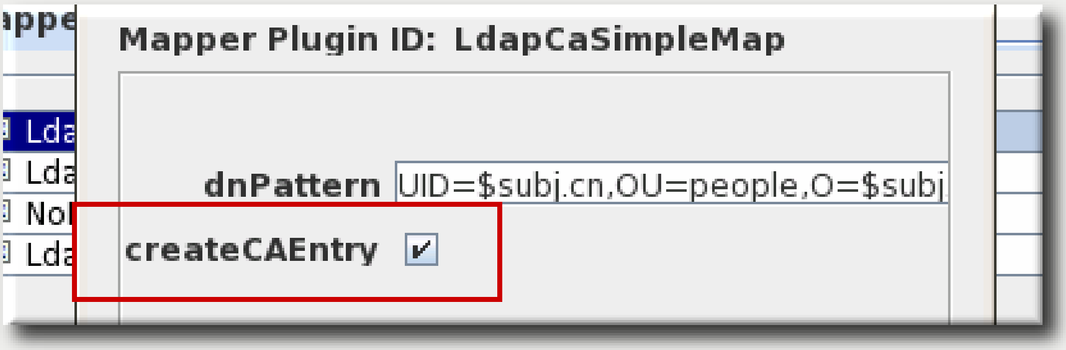
4. Create rules to connect publishers to mappers, as described in Section 7.5, “Creating Rules”.

5. Enable publishing, as described in Section 7.6, “Enabling Publishing”.

7.4.1. Configuring the LDAP Directory

Before certificates and CRLs can be published, the Directory Server must be configured to work with the publishing system. This means that user entries must have attributes that allow them to receive certificate information, and entries must be created to represent the CRLs.

1. Set up the entry for the CA. For the Certificate Manager to publish its CA certificate and CRL, the directory must include an entry for the CA.

> **Note**
>
> When LDAP publishing is configured, the Certificate Manager automatically creates or converts an entry for the CA in the directory. This option is set in both the CA and CRL mapper instances and enabled by default. If the directory restricts the Certificate Manager from creating entries in the directory, turn off this option in those mapper instances, and add an entry for the CA manually in the directory.
>
> 
>

When adding the CA's entry to the directory, select the entry type based on the DN of the CA:

- If the CA's DN begins with the **cn** component, create a new **person** entry for the CA. Selecting a different type of entry may not allow the **cn** component to be specified.
- If the CA's DN begins with the **ou** component, create a new **organizationalunit** entry for the CA.

The entry does not have to be in the **pkiCA** or **certificationAuthority** object class. The Certificate Manager will convert this entry to the **pkiCA** or **certificationAuthority** object class automatically by publishing its CA's signing certificate.

> **Note**
>
> The **pkiCA** object class is defined in RFC 4523, while the **certificationAuthority** object class is defined in the (obsolete) RFC 2256. Either object class is acceptable, depending on the schema definitions used by the Directory Server. In some situations, both object classes can be used for the same CA entry.

For more information on creating directory entries, see the Red Hat Directory Server documentation.

2. Add the correct schema elements to the CA and user directory entries.

   For a Certificate Manager to publish certificates and CRLs to a directory, it must be configured with specific attributes and object classes.

Object Type	Schema	Reason
End-entity certificate	userCertificate;binary (attribute)	This is the attribute to which the Certificate Manager publishes the certificate. This is a multi-valued attribute, and each value is a DER-encoded binary X.509 certificate. The LDAP object class named **inetOrgPerson** allows this attribute. The **strongAuthenticationUser** object class allows this attribute and can be combined with any other object class to allow certificates to be published to directory entries with other object classes. The Certificate Manager does not automatically add this object class to the schema table of the corresponding Directory Server. If the directory object that it finds does not allow the **userCertificate;binary** attribute, adding or removing the certificate fails.

Object Type	Schema	Reason
CA certificate	caCertificate;binary (attribute)	This is the attribute to which the Certificate Manager publishes the certificate. The Certificate Manager publishes its own CA certificate to its own LDAP directory entry when the server starts. The entry corresponds to the Certificate Manager's issuer name. This is a required attribute of the **pkiCA** or **certificationAuthority** object class. The Certificate Manager adds this object class to the directory entry for the CA if it can find the CA's directory entry.
CRL	certificateRevocationList;binary (attribute)	This is the attribute to which the Certificate Manager publishes the CRL. The Certificate Manager publishes the CRL to its own LDAP directory entry. The entry corresponds to the Certificate Manager's issuer name. This is an attribute of the **pkiCA** or **certificationAuthority** object class. The value of the attribute is the DER-encoded binary X.509 CRL. The CA's entry must already contain the **pkiCA** or **certificationAuthority** object class for the CRL to be published to the entry.

Object Type	Schema	Reason
Delta CRL	deltaRevocationList;binary (attribute)	This is the attribute to which the Certificate Manager publishes the delta CRL. The Certificate Manager publishes the delta CRL to its own LDAP directory entry, separate from the full CRL. The delta CRL entry corresponds to the Certificate Manager's issuer name. This attribute belongs to the **deltaCRL** or **certificationAuthority-V2** object class. The value of the attribute is the DER-encoded binary X.509 delta CRL.

3. Set up a bind DN for the Certificate Manager to use to access the Directory Server.

   The Certificate Manager user must have read-write permissions to the directory to publish certificates and CRLs to the directory so that the Certificate Manager can modify the user entries with certificate-related information and the CA entry with CA's certificate and CRL related information.

   The bind DN entry can be either of the following:

   - An existing DN that has write access, such as the Directory Manager.
   - A new user which is granted write access. The entry can be identified by the Certificate Manager's DN, such as **cn=testCA, ou=Research Dept, o=Example Corporation, st=California, c=US**.

   > **Note**
   >
   > Carefully consider what privileges are given to this user. This user can be restricted in what it can write to the directory by creating ACLs for the account. For instructions on giving write access to the Certificate Manager's entry, see the Directory Server documentation.

4. Set the directory authentication method for how the Certificate Manager authenticates to Directory Server. There are three options: basic authentication (simple username and password); SSL without client authentication (simple username and password); and SSL with client authentication (certificate-based).

   See the Red Hat Directory Server documentation for instructions on setting up these methods of communication with the server.

7.4.2. Configuring LDAP Publishers

The Certificate Manager creates, configures, and enables a set of publishers that are associated with LDAP publishing. The default publishers (for CA certificates, user certificates, CRLs, and cross-pair certificates) already conform to the X.500 standard attributes for storing certificates and CRLs and do not need to be changed.

Table 7.1. LDAP Publishers

Publisher	Description
LdapCaCertPublisher	Publishes CA certificates to the LDAP directory.
LdapCrlPublisher	Publishes CRLs to the LDAP directory.
LdapDeltaCrlPublisher	Publishes delta CRLs to the LDAP directory.
LdapUserCertPublisher	Publishes all types of end-entity certificates to the LDAP directory.
LdapCrossCertPairPublisher	Publishes cross-signed certificates to the LDAP directory.

7.4.3. Creating Mappers

Mappers are only used with LDAP publishing. Mappers define a relationship between a certificate's subject name and the DN of the directory entry to which the certificate is published. The Certificate Manager needs to derive the DN of the entry from the certificate or the certificate request so it can determine which entry to use. The mapper defines the relationship between the DN for the user entry and the subject name of the certificate or other input information so that the exact DN of the entry can be determined and found in the directory.

When it is configured, the Certificate Manager automatically creates a set of mappers defining the most common relationships. The default mappers are listed in Table 7.2, “Default Mappers”.

Table 7.2. Default Mappers

Mapper	Description
LdapUserCertMap	Locates the correct attribute of user entries in the directory in order to publish user certificates.
LdapCrlMap	Locates the correct attribute of the CA's entry in the directory in order to publish the CRL.
LdapCaCertMap	Locates the correct attribute of the CA's entry in the directory in order to publish the CA certificate.

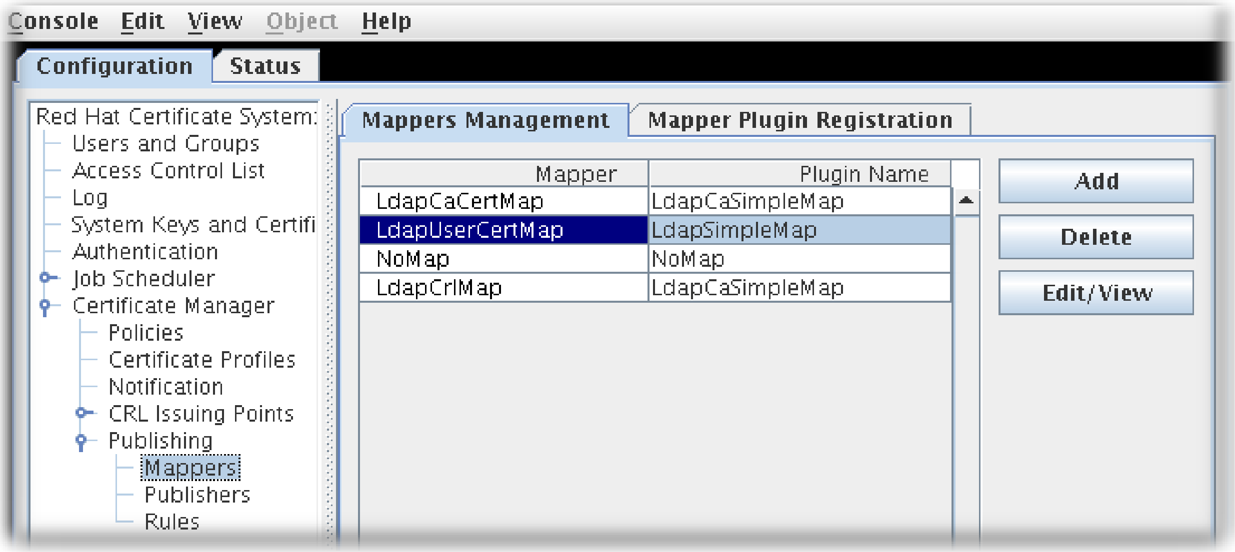
To use the default mappers, configure each of the macros by specifying the DN pattern and whether to create the CA entry in the directory. To use other mappers, create and configure an instance of the mapper. For more information, see Section C.2, “Mapper Plug-in Modules ”.

1. Log into the Certificate Manager Console.

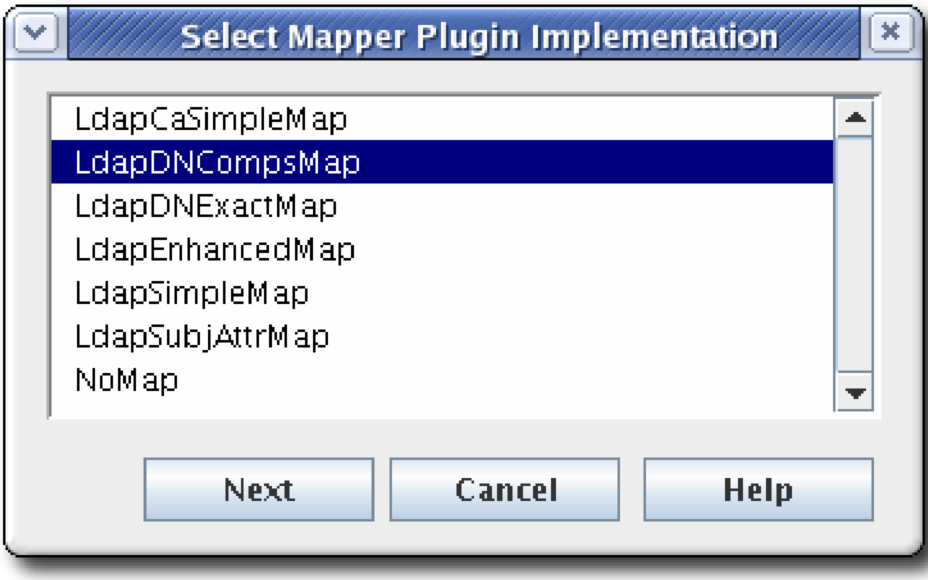
```
pkiconsole https://server.example.com:8443/ca
```

2. In the **Configuration** tab, select **Certificate Manager** from the navigation tree on the left. Select **Publishing**, and then **Mappers**.

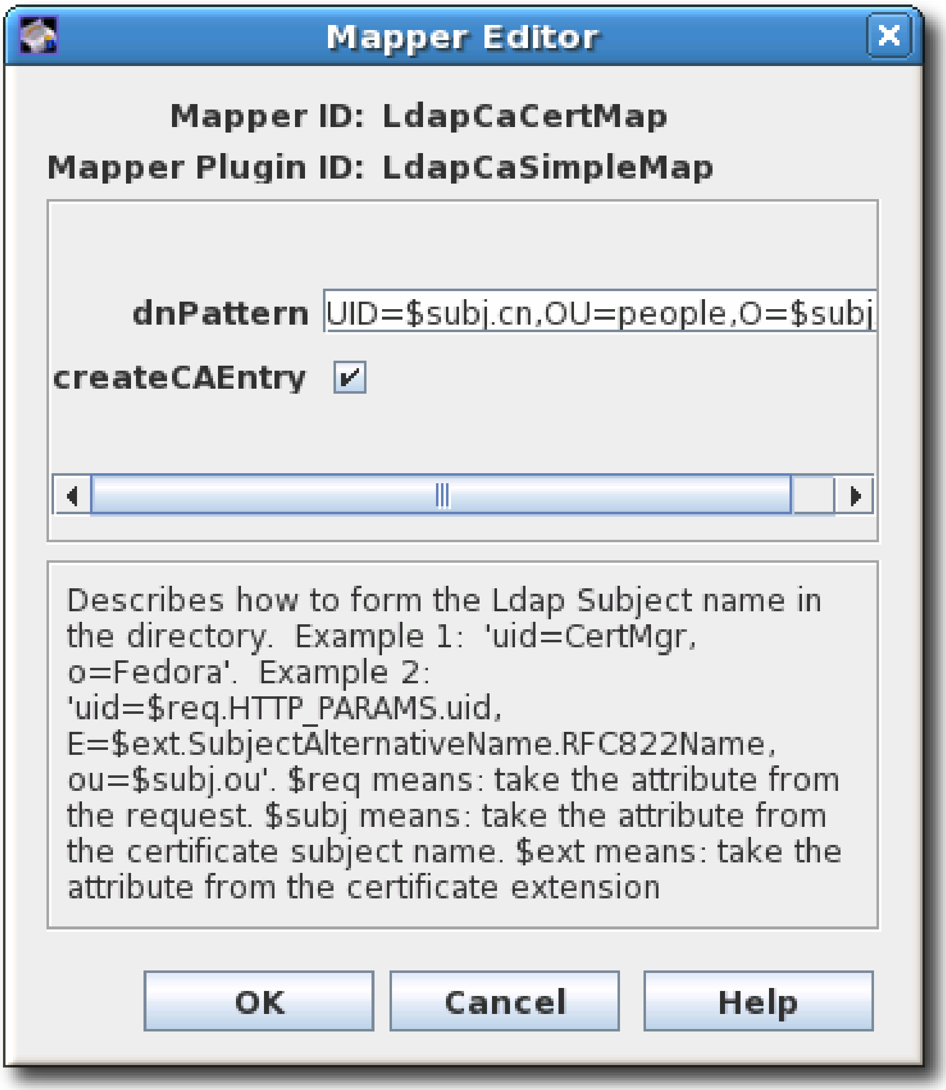
   The **Mappers Management** tab, which lists configured mappers, opens on the right.



3. To create a new mapper instance, click **Add**. The **Select Mapper Plugin Implementation** window opens, which lists registered mapper modules. Select a module, and edit it. For complete information about these modules, see Section C.2, "Mapper Plug-in Modules ".



4. Edit the mapper instance, and click **OK**.



See Section C.2, “Mapper Plug-in Modules ” for detailed information about each mapper.

7.4.4. Completing Configuration: Rules and Enabling

After configuring the mappers for LDAP publishing, configure the rules for the published certificates and CRLs, as described in Section 7.5, “Creating Rules”.

Once the configuration is complete, enable publishing, as described in Section 7.6, “Enabling Publishing”.

7.5. Creating Rules

Rules determine what certificate object is published in what location. Rules work independently, not in tandem. A certificate or CRL that is being published is matched against every rule. Any rule which it matches is activated. In this way, the same certificate or CRL can be published to a file, to an Online Certificate Status Manager, and to an LDAP directory by matching a file-based rule, an OCSP rule, and matching a directory-based rule.

Rules can be set for each object type: CA certificates, CRLs, user certificates, and cross-pair certificates. The rules can be more detailed for different kinds of certificates or different kinds of CRLs.

The rule first determines if the object matches by matching the type and predicate set up in the rule with the object. Where matching objects are published is determined by the publisher and mapper associated with the rule.

Rules are created for each type of certificate the Certificate Manager issues.

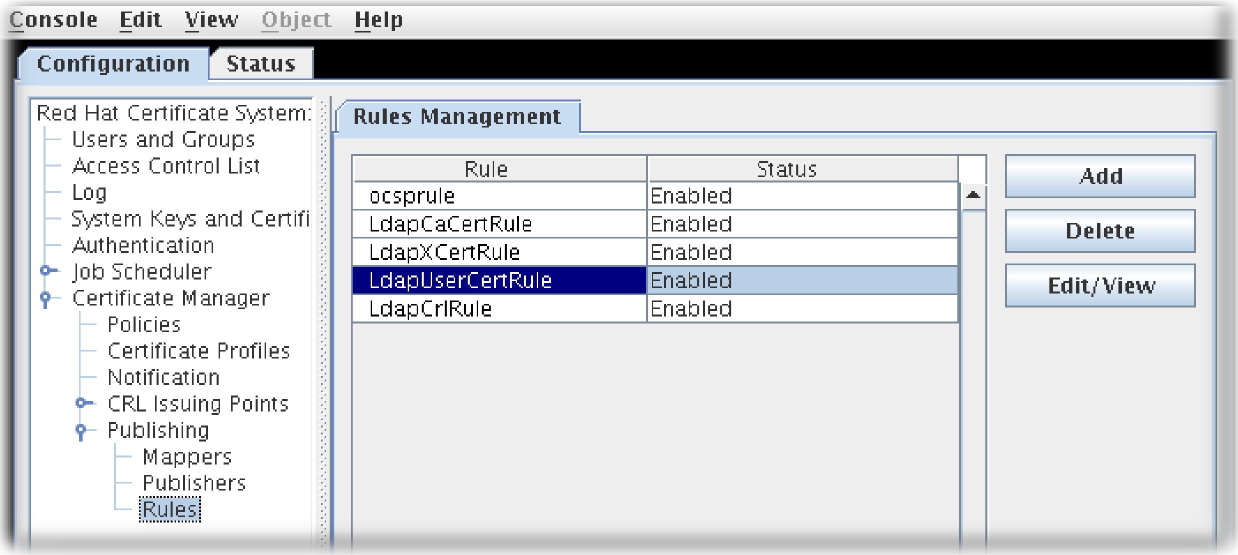
Modify publishing rules by doing the following:

1. Log into the Certificate Manager Console.

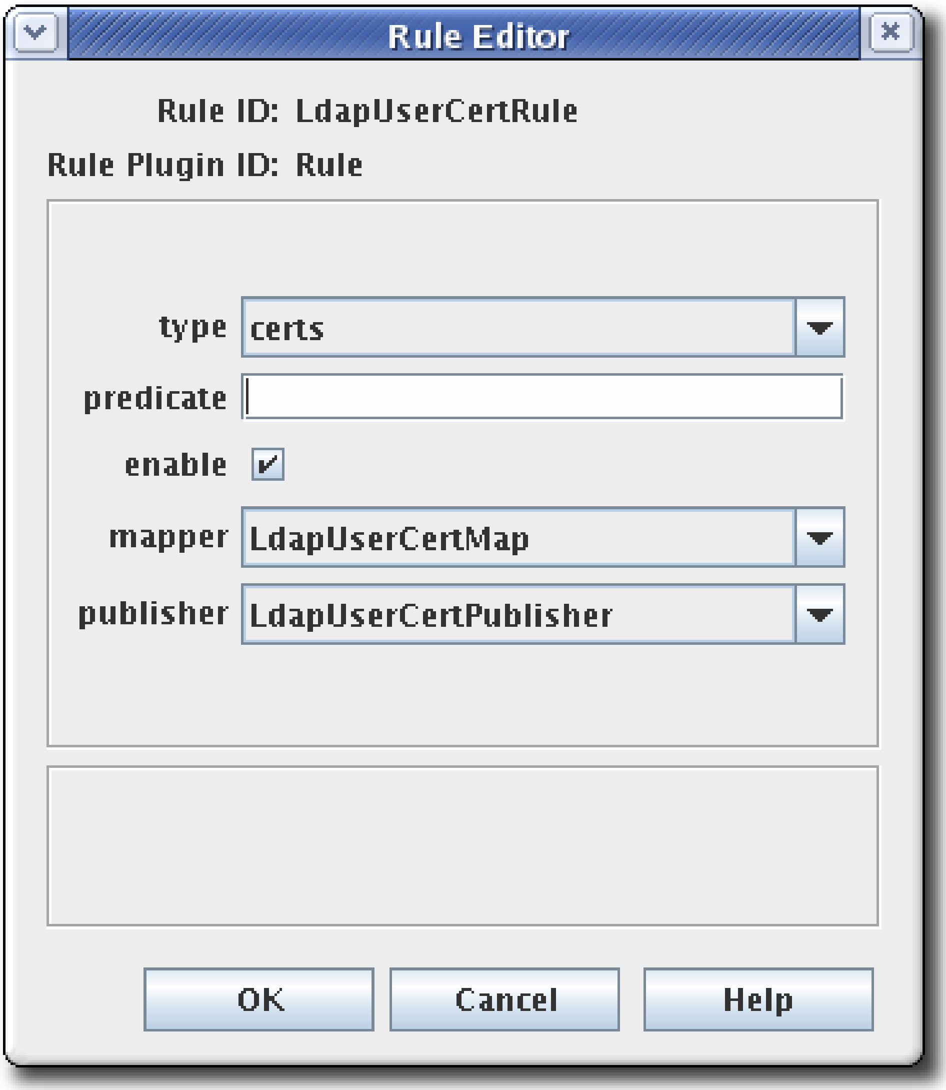
   ```
   pkiconsole https://server.example.com:8443/ca
   ```

2. In the **Configuration** tab, select **Certificate Manager** from the navigation tree on the left. Select **Publishing**, and then **Rules**.

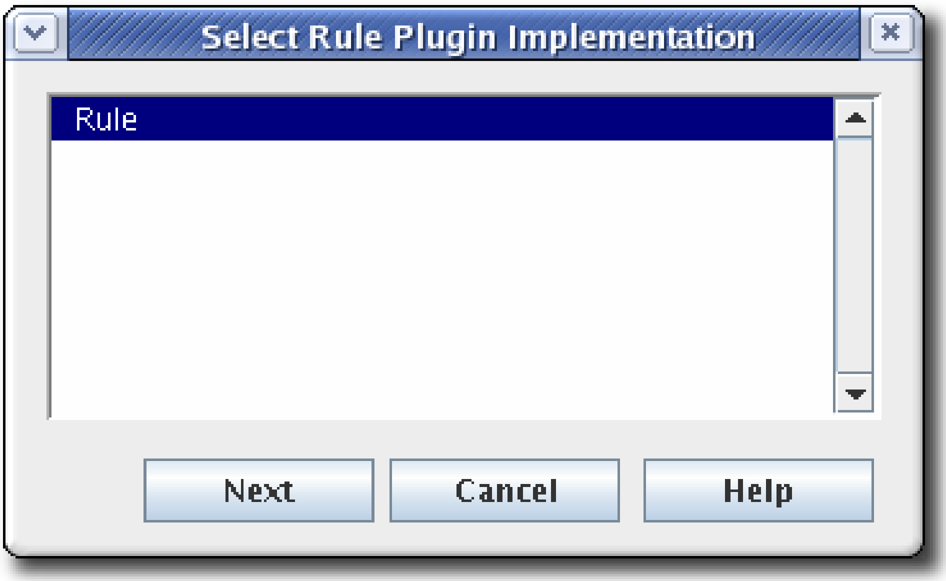
   The **Rules Management** tab, which lists configured rules, opens on the right.



3. To edit an existing rule, select that rule from the list, and click **Edit**. This opens the **Rule Editor** window.

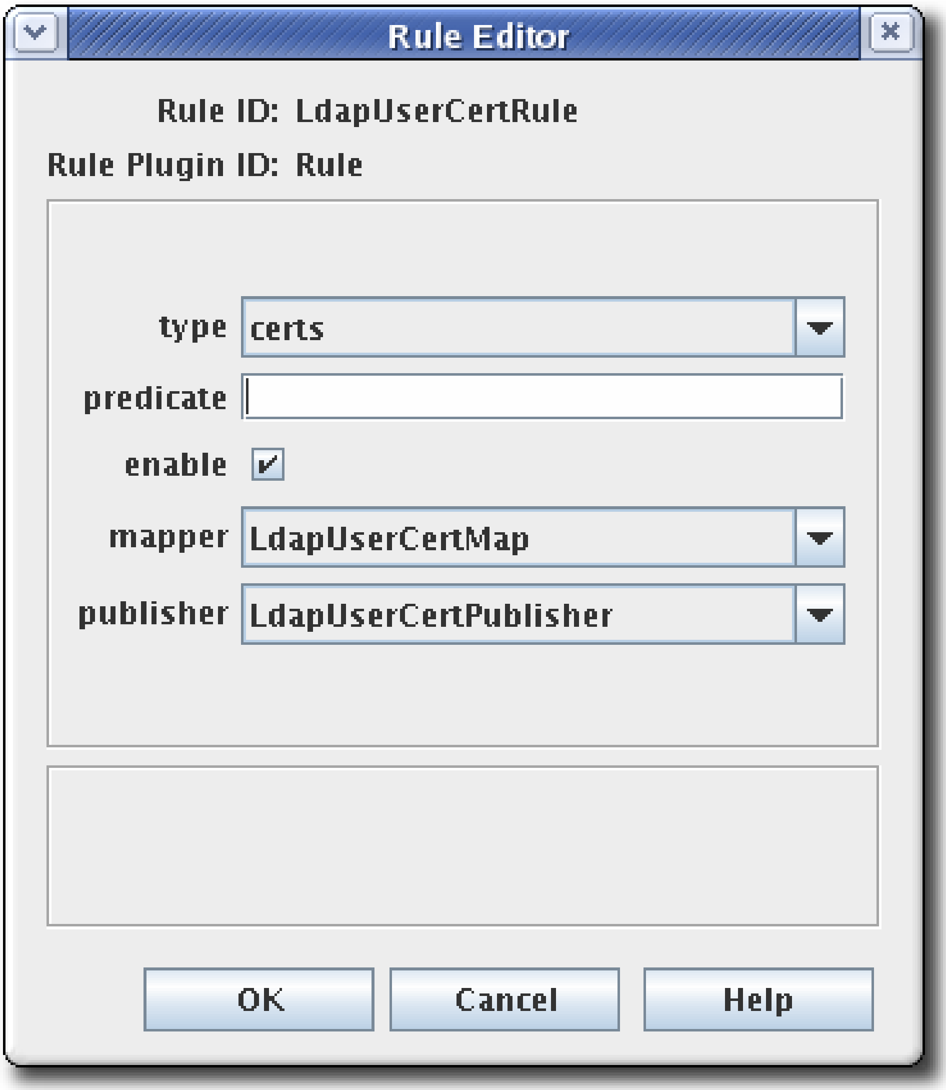


4. To create a rule, click **Add**. This opens the **Select Rule Plug-in Implementation** window.



Select the **Rule** module. This is the only default module. If any custom modules have been been registered, they are also available.

5. Edit the rule.



- **type**. This is the type of certificate for which the rule applies. For a CA signing certificate, the value is **cacert**. For a cross-signed certificate, the value is **xcert**. For all other types of certificates, the value is **certs**. For CRLs, specify **crl**.
- **predicate**. This sets the predicate value for the type of certificate or CRL issuing point to which this rule applies. The predicate values for CRL issuing points, delta CRLs, and certificates are listed in Table 7.3, “Predicate Expressions”.
- **enable**.
- **mapper**. Mappers are not necessary when publishing to a file; they are only needed for LDAP publishing. If this rule is associated with a publisher that publishes to an LDAP directory, select an appropriate mapper here. Leave blank for all other forms of publishing.
- **publisher**. Sets the publisher to associate with the rule.

Table 7.3, “Predicate Expressions” lists the predicates that can be used to identify CRL issuing points and delta CRLs and certificate profiles.

Table 7.3. Predicate Expressions

Predicate Type	Predicate
CRL Issuing Point	**issuingPointId==***Issuing_Point_Instance_ID* **&& isDeltaCRl==[true|false]** To publish only the master CRL, set **isDeltaCRl==false**. To publish only the delta CRL, set **isDeltaCRl==true**. To publish both, set a rule for the master CRL and another rule for the delta CRL.
Certificate Profile	**profileId==***profile_name* To publish certificates based on the profile used to issue them, set **profileId==** to a profile name, such as **caServerCert**.

7.6. Enabling Publishing

Publishing can be enabled for only files, only LDAP, or both. Publishing should be enabled after setting up publishers, rules, and mappers. Once enabled, the server attempts to begin publishing. If publishing was not configured correctly before being enabled, publishing may exhibit undesirable behavior or may fail.

> **Note**
>
> Configure CRLs. CRLs must be configured before they can be published. See Chapter 6, *Revoking Certificates and Issuing CRLs*.

1. Log into the Certificate Manager Console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

2. In the **Configuration** tab, select **Certificate Manager** from the navigation tree on the left. Select **Publishing**.

   The right pane shows the details for publishing to an LDAP-compliant directory.

3. To enable publishing to a file only, select **Enable Publishing**.

4. To enable LDAP publishing, select both **Enable Publishing** and **Enable Default LDAP Connection**.

In the **Destination** section, set the information for the Directory Server instance.

- **Host name**. If the Directory Server is configured for SSL client authenticated communication, the name must match the **cn** component in the subject DN of the Directory Server's SSL server certificate.

  The hostname can be the fully-qualified domain name or an IPv4 or IPv6 address.

- **Port number**.

- **Directory Manager DN**. This is the distinguished name (DN) of the directory entry that has Directory Manager privileges. The Certificate Manager uses this DN to access the directory tree and to publish to the directory. The access control set up for this DN determines whether the Certificate Manager can perform publishing. It is possible to create another DN that has limited read-write permissions for only those attributes that the publishing system actually needs to write.

- **Password.** This is the password which the CA uses to bind to the LDAP directory to which the certificate or CRL is published. The Certificate Manager saves this password in its **password.conf** file. For example:

  ```
  CA LDAP Publishing:password
  ```

  The parameter name which identifies the publishing password (**CA LDAP Publishing**) is set in the Certificate Manager's **CS.cfg** file in the **ca.publish.ldappublish.ldap.ldapauth.bindPWPrompt** parameter, and it can be edited.

- **Client certificate**. This sets the certificate the Certificate Manager uses for SSL client authentication to the publishing directory. By default, the Certificate Manager uses its SSL server certificate.

- **LDAP version**. Select LDAP version 3.

- **Authentication**. The way the Certificate Manager authenticates to the Directory Server. The choices are **Basic authentication** and **SSL client authentication**.

If the Directory Server is configured for basic authentication or for SSL communication without client authentication, select **Basic authentication** and specify values for the Directory manager DN and password.

If the Directory Server is configured for SSL communication with client authentication, select **SSL client authentication** and the **Use SSL communication** option, and identify the certificate that the Certificate Manager must use for SSL client authentication to the directory.

The server attempts to connect to the Directory Server. If the information is incorrect, the server displays an error message.

7.7. Enabling a Publishing Queue

Part of the enrollment process includes publishing the issued certificate to any directories or files. This, essentially, closes out the initial certificate request. However, publishing a certificate to an external network can significantly slow down the issuance process — which leaves the request open.

To avoid this situation, administrators can enable a *publishing queue*. The publishing queue separates the publishing operation (which may involve an external LDAP directory) from the request and enrollment operations, which uses a separate request queue. The request queue is updated immediately to show that the enrollment process is complete, while the publishing queue sends the information at the pace of the network traffic.

The publishing queue sets a defined, limited number of threads that publish generated certificates, rather than opening a new thread for each approved certificate.

The publishing queue is disabled by default. It can be enabled in the CA Console, along with enabling publishing.

Note

While the publishing queue is disabled by default, the queue is automatically enabled if LDAP publishing is enabled *in the Console*. Otherwise, the queue can be enabled manually.

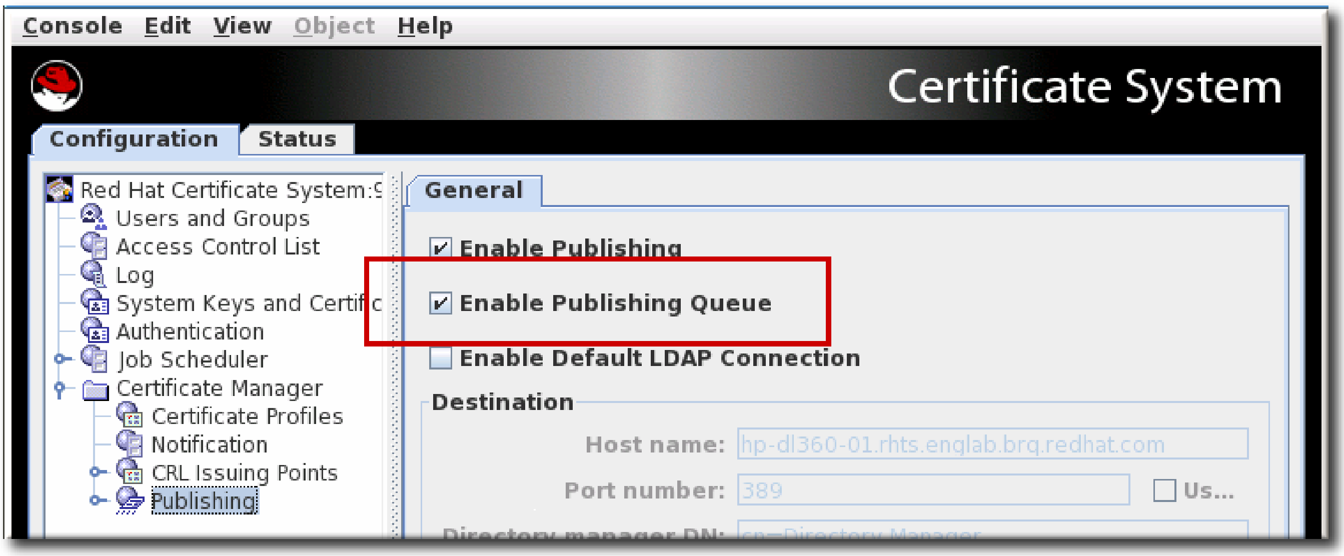


Figure 7.1. Enabling the Publishing Queue

> **Note**
>
> Enabling the publishing queue by editing the **CS.cfg** file allows administrators to set other options for publishing, like the number of threads to use for publishing operations and the queue page size.

1. Stop the CA server, so that you can edit the configuration files.

   ```
   ]# systemctl stop pki-tomcatd@instance-name.service
   ```

2. Open the CA's **CS.cfg** file.

   ```
   vim /var/lib/pki/instance-name/ca/conf/CS.cfg
   ```

3. Set the ***ca.publish.queue.enable*** to true. If the parameter is not present, then add a line with the parameter.

   ```
   ca.publish.queue.enable=true
   ```

4. Set other related publishing queue parameters:

   - ***ca.publish.queue.maxNumberOfThreads*** sets the maximum number of threads that can be opened for publishing operations. The default is 3.
   - ***ca.publish.queue.priorityLevel*** sets the priority for publishing operations. The priority value ranges from **-2** (lowest priority) to **2** (highest priority). Zero (0) is normal priority and is also the default.
   - ***ca.publish.queue.pageSize*** sets the maximum number of requests that can be stored in the publishing queue page. The default is 40.
   - ***ca.publish.queue.saveStatus*** sets the interval to save its status every specified number of publishing operations. This allows the publishing queue to be recovered if the CA is restarted or crashes. The default is 200, but any non-zero number will recover the queue when the CA restarts. Setting this parameter to 0 disables queue recovery.

   ```
   ca.publish.queue.maxNumberOfThreads=1
   ca.publish.queue.priorityLevel=0
   ca.publish.queue.pageSize=100
   ca.publish.queue.saveStatus=200
   ```

   > **Note**
   >
   > Setting ***ca.publish.queue.enable*** to false and ***ca.publish.queue.maxNumberOfThreads*** to 0 disables both the publishing queue and using separate threads for publishing issued certificates.

5. Restart the CA server.

```
]# systemctl restart pki-tomcatd@instance-name.service
```

7.8. Setting up Resumable CRL Downloads

Certificate System provides option for interrupted CRL downloads to be resumed smoothly. This is done by publishing the CRLs as a plain file over HTTP. This method of downloading CRLs gives flexibility in retrieving CRLs and lowers overall network congestion.

7.8.1. Retrieving CRLs Using wget

Because CRLs can be published as a text file over HTTP, they can be manually retrieved from the CA using a tool such as **wget**. The **wget** command can be used to retrieve any published CRL. For example, to retrieve a full CRL which is newer than the previous full CRL:

```
[root@server ~]# wget --no-check-certificate -d
https://server.example.com:8443/ca/ee/ca/crl/MasterCRL.bin
```

The relevant parameters for **wget** are summarized in Table 7.4, "wget Options to Use for Retrieving CRLs".

Table 7.4. wget Options to Use for Retrieving CRLs

Argument	Description
no argument	Retrieves the full CRL.
-N	Retrieves the CRL that is newer than the local copy (delta CRL).
-c	Retrieves a partially-downloaded file.
--no-check-certificate	Skips SSL for the connection, so it is not necessary to configure SSL between the host and client.
-d	Prints debug information.

7.9. Publishing Cross-Pair Certificates

The cross-pair certificates can be published as a **crossCertificatePair** entry to an LDAP directory or to a file; this is enabled by default. If this has been disabled, it can be re-enabled through the Certificate Manager Console by doing the following:

1. Open the CA console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

2. In the **Configuration** tab, select the **Certificate Manager** link in the left pane, then the **Publishing** link.

3. Click the **Rules** link under **Publishing**. This opens the **Rules Management** pane on the right.

4. If the rule exists and has been disabled, select the **enable** checkbox. If the rule has been deleted, then click **Add** and create a new rule.

a. Select **xcerts** from the **type** drop-down menu.

b. Make sure the **enable** checkbox is selected.

c. Select **LdapCaCertMap** from the **mapper** drop-down menu.

d. Select **LdapCrossCertPairPublisher** from the **publisher** drop-down menu.

The mapper and publisher specified in the publishing rule are both listed under **Mapper** and **Publisher** under the **Publishing** link in the left navigation window of the CA Console. The mapper, **LdapCaCertMap**, by default designates that the **crossCertificatePair** be stored to the **LdapCaSimpleMap** LDAP entry. The publisher, **LDAPCrossPairPublisher**, by default sets the attribute to store the cross-pair certificate in the CA entry to **crossCertificatePair;binary**.

7.10. Testing Publishing to Files

To verify that the Certificate Manager is publishing certificates and CRLs correctly to file:

1. Open the CA's end-entities page, and request a certificate.

2. Approve the request through the agent services page, if required.

3. Retrieve the certificate from the end-entities page, and download the certificate into the browser.

4. Check whether the server generated the DER-encoded file containing the certificate.

   Open the directory to which the binary blob of the certificate is supposed to be published. The certificate file should be named **cert-***serial_number***.der**.

5. Convert the DER-encoded certificate to its base 64-encoded format using the Binary to ASCII tool. For more information on this tool, refer to the *Certificate System Command-Line Tools Guide*.

   ```
   BtoA input_file output_file
   ```

   input_file sets the path to the file that contains the DER-encoded certificate, and *output_file* sets the path to the file to write the base-64 encoded certificate.

6. Open the ASCII file; the base-64 encoded certificate is similar to the one shown:

   ```
   -----BEGIN CERTIFICATE-----
   MMIIBtgYJYIZIAYb4QgIFoIIBpzCCAZ8wggGbMIIBRaADAgEAAgEBMA0GCSqGSIb3D
   QEBBAUAMFcxC
   AJBgNVBAYTAlVTMSwwKgYDVQQKEyNOZXRzY2FwZSBDb21tdW5pY2F0aWhfyyuougjg
   jjgmkgjkgmjg
   fjfgjjjgfyjfyj9ucyBDb3Jwb3JhdGlvbjpMEaMBgGA1UECxMRSXNzdWluZyhgdfhb
   fdpffjphotoo
   gdhkBBdXRob3JpdHkwHhcNOTYxMTA4MDkwNzM0WhcNOTgxMTA4MDkwNzMM0WjBXMQs
   wCQYDVQQGEwJ
   VUzEsMCoGA1UEChMjTmV0c2NhcGUgQ29tbXVuaWNhdGlvbnMgQ29ycG9yY2F0aW9uc
   yBDb3Jwb3Jhd
   GlvbjpMEaMBgGA1UECxMRSXNzdWluZyBBdXRob3JpdHkwHh
   -----END CERTIFICATE-----
   ```

7. Convert the base 64-encoded certificate to a readable form using the Pretty Print Certificate tool. For more information on this tool, refer to the *Certificate System Command-Line Tools Guide*.

   ```
   PrettyPrintCert input_file [output_file]
   ```

   input_file sets the path to the ASCII file that contains the base-64 encoded certificate, and *output_file*, optionally, sets the path to the file to write the certificate. If an output file is not set, the certificate information is written to the standard output.

8. Compare the output with the certificate issued; check the serial number in the certificate with the one used in the filename.

   If everything matches, the Certificate Manager is configured correctly to publish certificates to file.

9. Revoke the certificate.

10. Check whether the server generated the DER-encoded file containing the CRL.

    Open the directory to which the server is to publish the CRL as a binary blob. The CRL file should have a name in the form **crl-***this_update***.der**. *this_update* specifies the value derived from the time-dependent **This Update** variable of the CRL.

11. Convert the DER-encoded CRL to its base 64-encoded format using the Binary to ASCII tool.

    ```
    BtoA input_file output_file
    ```

12. Convert the base 64-encoded CRL to readable form using the Pretty Print CRL tool.

    ```
    PrettyPrintCrl input_file [output_file]
    ```

13. Compare the output.

7.11. Viewing Certificates and CRLs Published to File

Certificates and CRLs can be published to two types of files: base-64 encoded or DER-encoded. The content of these files can be viewed by converting the files to pretty-print format using the **dumpasn1** tool or the **PrettyPrintCert** or **PrettyPrintCrl** tool.

To view the content in a base-64 encoded file:

1. Convert the base-64 file to binary. For example:

   ```
   AtoB /tmp/example.b64 /tmp/example.bin
   ```

2. Use the **PrettyPrintCert** or **PrettyPrintCrl** tool to convert the binary file to pretty-print format. For example:

   ```
   PrettyPrintCert example.bin example.cert
   ```

Alternatively, the **dumpasn1** can be used to convert a binary certificate or CRL to pretty-print format. The **dumpasn1** tool can be downloaded at http://fedoraproject.org/extras/4/i386/repodata/repoview/dumpasn1-0-20050404-1.fc4.html.

To view the content of a DER-encoded file, simply run the **dumpasn1**, **PrettyPrintCert**, or **PrettyPrintCrl** tool with the DER-encoded file. For example:

```
PrettyPrintCrl example.der example.crl
```

7.12. Updating Certificates and CRLs in a Directory

The Certificate Manager and the publishing directory can become out of sync if certificates are issued or revoked while the Directory Server is down. Certificates that were issued or revoked need to be published or unpublished manually when the Directory Server comes back up.

To find certificates that are out of sync with the directory - valid certificates that are not in the directory and revoked or expired certificates that are still in the directory - the Certificate Manager keeps a record of whether a certificate in its internal database has been published to the directory. If the Certificate Manager and the publishing directory become out of sync, use the **Update Directory** option in the Certificate Manager agent services page to synchronize the publishing directory with the internal database.

The following choices are available for synchronizing the directory with the internal database:

- Search the internal database for certificates that are out of sync and publish or unpublish.
- Publish certificates that were issued while the Directory Server was down. Similarly, unpublish certificates that were revoked or that expired while Directory Server was down.
- Publish or unpublish a range of certificates based on serial numbers, from serial number *xx* to serial number *yy*.

A Certificate Manager's publishing directory can be manually updated by a Certificate Manager agent only.

7.12.1. Manually Updating Certificates in the Directory

The **Update Directory Server** form in the Certificate Manager agent services page can be used to update the directory manually with certificate-related information. This form initiates a combination of the following operations:

- Update the directory with certificates.
- Remove expired certificates from the directory.

  Removing expired certificates from the publishing directory can be automated by scheduling an automated job. For details, see Chapter 11, *Setting Automated Jobs*.
- Remove revoked certificates from the directory.

Manually update the directory with changes by doing the following:

1. Open the Certificate Manager agent services page.
2. Select the **Update Directory Server** link.
3. Select the appropriate options, and click **Update Directory**.

   The Certificate Manager starts updating the directory with the certificate information in its internal database. If the changes are substantial, updating the directory can take considerable time. During this period, any changes made through the Certificate Manager, including any certificates issued or any certificates revoked, may not be included in the update. If any certificates are issued or revoked while the directory is updated, update the directory again to reflect those changes.

When the directory update is complete, the Certificate Manager displays a status report. If the process is interrupted, the server logs an error message.

If the Certificate Manager is installed as a root CA, the CA signing certificate may get published using the publishing rule set up for user certificates when using the agent interface to update the directory with valid certificates. This may return an object class violation error or other errors in the mapper. Selecting the appropriate serial number range to exclude the CA signing certificate can avoid this problem. The CA signing certificate is the first certificate a root CA issues.

- Modify the default publishing rule for user certificates by changing the value of the **predicate** parameter to **profileId!=caCACert**.
- Use the **LdapCaCertPublisher** publisher plug-in module to add another rule, with the predicate parameter set to **profileId=caCACert**, for publishing subordinate CA certificates.

7.12.2. Manually Updating the CRL in the Directory

The **Certificate Revocation List** form in the Certificate Manager agent services page manually updates the directory with CRL-related information.

Manually update the CRL information by doing the following:

1. Open the Certificate Manager agent services page.
2. Select **Update Revocation List**.
3. Click **Update**.

The Certificate Manager starts updating the directory with the CRL in its internal database. If the CRL is large, updating the directory takes considerable time. During this period, any changes made to the CRL may not be included in the update.

When the directory is updated, the Certificate Manager displays a status report. If the process is interrupted, the server logs an error message.

7.13. Registering Custom Mapper and Publisher Plug-in Modules

New mapper or publisher plug-in modules can be registered in a Certificate Manager's publishing framework. Unwanted mapper or publisher plug-in modules can be deleted. Before deleting a module, delete all the rules that are based on this module.

1. Create the custom job class. For this example, the custom publisher plug-in is called **MyPublisher.java**.

2. Compile the new class.

```
javac -d . -classpath $CLASSPATH MyPublisher.java
```

3. Create a directory in the CA's **WEB-INF** web directory to hold the custom classes, so that the CA can access them.

```
mkdir /var/lib/pki/instance_name/ca/webapps/ca/WEB-INF/classes
```

4. Copy the new plug-in files into the new **classes** directory, and set the owner to the Certificate System system user (**pkiuser**).

```
cp -pr com /var/lib/pki/instance_name/ca/webapps/ca/WEB-
INF/classes

chown -R pkiuser:pkiuser
/var/lib/pki/instance_name/ca/webapps/ca/WEB-INF/classes
```

5. Register the plug-in.

   a. Log into the Certificate Manager Console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

   b. In the **Configuration** tab, select **Certificate Manager** from the navigation tree on the left. Select **Publishing**.

   c. To register a mapper module, select **Mappers**, and then select the **Mapper Plugin Registration** tab.

      To register a publisher module, select **Publishers**, and then select the **Publisher Plug-in Registration** tab.

   d. To register a plug-in, click **Register**.

   e. Set the plug-in name and plug-in class name. The class name is, the path to the implementing Java class. If this class is part of a package, include the package name. For example, to register a class named **customMapper** in a package named **com.customplugins**, the name is **com.customplugins.customMapper**.

Chapter 8. Authentication for Enrolling Certificates

This chapter covers how to enroll end entity certificates, how to create and manage server certificates, the authentication methods available in the Certificate System to use when enrolling end entity certificates, and how to set up those authentication methods.

Enrollment is the process of issuing certificates to an end entity. The process is creating and submitting the request, authenticating the user requesting it, and then approving the request and issuing the certificate.

The method used to authenticate the end entity determines the entire enrollment process. There are three ways that the Certificate System can authenticate an entity:

- In *agent-approved* enrollment, end-entity requests are sent to an agent for approval. The agent approves the certificate request.
- In *automatic* enrollment, end-entity requests are authenticated using a plug-in, and then the certificate request is processed; an agent is not involved in the enrollment process.
- In *CMC enrollment*, a third party application can create a request that is signed by an agent and then automatically processed.

A Certificate Manager is initially configured for agent-approved enrollment and for CMC authentication. Automated enrollment is enabled by configuring one of the authentication plug-in modules. More than one authentication method can be configured in a single instance of a subsystem.

> **Note**
>
> An email can be automatically sent to an end entity when the certificate is issued for any authentication method by configuring automated notifications. See Chapter 10, *Using Automated Notifications* for more information on notifications.

8.1. Configuring Agent-Approved Enrollment

The Certificate Manager is initially configured for agent-approved enrollment. An end entity makes a request which is sent to the agent queue for an agent's approval. An agent can modify request, change the status of the request, reject the request, or approve the request. Once the request is approved, the signed request is sent to the Certificate Manager for processing. The Certificate Manager processes the request and issues the certificate.

The agent-approved enrollment method is not configurable. If a Certificate Manager is not configured for any other enrollment method, the server automatically sends all certificate-related requests to a queue where they await agent approval. This ensures that all requests that lack authentication credentials are sent to the request queue for agent approval.

To use agent-approved enrollment, leave the authentication method blank in the profile's **.cfg** file. For example:

```
auth.instance_id=
```

8.2. Automated Enrollment

In automated enrollment, an end-entity enrollment request is processed as soon as the user successfully authenticates by the method set in the authentication plug-in module; no agent approval is necessary. The following authentication plug-in modules are provided:

- *Directory-based enrollment.* End entities are authenticated against an LDAP directory using their user ID and password or their DN and password. See Section 8.2.1, “Setting up Directory-Based Authentication”.
- *PIN-based enrollment.* End entities are authenticated against an LDAP directory using their user ID, password, and a PIN set in their directory entry. See Section 8.2.2, “Setting up PIN-Based Enrollment”.
- *Certificate-based authentication*. Entities of some kind — both end users and other entities, like servers or tokens — are authenticated to the CA using a certificate issued by the CA which proves their identity. This is most commonly used for renewal, where the original certificate is presented to authenticate the renewal process. See Section 8.2.3, “Using Certificate-Based Authentication”.
- *AgentCertAuth*. This method automatically approves a certificate request if the entity submitting the request is authenticated as a subsystem agent. A user authenticates as an agent by presenting an agent certificate. If the presented certificate is recognized by the subsystem as an agent certificate, then the CA automatically processes the certificate request.

  This form of automatic authentication can be associated with the certificate profile for enrolling for server certificates.

  This plug-in is enabled by default and has no parameters.
- *Flat file-based enrollment*. Used exclusively for router (SCEP) enrollments, a text file is used which contains a list of IP addresses, hostnames, or other identifier and a password, which is usually a random PIN. A router authenticates to the CA using its ID and PIN, and then the CA compares the presented credentials to the list of identities in the text file. See Section 8.2.4, “Configuring Flat File Authentication”.

8.2.1. Setting up Directory-Based Authentication

The **UidPwdDirAuth** and the **UdnPwdDirAuth** plug-in modules implement directory-based authentication. End users enroll for a certificate by providing their user IDs or DN and password to authenticate to an LDAP directory.

1. Create an instance of either the **UidPwdDirAuth** or **UdnPwdDirAuth** authentication plug-in module and configure the instance.

   a. Open the CA Console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

   b. In the **Configuration** tab, select **Authentication** in the navigation tree.

   The right pane shows the **Authentication Instance** tab, which lists the currently configured authentication instances.

> **Note**
>
> The **UidPwdDirAuth** plug-in is enabled by default.

c. Click **Add**.

   The **Select Authentication Plug-in Implementation** window appears.

d. Select **UidPwdDirAuth** for user ID and password authentication, or select **UdnPwdDirAuth** for DN and password authentication.

e. Fill in the following fields in the **Authentication Instance Editor** window:

   - **Authentication Instance ID.** Accept the default instance name, or enter a new name.
   - **dnpattern.** Specifies a string representing a subject name pattern to formulate from the directory attributes and entry DN.
   - **ldapStringAttributes.** Specifies the list of LDAP string attributes that should be considered *authentic* for the end entity. If specified, the values corresponding to these attributes are copied from the authentication directory into the authentication token and used by the certificate profile to generate the subject name. Entering values for this parameter is optional.
   - **ldapByteAttributes.** Specifies the list of LDAP byte (binary) attributes that should be considered *authentic* for the end entity. If specified, the values corresponding to these attributes will be copied from the authentication directory into the authentication token for use by other modules, such as adding additional information to users' certificates.

     Entering values for this parameter is optional.
   - **ldap.ldapconn.host.** Specifies the fully-qualified DNS hostname of the authentication directory.
   - **ldap.ldapconn.port.** Specifies the TCP/IP port on which the authentication directory listens to requests; if the **ldap.ldapconn.secureConn.** checkbox is selected, this should be the SSL port number.
   - **ldap.ldapconn.secureConn.** Specifies the type, SSL or non-SSL, of the port on which the authentication directory listens to requests from the Certificate System. Select if this is an SSL port.
   - **ldap.ldapconn.version.** Specifies the LDAP protocol version, either **2** or **3**. The default is **3**, since all Directory Servers later than version 3.x are LDAPv3.
   - **ldap.basedn.** Specifies the base DN for searching the authentication directory. The server uses the value of the **uid** field from the HTTP input (what a user enters in the enrollment form) and the base DN to construct an LDAP search filter.
   - **ldap.minConns.** Specifies the minimum number of connections permitted to the authentication directory. The permissible values are **1** to **3**.

- **ldap.maxConns.** Specifies the maximum number of connections permitted to the authentication directory. The permissible values are **3** to **10**.

f. Click **OK**. The authentication instance is set up and enabled.

2. Set the certificate profiles to use to enroll users by setting policies for specific certificates. Customize the enrollment forms by configuring the inputs in the certificate profiles, and include inputs for the information needed by the plug-in to authenticate the user. If the default inputs do not contain all of the information that needs to be collected, submit a request created with a third-party tool.

   For information on configuring the profiles, see Section 2.7.2, "Inserting LDAP Directory Attribute Values and Other Information into the Subject Alt Name".

Some environments require disallowing an anonymous bind for the LDAP server that is used for authentication. To create a bound connection between a CA and the LDAP server, you need to make the following configuration changes:

- Set up directory-based authentication according to the following example in **CS.cfg**:

```
auths.instance.UserDirEnrollment.ldap.ldapBoundConn=true
auths.instance.UserDirEnrollment.ldap.ldapauth.authtype=BasicAuth
auths.instance.UserDirEnrollment.ldap.ldapauth.bindDN=cn=Directory
Manager
auths.instance.UserDirEnrollment.ldap.ldapauth.bindPWPrompt=externalLD
AP
externalLDAP.authPrefix=auths.instance.UserDirEnrollment
cms.passwordlist=internaldb,replicationdb,externalLDAP
```

  where **bindPWPrompt** is the tag or prompt that is used in the **password.conf** file; It is also the name used under the **optionpasswordlist** and **authPrefix** options.

- Add the tag or prompt from **CS.cfg** with its password in **password.conf**:

```
externalLDAP=your_password
```

A directory-based authentication plug-in can also be configured to evaluate the group membership of the user for authentication. To set up the plug-in this way, the following options has to be configured in **CS.cfg**:

- **groupsEnable** is a boolean option that enables retrieval of groups. The default value is **false**.
- **groupsBasedn** is the base DN of groups. It needs to be specified when it differs from the default **basedn**.
- **groups** is the DN component for groups. The default value is **ou=groups**.
- **groupObjectClass** is one of the following group object classes: **groupofuniquenames**, **groupofnames**. The default value is **groupofuniquenames**.
- **groupUseridName** is the name of the user ID attribute in the group object member attribute. The default value is **cn**.
- **useridName** is the name of the user ID DN component. The default value is **uid**.

- **searchGroupUserByUserdn** is a boolean option that determines whether to search the group object member attribute for the **userdn** or **${groupUserIdName}=${uid}** attributes. The default value is **true**.

For example:

```
auths.instance.UserDirEnrollment.pluginName=UidPwdDirAuth
auths.instance.UserDirEnrollment.ldap.basedn=cn=users,cn=accounts,dc=loc
al
auths.instance.UserDirEnrollment.ldap.groupObjectClass=groupofnames
auths.instance.UserDirEnrollment.ldap.groups=cn=groups
auths.instance.UserDirEnrollment.ldap.groupsBasedn=cn=accounts,dc=local
auths.instance.UserDirEnrollment.ldap.groupsEnable=true
auths.instance.UserDirEnrollment.ldap.ldapconn.host=local
auths.instance.UserDirEnrollment.ldap.ldapconn.port=636
auths.instance.UserDirEnrollment.ldap.ldapconn.secureConn=true
```

Finally, you have to modify the ***/instance_path*/ca/profiles/ca/*profile_id*.cfg** file to configure the profile to use the **UserDirEnrollment** auth instance defined in **CS.cfg**, and if appropriate, provide an ACL for authorization based on groups. For example:

```
auth.instance_id=UserDirEnrollment
auths.acl=group="cn=devlab-access,ou=engineering,dc=example,dc=com"
```

8.2.2. Setting up PIN-Based Enrollment

PIN-based authentication involves setting up PINs for each user in the LDAP directory, distributing those PINs to the users, and then having the users provide the PIN along with their user ID and password when filling out a certificate request. Users are then authenticated both against an LDAP directory using their user ID and password and against the PIN in their LDAP entry. When the user successfully authenticates, the request is automatically processed, and a new certificate is issued.

The Certificate System provides a tool, **setpin**, that adds the necessary schema for PINs to the Directory Server and generates the PINs for each user.

The PIN tool performs the following functions:

- Adds the necessary schema for PINs to the LDAP directory.
- Adds a PIN manager user who has read-write permissions to the PINs that are set up.
- Sets up ACIs to allow for PIN removal once the PIN has been used, giving read-write permissions for PINs to the PIN manager, and preventing users from creating or changing PINs.
- Creates PINs in each user entry.

> **Note**
>
> This tool is documented in the *Certificate System Command-Line Tools Guide*.

1. Use the PIN tool to add schema needed for PINs, add PINs to the user entries, and then distribute the PINs to users.

a. Open the **/usr/share/pki/native-tools/** directory.

b. Open the **setpin.conf** file in a text editor.

c. Follow the instructions outlined in the file and make the appropriate changes.

   Usually, the parameters which need updated are the Directory Server's host name, Directory Manager's bind password, and PIN manager's password.

d. Run the **setpin** command with its **optfile** option pointing to the **setpin.conf** file.

```
setpin optfile=/usr/share/pki/native-tools/setpin.conf
```

   The tool modifies the schema with a new attribute (by default, **pin**) and a new object class (by default, **pinPerson**), creates a **pinmanager** user, and sets the ACI to allow only the **pinmanager** user to modify the **pin** attribute.

e. To generate PINs for specific user entries or to provide user-defined PINs, create an input file with the DNs of those entries listed. For ezample:

```
dn:uid=bjensen,ou=people,dc=example,dc=com
dn:uid=jsmith,ou=people,dc=example,dc=com
dn:jtyler,ou=people,dc=example,dc=com
...
```

   For information on constructing an input file, see the PIN generator chapter in the *Certificate System Command-Line Tools Guide*.

f. Disable setup mode for the **setpin** command. Either comment out the **setup** line or change the value to no.

```
vim /usr/share/pki/native-tools/setpin.conf

setup=no
```

   Setup mode creates the required uers and object classes, but the tool will not generate PINs while in setup mode.

g. Run the **setpin** command to create PINs in the directory.

> **Note**
>
> Test-run the tool first without the **write** option to generate a list of PINs without actually changing the directory.

   For example:

```
setpin host=yourhost port=9446 length=11 input=infile
output=outfile write "binddn=cn=pinmanager,o=example.com"
bindpw="password" basedn=o=example.com "filter=(uid=u*)"
hash=sha256
```

> **Warning**
>
> Do not set the **hash** argument to **none**. Running the **setpin** command with **hash=none** results in the pin being stored in the user LDAP entry as plain text.

h. Use the output file for delivering PINs to users after completing setting up the required authentication method.

   After confirming that the PIN-based enrollment works, deliver the PINs to users so they can use them during enrollment. To protect the privacy of PINs, use a secure, out-of-band delivery method.

2. Set the policies for specific certificates in the certificate profiles to enroll users. See Chapter 2, *Making Rules for Issuing Certificates (Certificate Profiles)* for information about certificate profile policies.

3. Create and configure an instance of the **UidPwdPinDirAuth** authentication plug-in.

   a. Open the CA Console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

   b. In the **Configuration** tab, select **Authentication** in the navigation tree.

      The right pane shows the **Authentication Instance** tab, which lists the currently configured authentication instances.

   c. Click **Add**.

      The **Select Authentication Plug-in Implementation** window appears.

   d. Select the **UidPwdPinDirAuth** plug-in module.

   e. Fill in the following fields in the **Authentication Instance Editor** window:

      - **Authentication Instance ID.** Accept the default instance name or enter a new name.

      - **removePin.** Sets whether to remove PINs from the authentication directory after end users successfully authenticate. Removing PINs from the directory restricts users from enrolling more than once, and thus prevents them from getting more than one certificate.

      - **pinAttr.** Specifies the authentication directory attribute for PINs. The **PIN Generator** utility sets the attribute to the value of the **objectclass** parameter in the **setpin.conf** file; the default value for this parameter is **pin**.

      - **dnpattern.** Specifies a string representing a subject name pattern to formulate from the directory attributes and entry DN.

      - **ldapStringAttributes.** Specifies the list of LDAP string attributes that should be considered *authentic* for the end entity. Entering values for this parameter is optional.

      - **ldapByteAttributes.** Specifies the list of LDAP byte (binary) attributes that should be considered *authentic* for the end entity. If specified, the values corresponding to these attributes will be copied from the authentication directory into the authentication token for use by other modules, such as adding additional information to users' certificates.

Entering values for this parameter is optional.

- **`ldap.ldapconn.host.`** Specifies the fully-qualified DNS host name of the authentication directory.
- **`ldap.ldapconn.port.`** Specifies the TCP/IP port on which the authentication directory listens to requests from the Certificate System.
- **`ldap.ldapconn.secureConn.`** Specifies the type, SSL or non-SSL, of the port on which the authentication directory listens to requests. Select if this is an SSL port.
- **`ldap.ldapconn.version.`** Specifies the LDAP protocol version, either **2** or **3**. By default, this is **3**, since all Directory Server versions later than 3.x are LDAPv3.
- **`ldap.ldapAuthentication.bindDN.`** Specifies the user entry as whom to bind when removing PINs from the authentication directory. Specify this parameter only if the **`removePin`** checkbox is selected. It is recommended that a separate user entry that has permission to modify only the PIN attribute in the directory be created and used. For example, do not use the Directory Manager's entry because it has privileges to modify the entire directory content.
- **`password.`** Gives the password associated with the DN specified by the **`ldap.ldapauthbindDN`** parameter. When saving changes, the server stores the password in the single sign-on password cache and uses it for subsequent start ups. This parameter needs set only if the **`removePin`** checkbox is selected.
- **`ldap.ldapAuthentication.clientCertNickname.`** Specifies the nickname of the certificate to use for SSL client authentication to the authentication directory to remove PINs. Make sure that the certificate is valid and has been signed by a CA that is trusted in the authentication directory's certificate database and that the authentication directory's **`certmap.conf`** file has been configured to map the certificate correctly to a DN in the directory. This is needed for PIN removal only.
- **`ldap.ldapAuthentication.authtype.`** Specifies the authentication type, basic authentication or SSL client authentication, required in order to remove PINs from the authentication directory.
  - **`BasicAuth`** specifies basic authentication. With this option, enter the correct values for **`ldap.ldapAuthentication.bindDN`** and **`password`** parameters; the server uses the DN from the **`ldap.ldapAuthentication.bindDN`** attribute to bind to the directory.
  - **`SslClientAuth`** specifies SSL client authentication. With this option, set the value of the **`ldap.ldapconn.secureConn`** parameter to **`true`** and the value of the **`ldap.ldapAuthentication.clientCertNickname`** parameter to the nickname of the certificate to use for SSL client authentication.

- **ldap.basedn.** Specifies the base DN for searching the authentication directory; the server uses the value of the **uid** field from the HTTP input (what a user enters in the enrollment form) and the base DN to construct an LDAP search filter.
- **ldap.minConns.** Specifies the minimum number of connections permitted to the authentication directory. The permissible values are **1** to **3**.
- **ldap.maxConns.** Specifies the maximum number of connections permitted to the authentication directory. The permissible values are **3** to **10**.

f. Click **OK**.

4. Customize the enrollment forms by configuring the inputs in the certificate profiles. Include the information that will be needed by the plug-in to authenticate the user. If the default inputs do not contain all of the information that needs to be collected, submit a request created with a third-party tool.

8.2.3. Using Certificate-Based Authentication

Certificate-based authentication is when a certificate is presented that verifies the identity of the requester and automatically validates and authenticates the request being submitted. This is most commonly used for renewal processes, when the original certificate is presented by the user, server, and application and that certificate is used to authenticate the request, as illustrated in Example 2.5, “Certificate-Based Renewal Profile”.

There are other circumstances when it may be useful to use certificate-based authentication for initially requesting a certificate. For example, tokens may be bulk-loaded with generic certificates which are then used to authenticate the users when they enroll for their user certificates or, alternatively, users can be issued signing certificates which they then use to authenticate their requests for encryption certificates.

The certificate-based authentication module, **SSLclientCertAuth**, is enabled by default, and this authentication method can be referenced in any custom certificate profile.

8.2.4. Configuring Flat File Authentication

A router certificate is enrolled and authenticated using a randomly-generated PIN. The CA uses the **flatFileAuth** authentication module to process a text file which contains the router's authentication credentials.

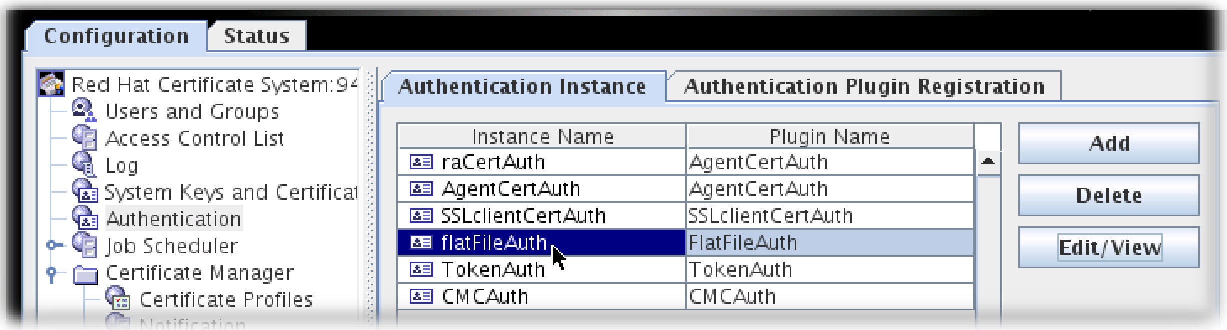
8.2.4.1. Configuring the flatFileAuth Module

Flat file authentication is already configured for SCEP enrollments, but the location of the flat file and its authentication parameters can be edited.

1. Open the CA Console.

```
pkiconsole https://server.example.com:8443/ca
```

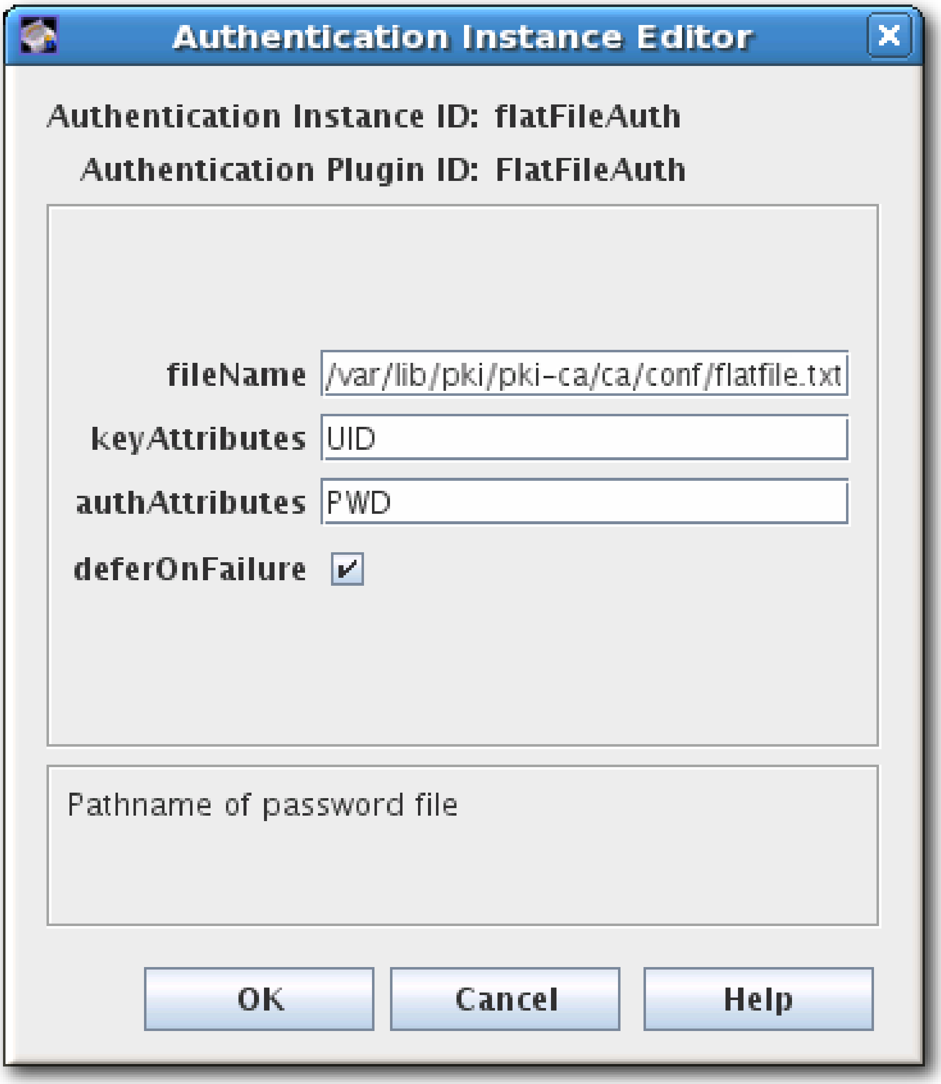
2. In the **Configuration** tab, select **Authentication** in the navigation tree.
3. Select the **flatFileAuth** authentication module.



4. Click **Edit/View**.

5. To change the file location and name, reset the **fileName** field.

   To change the authentication name parameter, reset the **keyAttributes** value to another value submitted in the SCEP enrollment form, like CN. It is also possible to use multiple name parameters by separating them by commas, like **UID,CN**. To change the password parameter name, reset the **authAttributes** field.



6. Save the edits.

8.2.4.2. Editing flatfile.txt

The same **flatfile.txt** file is used to authenticate every SCEP enrollment. This file must be manually updated every time a new PIN is issued to a router.

By default, this file is in **/var/lib/pki/pki-ca/ca/conf/** and specifies two parameters per authentication entry, the UID of the site (usually its IP address, either IPv4 or IPv6) and the PIN issued by the router.

```
UID:192.168.123.123
PIN:HU89dj
```

Each entry must be followed by a blank line. For example:

```
UID:192.168.123.123
PIN:HU89dj

UID:12.255.80.13
PIN:fiowIO89

UID:0.100.0.100
PIN:GRIOjisf
```

If the authentication entries are not separated by an empty line, then when the router attempts to authenticate to the CA, it will fail. For example:

```
... flatfile.txt entry ...
UID:192.168.123.123
PIN:HU89dj
UID:12.255.80.13
PIN:fiowIO89

... error log entry ...
[13/Jun/2016:13:03:09][http-9180-Processor24]: FlatFileAuth:
authenticating user: finding user from key: 192.168.123.123
[13/Jun/2016:13:03:09][http-9180-Processor24]: FlatFileAuth: User not
found in password file.
```

8.3. Using CMC Enrollment

CMC enrollment allows an enrollment client to use the CMCAuth plug-in for authentication, by which the certificate request is pre-signed with an agent certificate. The Certificate Manager automatically issues certificates when a valid request signed with the agent certificate is received.

Note

CMC enrollments are enabled by default. It should not be necessary to enable the CMC enrollment authentication plug-ins or profiles unless the configuration has been changed.

The CMCAuth authentication plug-in also provides CMC revocation for the client. CMC revocation allows the client to have the certificate request signed by the agent certificate, and then send such a request to the Certificate Manager. The Certificate Manager automatically revokes certificates when a valid request signed with the agent certificate is received. CMC revocation can be created with the **CMCRevoke** command line tool. For more information about **CMCRevoke**, see Section 6.2, “Performing a CMC Revocation”.

A CMC request can be submitted through browser end-entities forms or using a tool such as **HttpClient** to post the request to the appropriate profile. The **CMCRequest** tool generates a signed certificate request which can then be submitted using the **HttpClient** tool or the browser end-entities forms to enroll and receive the certificate automatically and immediately.

The **CMCRequest** tool has a simple command syntax, with all the configuration given in the **.cfg** input file:

```
CMCRequest /path/to/file.cfg
```

A single CMC enrollment can also be created using the **CMCEnroll** tool, with the following syntax:

```
CMCEnroll -d /agent's/certificate/directory -h password -n cert_nickname
-r certrequest.file -p certDB_passwd [-c "comment"]
```

These tools are described in more detail in the *Command-Line Tools Guide*.

Note

Surround values that include spaces in quotation marks.

8.3.1. Testing CMCEnroll

1. Create a certificate request using the **certutil** tool.

2. Copy the PKCS #10 ASCII output to a text file.

3. Run the CMCEnroll utility.

   For example, if the input file called **request34.txt**, the agent certificate is stored in the browser databases, the certificate common name of the agent certificate is **CertificateManagerAgentsCert**, and the password for the certificate database is **secret**, the command is as follows:

   ```
   CMCEnroll -d ~jsmith/.mozilla/firefox/1234.jsmith -n
   "CertificateManagerAgentsCert" -r /export/requests/request34.txt -
   p secret
   ```

   The output of this command is stored in a file with the same filename with **.out** appended to the filename.

4. Submit the signed certificate through the end-entities page.

   a. Open the end-entities page.

      ```
      https://server.example.com:8443/ca/ee/ca
      ```

b. Select the CMC enrollment form from the list of certificate profiles.

c. Paste the content of the output file into the **Certificate Request** text area of this form.

d. Remove **-----BEGIN NEW CERTIFICATE REQUEST-----** and **----END NEW CERTIFICATE REQUEST-----** from the pasted content.

e. Fill in the contact information, and submit the form.

5. The certificate is immediately processed and returned.

6. Use the agent page to search for the new certificate.

8.4. Testing Enrollment

For information on testing enrollment through the profiles, see Chapter 2, *Making Rules for Issuing Certificates (Certificate Profiles)*. To test whether end users can successfully enroll for a certificate using the authentication method set:

1. Open the end-entities page.

```
https://server.example.com:8443/ca/ee/ca
```

2. In the **Enrollment** tab, open the customized enrollment form.

3. Fill in the values, and submit the request.

4. Enter the password to the key database when prompted.

5. When the correct password is entered, the client generates the key pair.

   Do not interrupt the key-generation process. Upon completion of the key generation, the request is submitted to the server to issue the certificate. The server subjects the request to the certificate profile and issues the certificate only if the request meets all the requirements.

   When the certificate is issued, install the certificate in the browser.

6. Verify that the certificate is installed in the browser's certificate database.

7. If PIN-based directory authentication was configured with PIN removal, re-enroll for another certificate using the same PIN. The request should be rejected.

8.5. Registering Custom Authentication Plug-ins

Custom authentication plug-in modules can be registered through the CA Console. Authentication plug-in modules can also be deleted through the CA Console. Before deleting a module, delete instances that are based on that module.

Note

For writing custom plug-ins, refer to the Authentication Plug-in Tutorial.

1. Create the custom authentication class. For this example, the custom authentication

plug-in is called **UidPwdDirAuthenticationTestms.java**.

2. Compile the new class.

```
javac -d . -classpath $CLASSPATH
UidPwdDirAuthenticationTestms.java
```

3. Create a directory in the CA's **WEB-INF** web directory to hold the custom classes, so that the CA can access them for the enrollment forms.

```
mkdir /usr/share/pki/ca/webapps/ca/WEB-INF/classes
```

4. Copy the new plug-in files into the new **classes** directory, and set the owner to the Certificate System system user (**pkiuser**).

```
cp -pr com /usr/share/pki/ca/webapps/ca/WEB-INF/classes

chown -R pkiuser:pkiuser /usr/share/pki/ca/webapps/ca/WEB-
INF/classes
```

5. Log into the console.

```
pkiconsole https://server.example.com:8443/ca
```

6. Register the plug-in.

   a. In the **Configuration** tab, click **Authentication** in the navigation tree.

   b. In the right pane, click the **Authentication Plug-in Registration** tab.

      The tab lists modules that are already registered.

   c. To register a plug-in, click **Register**.

      The **Register Authentication Plug-in Implementation** window appears.

   d. Specify which module to register by filling in the two fields:

      - **Plugin name.** The name for the module.
      - **Class name.** The full name of the class for this module. This is the path to the implementing Java™ class. If this class is part of a package, include the package name. For example, to register a class named **customAuth** in a package named **com.customplugins**, the class name is **com.customplugins.customAuth**.

7. After registering the module, add the module as an active authentication instance.

   a. In the **Configuration** tab, click **Authentication** in the navigation tree.

   b. In the right pane, click the **Authentication Instance** tab.

   c. Click **Add**.

   d. Select the custom module, **UidPwdDirAuthenticationTestms.java**, from the list to add the module. Fill in the appropriate configuration for the module.

8. Create a new end-entity enrollment form to use the new authentication module.

```
cd /var/lib/pki/pki-ca/profiles/ca

cp -p caDirUserCert.cfg caDirUserCertTestms.cfg

vi caDirUserCertTestms.cfg

desc=Test ms - This certificate profile is for enrolling user
certificates with directory-based authentication.
visible=true
enable=true
enableBy=admin
name=Test ms - Directory-Authenticated User Dual-Use Certificate
Enrollment
auth.instance_id=testms
...
```

9. Add the new profile to the CA's **CS.cfg** file.

> **Note**
>
> Back up the **CS.cfg** file before editing it.

```
vim /var/lib/pki/instance-name/ca/conf/CS.cfg

profile.list=caUserCert,caDualCert,caSignedLogCert,caTPSCert,caRAR
outerCert,caRouterCert,caServerCert,caOtherCert,caCACert,caInstall
CACert,caRACert,caOCSPCert,caTransportCert,caDirUserCert,caAgentSe
rverCert,caAgentFileSigning,caCMCUserCert,caFullCMCUserCert,caSimp
leCMCUserCert,caTokenDeviceKeyEnrollment,caTokenUserEncryptionKeyE
nrollment,caTokenUserSigningKeyEnrollment,caTempTokenDeviceKeyEnro
llment,caTempTokenUserEncryptionKeyEnrollment,caTempTokenUserSigni
ngKeyEnrollment,caAdminCert,caInternalAuthServerCert,caInternalAut
hTransportCert,caInternalAuthKRAstorageCert,caInternalAuthSubsyste
mCert,caInternalAuthOCSPCert,DomainController,caDirUserCertTestms
...
profile.caDirUserCertTestms.class_id=caEnrollImpl
profile.caDirUserCertTestms.config=/var/lib/pki/pki-
ca/profiles/ca/caDirUserCertTestms.cfg
```

10. Restart the CA.

```
systemctl restart pki-tomcatd@instance_name.service
```

Chapter 9. Authorization for Enrolling Certificates (Access Evaluators)

This chapter describes the authorization mechanism using access evaluators.

9.1. Authorization Mechanism

In addition to the *authentication* mechanism, each enrollment profile can be configured to have its own *authorization* mechanism. The authorization mechanism is executed only after a successful authentication.

The authorization mechanism is provided by the Access Evaluator plug-in framework. Access evaluators are pluggable classes that are used for evaluating access control instructions (ACI) entries. The mechanism provides an *evaluate* method that takes a predefined list of arguments (that is, **type**, **op**, **value**), evaluates an expression such as **group='Certificate Manager Agents'** and returns a boolean depending on the result of evaluation.

9.2. Default Evaluators

Red Hat Certificate System provides four default evaluators. The following entries are listed by default in the **CS.cfg** file:

```
accessEvaluator.impl.group.class=com.netscape.cms.evaluators.GroupAccess
Evaluator
accessEvaluator.impl.ipaddress.class=com.netscape.cms.evaluators.IPAddre
ssAccessEvaluator
accessEvaluator.impl.user.class=com.netscape.cms.evaluators.UserAccessEv
aluator
accessEvaluator.impl.user_origreq.class=com.netscape.cms.evaluators.User
OrigReqAccessEvaluator
```

The **group** access evaluator evaluates the group membership properties of a user. For example, in the following enrollment profile entry, only the CA agents are allowed to go through enrollment with that profile:

```
authz.acl=group="Certificate Manager Agents"
```

The **ipaddress** access evaluator evaluates the IP address of the requesting subject. For example, in the following enrollment profile entry, only the host bearing the specified IP address can go through enrollment with that profile:

```
authz.acl=ipaddress="a.b.c.d.e.f"
```

The **user** access evaluator evaluates the user ID for exact match. For example, in the following enrollment profile entry, only the user matching the listed user is allowed to go through enrollment with that profile:

```
authz.acl=user="bob"
```

The **user_origreq** access evaluator evaluates the authenticated user against a previous matching request for equality. This special evaluator is designed specifically for renewal purpose to make sure the user requesting the renewal is the same user that owns the original request. For example, in the following renewal enrollment profile entry, the UID of the authenticated user must match the UID of the user requesting the renewal:

```
authz.acl=user_origreq="auth_token.uid"
```

New evaluators can be written in the current framework and can be registered through the CS console. The default evaluators can be used as templates to expand and customize into more targeted plug-ins.

Chapter 10. Using Automated Notifications

The Certificate System can be configured to send automatic email notifications to end users when certificates are issued or revoked or to an agent when a new request has arrived in the agent request queue. This chapter describes automated notifications and details how to enable, configure, and customize the notification email messages that are sent.

> **Note**
>
> Because of the types of notifications that can be sent, only Certificate Managers have the ability to be configured for notifications; this option is not available on the other subsystems.

10.1. About Automated Notifications for the CA

Automated notifications are email messages sent when a specified event occurs. The system uses listeners that monitor the system to determine when a particular event has occurred; when the event happens, then the system is triggered to send an email to the configured recipient. Each type of notification uses a template, either in plain text or HTML, to construct the notification message. The template contains text and tokens that are expanded to fill in the correct information for a particular event. The messages can be customized by changing the text and tokens contained in the templates. The HTML templates can also be customized for different appearances and formatting.

10.1.1. Types of Automated Notifications

There are three types of automated notifications:

- *Certificate Issued*.

  A notification message is automatically sent to users who have been issued certificates. A rejection message is sent to a user if the user's certificate request is rejected.

- *Certificate Revocation*.

  A notification message is automatically sent to users when the user certificate is revoked.

- *Request in Queue*.

  A notification message is automatically sent to one or more agents when a request enters the agent request queue, using the email addresses set for the agent. This notification type sends an email every time a message enters the queue. For more information about the request in queue job, see Section 11.1.2.2, “requestInQueueNotifier (RequestInQueueJob)”.

  There is also a job that sends a notification to agents about the status of the queue, which includes a summary of the queue status at certain intervals.

10.1.2. Determining End-Entity Email Addresses

The notification system determines the email address of an end entity by checking first the certificate request or revocation request, then the subject name of the certificate, and last the Subject Alternative Name extension of the certificate, if the certificate contains this extension. If an email address cannot be found, the notification is sent to the email address specified in the **Sender's Email Address** field of the **Notification** panel.

10.2. Setting up Automated Notifications for the CA

10.2.1. Setting up Automated Notifications in the Console

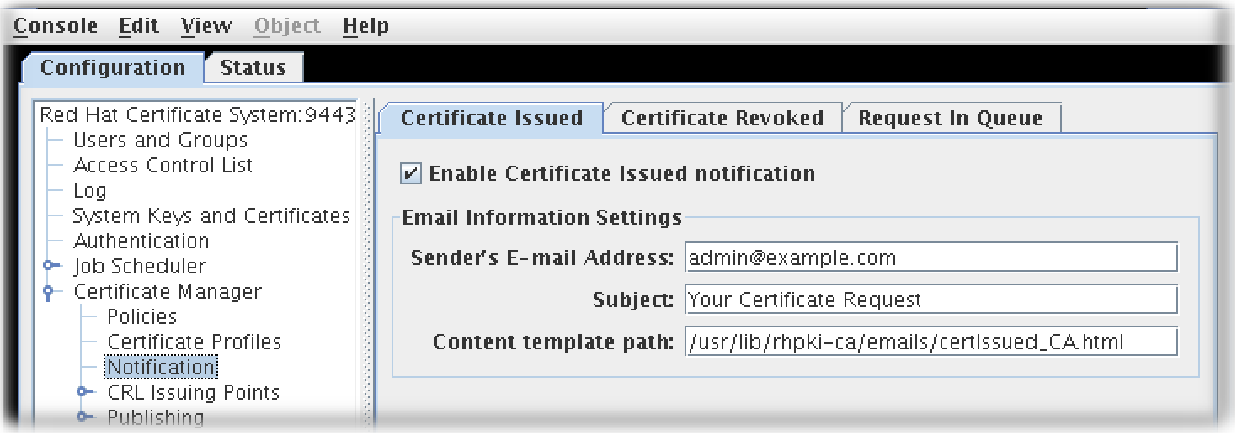
1. Open the Certificate Manager Console.

```
pkiconsole https://server.example.com:8443/ca
```

2. Open the **Configuration** tab.

3. Open the **Certificate Manager** heading in the navigation tree on the left. Then select **Notification**.

   The **Notification** tabs appear in the right side of the window.



4. Notifications can be sent for three kinds of events: newly-issued certificates, revoked certificates, and new certificate requests. To send a notification for any event, select the tab, check the **Enable** checkbox, and specify information in the following fields:

   - **Sender's E-mail Address**. Type the sender's full email address of the user who is notified of any delivery problems.
   - **Recipient's E-mail Address**. These are the email addresses of the agents who will check the queue. To list more than one recipient, separate the email addresses with commas. *For new requests in queue only.*
   - **Subject**. Type the subject title for the notification.
   - **Content template path**. Type the path, including the filename, to the directory that contains the template to use to construct the message content.

5. Click **Save**.

> **Note**
>
> Make sure the mail server is set up correctly. See Section 10.4, “Configuring a Mail Server for Certificate System Notifications”.

6. Customize the notification message templates. See Section 10.3, “Customizing Notification Messages” for more information.

7. Test the configuration. See Section 10.2.3, “Testing Configuration”.

10.2.2. Configuring Specific Notifications by Editing the CS.cfg File

1. Stop the CA subsystem.

   ```
   systemctl stop pki-tomcatd@instance_name.service
   ```

2. Open the **CS.cfg** file for that instance. This file is in the instance's **conf/** directory.

3. Edit all of the configuration parameters for the notification type being enabled.

   For certificate issuing notifications, there are four parameters:

   ```
   ca.notification.certIssued.emailSubject
   ca.notification.certIssued.emailTemplate
   ca.notification.certIssued.enabled
   ca.notification.certIssued.senderEmail
   ```

   For certificate revocation notifications, there are four parameters:

   ```
   ca.notification.certRevoked.emailSubject
   ca.notification.certRevoked.emailTemplate
   ca.notification.certRevoked.enabled
   ca.notification.certRevoked.senderEmail
   ```

   For certificate request notifications, there are five parameters:

   ```
   ca.notification.requestInQ.emailSubject
   ca.notification.requestInQ.emailTemplate
   ca.notification.requestInQ.enabled
   ca.notification.requestInQ.recipientEmail
   ca.notification.requestInQ.senderEmail
   ```

   The parameters for the notification messages are explained in Section 10.2, “Setting up Automated Notifications for the CA”.

4. Save the file.

5. Restart the CA instance.

   ```
   systemctl start pki-tomcatd@instance_name.service
   ```

6. If a job has been created to send automated messages, check that the mail server is correctly configured. See Section 10.4, “Configuring a Mail Server for Certificate System Notifications”.

7. The messages that are sent automatically can be customized; see Section 10.3, “Customizing Notification Messages” for more information.

10.2.3. Testing Configuration

To test whether the subsystem sends email notifications as configured, do the following:

1. Change the email address in the notification configuration for the request in queue notification to an accessible agent or administrator email address.

2. Open the end-entities page, and request a certificate using the agent-approved enrollment form.

   When the request gets queued for agent approval, a request-in-queue email notification should be sent. Check the message to see if it contains the configured information.

3. Log into the agent interface, and approve the request.

   When the server issues a certificate, the user receive a certificate-issued email notification to the address listed in the request. Check the message to see if it has the correct information.

4. Log into the agent interface, and revoke the certificate.

   The user email account should contain an email message reading that the certificate has been revoked. Check the message to see if it has the correct information.

10.3. Customizing Notification Messages

The email notifications are constructed using a template for each type of message. This allows messages to be informative, easily reproducible, and easily customizable. The CA uses templates for its notification messages. Separate templates exist for HTML and plain text messages.

10.3.1. Customizing CA Notification Messages

Each type of CA notification message has an HTML template and a plain text template associated with it. Messages are constructed from text, tokens, and, for the HTML templates, HTML markup. *Tokens* are variables, identified by a dollar sign (**$**), in the message that are replaced by the current value when the message is constructed. See Table 10.3, “Notification Variables” for a list of available tokens.

The contents of any message type can be modified by changing the text and tokens in the message template. The appearance of the HTML messages can be changed by modifying the HTML commands in the HTML message template.

The default text version of the certificate-issuance-notification message is as follows:

```
Your certificate request has been processed successfully.
SubjectDN= $SubjectDN
```

```
IssuerDN= $IssuerDN
notAfter= $NotAfter
notBefore= $NotBefore
Serial Number= 0x$HexSerialNumber
To get your certificate, please follow this URL:
https://$HttpHost:$HttpPort/displayBySerial?op=displayBySerial&
 serialNumber=$SerialNumber
Please contact your admin if there is any problem.
And, of course, this is just a \$SAMPLE\$ email notification form.
```

This template can be customized as desired, by rearranging, adding, or removing tokens and text, as shown:

```
THE EXAMPLE COMPANY CERTIFICATE ISSUANCE CENTER
Your certificate has been issued!
You can pick up your new certificate at the following website:
https://$HttpHost:$HttpPort/displayBySerial?op=displayBySerial&
 serialNumber=$SerialNumber
This certificate has been issued with the following information:
Serial Number= 0x$HexSerialNumber
Name of Certificate Holder = $SubjectDN
Name of Issuer = $IssuerDN
Certificate Expiration Date = $NotAfter
Certificate Validity Date = $NotBefore
Contact IT by calling X1234, or going to the IT website http://IT
 if you have any problems.
```

Notification message templates are located in the **/var/lib/pki/*instance_name*/ca/emails** directory.

The name and location of these messages can be changed; make the appropriate changes when configuring the notification. All template names can be changed except for the certificate rejected templates; these names must remain the same. The templates associated with certificate issuance and certificate rejection must be located in the same directory and must use the same extension.

Table 10.1, “Notification Templates” lists the default template files provided for creating notification messages. Table 10.2, “Job Notification Email Templates” lists the default template files provided for creating job summary messages.

Table 10.1. Notification Templates

Filename	Description
certIssued_CA	Template for plain text notification emails to end entities when certificates are issued.
certIssued_CA.html	Template for HTML-based notification emails to end entities when certificates are issued.
certRequestRejected.html	Template for HTML-based notification emails to end entities when certificate requests are rejected.
certRequestRevoked_CA	Template for plain text notification emails to end entities when a certificate is revoked.

Filename	Description
certRequestRevoked_CA.html	Template for HTML-based notification emails to end entities when a certificate is revoked.
reqInQueue_CA	Template for plain text notification emails to agents when a request enters the queue.
reqInQueue_CA.html	Template for HTML-based notification emails to agents when a request enters the queue.

Table 10.2. Job Notification Email Templates

Filename	Description
rnJob1.txt	Template for formulating the message content sent to end entities to inform them that their certificates are about to expire and that the certificates should be renewed or replaced before they expire.
rnJob1Summary.txt	Template for constructing the summary report to be sent to agents and administrators. Uses the **`rnJob1Item.txt`** template to format items in the message.
rnJob1Item.txt	Template for formatting the items included in the summary report.
riq1Item.html	Template for formatting the items included in the summary table, which is constructed using the **`riq1Summary.html`** template.
riq1Summary.html	Template for formulating the report or table that summarizes how many requests are pending in the agent queue of a Certificate Manager.
publishCerts	Template for the report or table that summarizes the certificates to be published to the directory. Uses the **`publishCertsItem.html`** template to format the items in the table.
publishCertsItem.html	Template for formatting the items included in the summary table.
ExpiredUnpublishJob	Template for the report or table that summarizes removal of expired certificates from the directory. Uses the **`ExpiredUnpublishJobItem`** template to format the items in the table.
ExpiredUnpublishJobItem	Template for formatting the items included in the summary table.

Table 10.3, “Notification Variables” lists and defines the variables that can be used in the notification message templates.

Table 10.3. Notification Variables

Token	Description
$CertType	Specifies the type of certificate; these can be any of the following: » TLS client (**client**) » TLS server (**server**) » CA signing certificate (**ca**) » other (**other**).
$ExecutionTime	Gives the time the job was run.
$HexSerialNumber	Gives the serial number of the certificate that was issued in hexadecimal format.
$HttpHost	Gives the fully qualified host name of the Certificate Manager to which end entities should connect to retrieve their certificates.
$HttpPort	Gives the Certificate Manager's end-entities (non-TLS) port number.
$InstanceID	Gives the ID of the subsystem that sent the notification.
$IssuerDN	Gives the DN of the CA that issued the certificate.
$NotAfter	Gives the end date of the validity period.
$NotBefore	Gives the beginning date of the validity period.
$RecipientEmail	Gives the email address of the recipient.
$RequestId	Gives the request ID.
$RequestorEmail	Gives the email address of the requester.
$RequestType	Gives the type of request that was made.
$RevocationDate	Gives the date the certificate was revoked.
$SenderEmail	Gives the email address of the sender; this is the same as the one specified in the **Sender's E-mail Address** field in the notification configuration.
$SerialNumber	Gives the serial number of the certificate that has been issued; the serial number is displayed as a hexadecimal value in the resulting message.
$Status	Gives the request status.
$SubjectDN	Gives the DN of the certificate subject.
$SummaryItemList	Lists the items in the summary notification. Each item corresponds to a certificate the job detects for renewal or removal from the publishing directory.
$SummaryTotalFailure	Gives the total number of items in the summary report that failed.
$SummaryTotalNum	Gives the total number of certificate requests that are pending in the queue or the total number of certificates to be renewed or removed from the directory in the summary report.
$SummaryTotalSuccess	Shows how many of the total number of items in the summary report succeeded.

10.4. Configuring a Mail Server for Certificate System Notifications

The notifications and jobs features use the mail server configured in the Certificate System CA instances to send notification messages. Set up a mail server by doing the following:

1. Open the CA subsystem administrative console. For example:

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

2. In the **Configuration** tab, highlight the instance name at the top, and select the **SMTP** tab.

3. Supply the server name and port number of the mail server.

   The server name is the fully qualified DNS hostname of the machine on which the mail server is installed, such as **mail.example.com**. By default, the hostname of the mail server is **localhost** instead of the actual hostname.

   The default port number on which the SMTP mail server listens is **25**.

4. Click **Save**.

10.5. Creating Custom Notifications for the CA

It can be possible to create custom notification functions to handle other PKI operations, such as token enrollments, by editing existing email notifications plug-ins for the Certificate System CA. Before attempting to create or use custom notification plug-ins, contact Red Hat support services.

Chapter 11. Setting Automated Jobs

The Certificate System provides a customizable Job Scheduler that supports various mechanisms for scheduling **cron** jobs. This chapter explains how to configure Certificate System to use specific job plug-in modules for accomplishing jobs.

11.1. About Automated Jobs

The Certificate Manager Console includes a *Job Scheduler* option that can execute specific jobs at specified times. The Job Scheduler is similar to a traditional Unix **cron** daemon; it takes registered **cron** jobs and executes them at a pre-configured date and time. If configured, the scheduler checks at specified intervals for jobs waiting to be executed; if the specified execution time has arrived, the scheduler initiates the job automatically.

Jobs are implemented as Java™ classes, which are then registered with Certificate System as plug-in modules. One implementation of a job module can be used to configure multiple instances of the job. Each instance must have a unique name (an alphanumeric string with no spaces) and can contain different input parameter values to apply to different jobs.

11.1.1. Setting up Automated Jobs

The automated jobs feature is set up by doing the following:

- Enabling and configuring the Job Scheduler; see Section 11.2, “Setting up the Job Scheduler” for more information.
- Enabling and configuring the job modules and setting preferences for those job modules; see Section 11.3, “Setting up Specific Jobs” for more information.
- Customizing the email notification messages sent with these jobs by changing the templates associated with the types of notification. The message contents are composed of both plain text messages and HTML messages; the appearance is modified by changing the HTML templates. See Section 10.3.1, “Customizing CA Notification Messages” for more information.

11.1.2. Types of Automated Jobs

The types of automated jobs are **RenewalNotificationJob**, **RequestInQueueJob**, **PublishCertsJob**, and **UnpublishExpiredJob**. One instance of each job type is created when Certificate System is deployed.

11.1.2.1. certRenewalNotifier (RenewalNotificationJob)

The **certRenewalNotifier** job checks for certificates that are about to expire in the internal database. When it finds one, it automatically emails the certificate's owner and continues sending email reminders for a configured period of time or until the certificate is replaced. The job collects a summary of all renewal notifications and mails the summary to the configured agents or administrators.

The job determines the email address to send the notification using an email resolver. By default, the email address is found in the certificate itself or in the certificate's associated enrollment request.

11.1.2.2. requestInQueueNotifier (RequestInQueueJob)

The **requestInQueueNotifier** job checks the status of the request queue at pre-configured time intervals. If any deferred enrollment requests are waiting in the queue, the job constructs an email message summarizing its findings and sends it to the specified agents.

11.1.2.3. publishCerts (PublishCertsJob)

The **publishCerts** job checks for any new certificates that have been added to the publishing directory that have not yet been published. When these new certificates are added, they are automatically published to an LDAP directory or file by the **publishCerts** job.

> **Note**
>
> Most of the time, publishers immediately publish any certificates that are created matching their rules to the appropriate publishing directory.
>
> If a certificate is successfully published when it is created, then the **publishCerts** job will not re-publish the certificate. Therefore, the new certificate will not be listed in the job summary report, since the summary only lists certificates published by the **publishCerts** job.

11.1.2.4. unpublishExpiredCerts (UnpublishExpiredJob)

Expired certificates are not automatically removed from the publishing directory. If a Certificate Manager is configured to publish certificates to an LDAP directory, over time the directory will contain expired certificates.

The **unpublishExpiredCerts** job checks for certificates that have expired and are still marked as **published** in the internal database at the configured time interval. The job connects to the publishing directory and deletes those certificates; it then marks those certificates as **unpublished** in the internal database. The job collects a summary of expired certificates that it deleted and mails the summary to the agents or administrators specified by the configuration.

> **Note**
>
> This job automates removing expired certificates from the directory. Expired certificates can also be removed manually; for more information on this, see Section 7.12, “Updating Certificates and CRLs in a Directory”.

11.2. Setting up the Job Scheduler

The Certificate Manager can execute a job only if the Job Scheduler is enabled. The job settings, such as enabling the job schedule, setting the frequency, and enabling the job modules, can be done through the Certificate System CA Console or through editing the **CS.cfg** file.

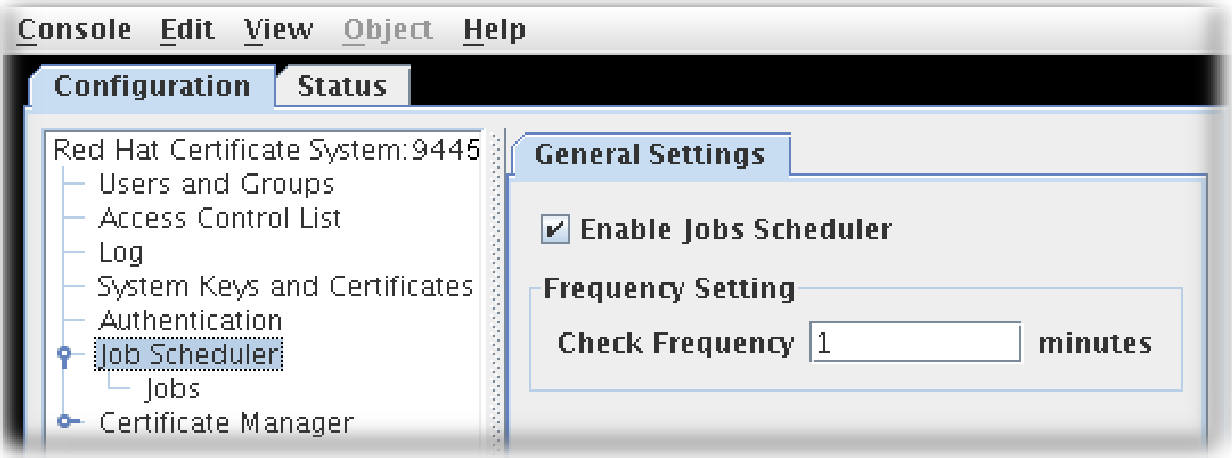
To turn the Job Scheduler on:

1. Open the Certificate Manager Console.

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

2. In the **Configuration** tab navigation tree, click **Job Scheduler**.

   This opens the **General Settings** tab, which shows whether the Job Scheduler is currently enabled.

3. Click the **Enable Jobs Schedule** checkbox to enable or disable the Job Scheduler.

   Disabling the Job Scheduler turns off all the jobs.

4. Set the frequency which the scheduler checks for jobs in the **Check Frequency** field.

   The frequency is how often the Job Scheduler daemon thread wakes up and calls the configured jobs that meet the **cron** specification. By default, it is set to one minute.

   > **Note**
   >
   > The window for entering this information may be too small to see the input. Drag the corners of the Certificate Manager Console to enlarge the entire window.

5. Click **Save**.

11.3. Setting up Specific Jobs

Automated jobs can be configured through the Certificate Manager Console or by editing the configuration file directory. It is recommended that these changes be made through the Certificate Manager Console.

11.3.1. Configuring Specific Jobs Using the Certificate Manager Console

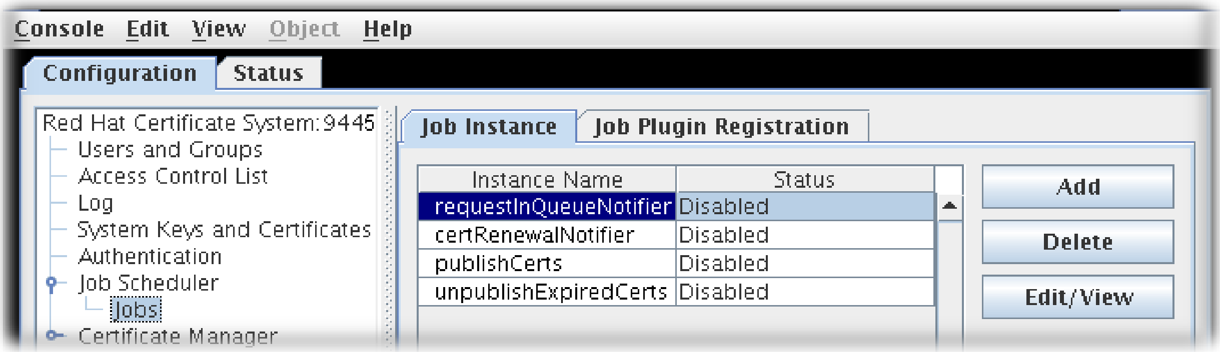
To enable and configure an automated job using the Certificate Manager Console:

1. Open the Certificate Manager Console.

```
pkiconsole https://server.example.com:8443/ca
```

2. Confirm that the Jobs Scheduler is enabled. See Section 11.2, “Setting up the Job Scheduler” for more information.

3. In the **Configuration** tab, select **Job Scheduler** from the navigation tree. Then select **Jobs** to open the **Job Instance** tab.



Select the job instance from the list, and click **Edit/View**.

The **Job Instance Editor** opens, showing the current job configuration.

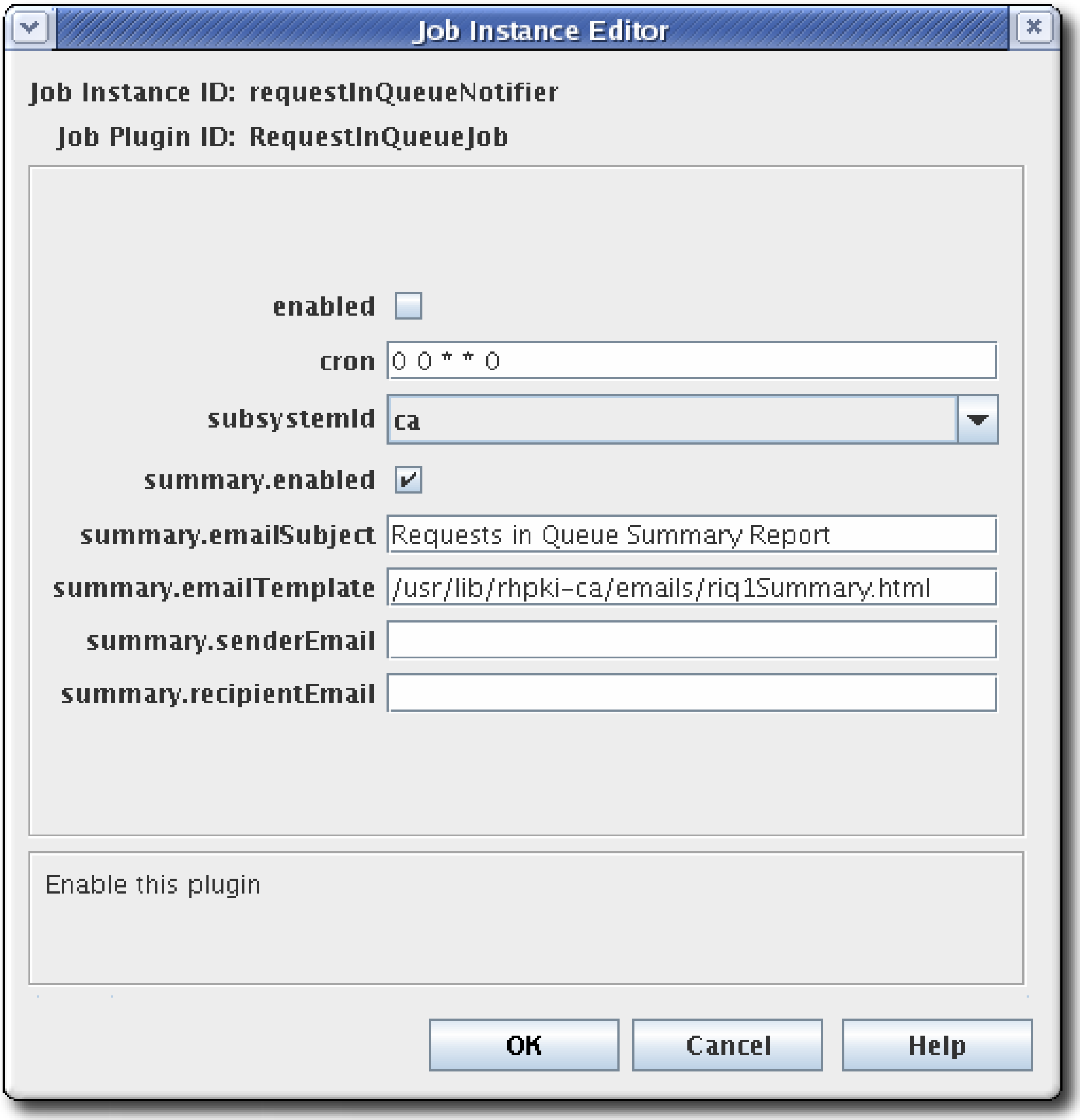


Figure 11.1. Job Configuration

4. Select **enabled** to turn on the job.

5. Set the configuration settings by specifying them in the fields for this dialog.

   - For **certRenewalNotifier**, see Section 11.3.3, "Configuration Parameters of certRenewalNotifier".

   - For **requestInQueueNotifier**, see Section 11.3.4, "Configuration Parameters of requestInQueueNotifier".

   - For **publishCerts**, see Section 11.3.5, "Configuration Parameters of publishCerts".

   - For **unpublishExpiredCerts**, see Section 11.3.6, "Configuration Parameters of unpublishExpiredCerts".

- For more information about setting the **cron** time frequencies, see Section 11.3.7, "Frequency Settings for Automated Jobs".

6. Click **OK**.

7. Click **Refresh** to view any changes in the main window.

8. If the job is configured to send automatic messages, check that a mail server is set up correctly. See Section 10.4, "Configuring a Mail Server for Certificate System Notifications".

9. Customize the email message text and appearance.

11.3.2. Configuring Jobs by Editing the Configuration File

1. Ensure that the Jobs Scheduler is enabled and configured; see Section 11.2, "Setting up the Job Scheduler".

2. Stop the CA subsystem instance.

```
systemctl stop pki-tomcatd@instance_name.service
```

3. Open the **CS.cfg** file for that server instance in a text editor.

4. Edit all of the configuration parameters for the job module being configured.

   - To configure the **certRenewalNotifier** job, edit all parameters that begin with **jobsScheduler.job.certRenewalNotifier**; see Section 11.3.3, "Configuration Parameters of certRenewalNotifier".

   - To configure the **requestInQueueNotifier** job, edit all parameters that begin with **jobsScheduler.job.requestInQueueNotifier**; see Section 11.3.4, "Configuration Parameters of requestInQueueNotifier".

   - To configure the **publishCerts** job, edit all parameters that begin with **jobsScheduler.job.publishCerts**; see Section 11.3.5, "Configuration Parameters of publishCerts".

   - To configure the **unpublishExpiredCerts** job, edit all parameters that begin with **jobsScheduler.job.unpublishExpiredCerts**; see Section 11.3.6, "Configuration Parameters of unpublishExpiredCerts".

5. Save the file.

6. Restart the server instance.

```
systemctl start pki-tomcatd@instance_name.service
```

7. If the job will send automated messages, check that the mail server is set up correctly. See Section 10.4, "Configuring a Mail Server for Certificate System Notifications".

8. Customize the automatic job messages.

11.3.3. Configuration Parameters of certRenewalNotifier

Table 11.1, "certRenewalNotifier Parameters" gives details for each of these parameters that can be configured for the **certRenewalNotifier** job, either in the **CS.cfg** file or in the Certificate Manager Console.

Table 11.1. certRenewalNotifier Parameters

Parameter	Description
enabled	Specifies whether the job is enabled or disabled. The value **true** enables the job; **false** disables it.
cron	Sets the schedule when this job should be run. This sets the time at which the Job Scheduler daemon thread checks the certificates for sending renewal notifications. These settings must follow the conventions in Section 11.3.7, "Frequency Settings for Automated Jobs". For example: `0 3 * * 1-5` The job in the example is run Monday through Friday at 3:00 pm.
notifyTriggerOffset	Sets how long (in days) before the certificate expiration date the first notification will be sent.
notifyEndOffset	Sets how long (in days) after the certificate expires that notifications will continue to be sent if the certificate is not replaced.
senderEmail	Sets the sender of the notification messages, who will be notified of any delivery problems.
emailSubject	Sets the text of the subject line of the notification message.
emailTemplate	Sets the path, including the filename, to the directory that contains the template to use to create the message content.
summary.enabled	Sets whether a summary report of renewal notifications should be compiled and sent. The value **true** enables sending the summary; **false** disables it. If enabled, set the remaining summary parameters; these are required by the server to send the summary report.
summary.recipientEmail	Specifies the recipients of the summary message. These can be agents who need to know the status of user certificates or other users. Set more than one recipient by separating each email address with a comma.
summary.senderEmail	Specifies the email address of the sender of the summary message.

Parameter	Description
`summary.emailSubject`	Gives the subject line of the summary message.
`summary.itemTemplate`	Gives the path, including the filename, to the directory that contains the template to use to create the content and format of each item to be collected for the summary report.
`summary.emailTemplate`	Gives the path, including the filename, to the directory that contains the template to use to create the summary report email notification.

11.3.4. Configuration Parameters of requestInQueueNotifier

Table 11.2, “requestInQueueNotifier Parameters” gives details for each of these parameters that can be configured for the **`requestInQueueNotifier`** job, either in the **`CS.cfg`** file or in the Certificate Manager Console.

Table 11.2. requestInQueueNotifier Parameters

Parameter	Description
`enabled`	Sets whether the job is enabled (**`true`**) or disabled (**`false`**).
`cron`	Sets the time schedule for when the job should run. This is the time at which the Job Scheduler daemon thread checks the queue for pending requests. This setting must follow the conventions in Section 11.3.7, “Frequency Settings for Automated Jobs”. For example: `0 0 * * 0`
`subsystemid`	Specifies the subsystem which is running the job. The only possible value is **`ca`**, for the Certificate Manager.
`summary.enabled`	Specifies whether a summary of the job accomplished should be compiled and sent. The value **`true`** enables the summary reports; **`false`** disables them. If enabled, set the remaining summary parameters; these are required by the server to send the summary report.
`summary.emailSubject`	Sets the subject line of the summary message.
`summary.emailTemplate`	Specifies the path, including the filename, to the directory containing the template to use to create the summary report.
`summary.senderEmail`	Specifies the sender of the notification message, who will be notified of any delivery problems.

Parameter	Description
summary.recipientEmail	Specifies the recipients of the summary message. These can be agents who need to process pending requests or other users. More than one recipient can be listed by separating each email address with a comma.

11.3.5. Configuration Parameters of publishCerts

Table 11.3, "publishCerts Parameters" gives details for each of these parameters that can be configured for the **publishCerts** job, either in the **CS.cfg** file or in the Certificate Manager Console.

Table 11.3. publishCerts Parameters

Parameter	Description
enabled	Sets whether the job is enabled. The value **true** is enabled; **false** is disabled.
cron	Sets the time schedule for when the job runs. This is the time the Job Scheduler daemon thread checks the certificates to removing expired certificates from the publishing directory. This setting must follow the conventions in Section 11.3.7, "Frequency Settings for Automated Jobs". For example: `0 0 * * 6`
summary.enabled	Specifies whether a summary of the certificates removed by the job should be compiled and sent. The value **true** enables the summaries; **false** disables them. If enabled, set the remaining summary parameters; these are required by the server to send the summary report.
summary.emailSubject	Gives the subject line of the summary message.
summary.emailTemplate	Specifies the path, including the filename, to the directory containing the template to use to create the summary report.
summary.itemTemplate	Specifies the path, including the filename, to the directory containing the template to use to create the content and format of each item collected for the summary report.
summary.senderEmail	Specifies the sender of the summary message, who will be notified of any delivery problems.

Parameter	Description
summary.recipientEmail	Specifies the recipients of the summary message. These can be agents who need to know the status of user certificates or other users. More than one recipient can be set by separating each email address with a comma.

11.3.6. Configuration Parameters of unpublishExpiredCerts

Table 11.4, “unpublishExpiredCerts Parameters” gives details for each of these parameters that can be configured for the **unpublishedExpiresCerts** job, either in the **CS.cfg** file or in the Certificate Manager Console.

Table 11.4. unpublishExpiredCerts Parameters

Parameter	Description
enabled	Sets whether the job is enabled. The value **true** is enabled; **false** is disabled.
cron	Sets the time schedule for when the job runs. This is the time the Job Scheduler daemon thread checks the certificates to removing expired certificates from the publishing directory. This setting must follow the conventions in Section 11.3.7, “Frequency Settings for Automated Jobs”. For example: `0 0 * * 6`
summary.enabled	Specifies whether a summary of the certificates removed by the job should be compiled and sent. The value **true** enables the summaries; **false** disables them. If enabled, set the remaining summary parameters; these are required by the server to send the summary report.
summary.emailSubject	Gives the subject line of the summary message.
summary.emailTemplate	Specifies the path, including the filename, to the directory containing the template to use to create the summary report.
summary.itemTemplate	Specifies the path, including the filename, to the directory containing the template to use to create the content and format of each item collected for the summary report.
summary.senderEmail	Specifies the sender of the summary message, who will be notified of any delivery problems.

Parameter	Description
summary.recipientEmail	Specifies the recipients of the summary message. These can be agents who need to know the status of user certificates or other users. More than one recipient can be set by separating each email address with a comma.

11.3.7. Frequency Settings for Automated Jobs

The Job Scheduler uses a variation of the Unix **crontab** entry format to specify dates and times for checking the job queue and executing jobs. As shown in Table 11.5, “Time Values for Scheduling Jobs” and Figure 11.1, “Job Configuration”, the time entry format consists of five fields. (The sixth field specified for the Unix **crontab** is not used by the Job Scheduler.) Values are separated by spaces or tabs.

Each field can contain either a single integer or a pair of integers separated by a hyphen (**-**) to indicate an inclusive range. To specify all legal values, a field can contain an asterisk rather than an integer. Day fields can contain a comma-separated list of values. The syntax of this expression is

```
Minute Hour Day_of_month Month_of_year Day_of_week
```

Table 11.5. Time Values for Scheduling Jobs

Field	Value
Minute	0-59
Hour	0-23
Day of month	1-31
Month of year	1-12
Day of week	0-6 (where 0=Sunday)

For example, the following time entry specifies every hour at 15 minutes (1:15, 2:15, 3:15, and so on):

```
15 * * * *
```

The following example sets a job to run at noon on April 12:

```
0 12 12 4 *
```

The day-of-month and day-of-week options can contain a comma-separated list of values to specify more than one day. If both day fields are specified, the specification is inclusive; that is, the day of the month is not required to fall on the day of the week to be valid. For example, the following entry specifies a job execution time of midnight on the first and fifteenth of every month *and* on every Monday:

```
0 0 1,15 * 1
```

To specify one day type without the other, use an asterisk in the other day field. For example, the following entry runs the job at 3:15 a.m. every weekday morning:

```
15 3 * * 1-5
```

11.4. Registering a Job Module

Custom job plug-ins can be registered through the Certificate Manager Console. Registering a new module involves specifying the name of the module and the full name of the Java™ class that implements the module.

To register a new job module:

1. Create the custom job class. For this example, the custom job plug-in is called **MyJob.java**.

2. Compile the new class.

   ```
   javac -d . -classpath $CLASSPATH MyJob.java
   ```

3. Create a directory in the CA's **WEB-INF** web directory to hold the custom classes, so that the CA can access them.

   ```
   mkdir /var/lib/pki/instance_name/ca/webapps/ca/WEB-INF/classes
   ```

4. Copy the new plug-in files into the new **classes** directory, and set the owner to the Certificate System system user (**pkiuser**).

   ```
   cp -pr com /var/lib/pki/instance_name/ca/webapps/ca/WEB-
   INF/classes

   chown -R pkiuser:pkiuser
   /var/lib/pki/instance_name/ca/webapps/ca/WEB-INF/classes
   ```

5. Register the plug-in.

   a. Log into the Certificate Manager Console.

      ```
      pkiconsole https://server.example.com:8443/ca
      ```

   b. In the **Configuration** tab, select **Job Scheduler** in the left navigation tree. Select **Jobs**.

      The Job Instance tab opens, which lists any currently configured jobs. Select the **Job Plugin Registration** tab.

   c. Click **Register** to add the new module.

   d. In the **Register Job Scheduler Plugin Implementation** window, supply the following information:

      - **Plugin name.** Type a name for the plug-in module.

      - **Class name.** Type the full name of the class for this module; this is the path to the implementing Java™ class. If this class is part of a package, include the package name. For example, to register a class named **customJob** that is in a package named **com.customplugins**, type **com.customplugins.customJob**.

e. Click **OK**.

Note

It is also possible to delete job modules, but this is not recommended.

If it is necessary to delete a module, open the **Job Plugin Registration** tab as when registering a new module, select the module to delete, and click **Delete**. When prompted, confirm the deletion.

Part III. Managing the Subsystem Instances

Chapter 12. The Certificate System Configuration Files

The primary configuration file for every subsystem is its **CS.cfg** file. This chapter covers basic information about and rules for editing the **CS.cfg** file. This chapter also describes some other useful configuration files used by the subsystems, such as password and web services files.

12.1. File and Directory Locations for Certificate System Subsystems

Certificate System servers consist of an Apache Tomcat instance, which contains *one or more* subsystems. Each subsystem consists of a web application, which handles requests for a specific type of PKI function.

The available subsystems are: CA, KRA, OCSP, TKS, and TPS. Each instance can contain only one of each type of a PKI subsystem. See Section 13.1, “PKI Instances” for more information.

A subsystem can be installed within a particular instance using the **pkispawn** command.

12.1.1. Instance-specific Information

Server instances are located under the **/var/lib/pki/*instance_name*/** directory. Each instance has ports and server-specific configuration under the **/var/lib/pki/*instance_name*/conf/** directory. Note that the default instance name is **pki-tomcat**.

Table 12.1. Certificate Server Port Assignments (Default)

Port Type	Port Number	Notes
Secure port	8443	Main port used to access PKI services by end-users, agents, and admins over HTTPS.
Insecure port	8080	Used to access the server insecurely for some end-entity functions over HTTP. Used for instance to provide CRLs, which are already signed and therefore need not be encrypted.
AJP port	8009	Used to access the server from a front end Apache proxy server through an AJP connection. Redirects to the HTTPS port.
Tomcat port	8005	Used by the web server.

Table 12.2. Instance Information for the Default Instance (pki-tomcat)

Setting	Value
Main directory	/var/lib/pki/pki-tomcat/
Configuration directory	/var/lib/pki-tomcat/conf/ [a]
Server configuration files	/var/lib/pki-tomcat/conf/server.xml
	/var/lib/pki-tomcat/conf/password.conf
Security databases	/var/lib/pki-tomcat/conf/alias/
Log files	/var/lib/pki/pki-tomcat/logs/ [b]

Setting	Value
Stdout logs	Logs are now written to the journal; [c] to access the journal, run the following command: `journalctl -u pki-tomcatd@pki-tomcat.service`
Process file	/var/run/pki-tomcat.pid

[a] This directory is usually linked to /etc/pki/pki-tomcat/
[b] This directory contains access log and is linked to /var/log/pki/pki-tomcat/
[c] Instances no longer write to the catalina.out file

12.1.2. CA Subsystem Information

This section contains details about the CA subsystem, which is one of the possible subsystems that can be installed as a web application in a Certificate Server instance.

Table 12.3. CA Subsystem Information for the Default Instance (pki-tomcat)

Setting	Value
Main directory	/var/lib/pki/pki-tomcat/ca/
Configuration directory	/var/lib/pki/pki-tomcat/ca/conf/ [a]
Configuration file	/var/lib/pki/pki-tomcat/ca/conf/CS.cfg
Subsystem certificates	CA signing certificate
	OCSP signing certificate (for the CA's internal OCSP service)
	SSL server certificate
	Audit log signing certificate
	Subsystem certificate [b]
Security databases	/var/lib/pki/pki-tomcat/alias/ [c]
Log files	/var/lib/pki/pki-tomcat/ca/logs/ [d]
Install log	/var/log/pki/pki-ca-spawn.*date*.log
Unnstall log	/var/log/pki/pki-ca-destroy.*date*.log
Audit logs	/var/log/pki/pki-tomcat/ca/signedAudit/
Profile files	/var/lib/pki/pki-tomcat/ca/profiles/ca/
Email notification templates	/var/lib/pki/pki-tomcat/ca/emails/
Web services files	*Agent services:* /var/lib/pki/pki-tomcat/ca/webapps/ca/agent/
	Admin services: /var/lib/pki/pki-tomcat/ca/webapps/ca/admin/
	End user services: /var/lib/pki/pki-tomcat/ca/webapps/ca/ee/

[a] Aliased to /etc/pki/pki-tomcat/ca/
[b] The subsystem certificate is always issued by the security domain so that domain-level operations that require client authentication are based on this subsystem certificate.
[c] Note that all subsystem certificates are stored in the instance security database
[d] Aliased to /var/log/pki/pki-tomcat/ca/

12.1.3. KRA Subsystem Information

This section contains details about the KRA subsystem, which is one of the possible subsystems that can be installed as a web application in a Certificate Server instance.

Table 12.4. KRA Subsystem Information for the Default Instance (pki-tomcat)

Setting	Value
Main directory	/var/lib/pki/pki-tomcat/kra/
Configuration directory	/var/lib/pki/pki-tomcat/kra/conf/ [a]
Configuration file	/var/lib/pki/pki-tomcat/kra/conf/CS.cfg
Subsystem certificates	Transport certificate
	Storage certificate
	SSL server certificate
	Audit log signing certificate
	Subsystem certificate [b]
Security databases	/var/lib/pki/pki-tomcat/alias/ [c]
Log files	/var/lib/pki/pki-tomcat/kra/logs/
Install log	/var/log/pki/pki-kra-spawn-*date*.log
Uninstall log	/var/log/pki/pki-kra-destroy-*date*.log
Audit logs	/var/log/pki/pki-tomcat/kra/signedAudit/
Web services files	*Agent services:* /var/lib/pki/pki-tomcat/kra/webapps/kra/agent/
	Admin services: /var/lib/pki/pki-tomcat/kra/webapps/kra/admin/

[a] Linked to /etc/pki/pki-tomcat/kra/

[b] The subsystem certificate is always issued by the security domain so that domain-level operations that require client authentication are based on this subsystem certificate.

[c] Note that all subsystem certificates are stored in the instance security database

12.1.4. OCSP Subsystem Information

This section contains details about the OCSP subsystem, which is one of the possible subsystems that can be installed as a web application in a Certificate Server instance.

Table 12.5. OCSP Subsystem Information for the Default Instance (pki-tomcat)

Setting	Value
Main directory	/var/lib/pki/pki-tomcat/ocsp/
Configuration directory	/var/lib/pki/pki-tomcat/ocsp/conf/ [a]
Configuration file	/var/lib/pki/pki-tomcat/ocsp/conf/CS.cfg
Subsystem certificates	Transport certificate
	Storage certificate
	SSL server certificate
	Audit log signing certificate
	Subsystem certificate [b]
Security databases	/var/lib/pki/pki-tomcat/alias/ [c]
Log files	/var/lib/pki/pki-tomcat/ocsp/logs/
Install log	/var/log/pki/pki-ocsp-spawn-*date*.log
Uninstall log	/var/log/pki/pki-ocsp-destroy-*date*.log
Audit logs	/var/log/pki/pki-tomcat/ocsp/signedAudit/
Web services files	*Agent services:* /var/lib/pki/pki-tomcat/ocsp/webapps/ocsp/agent/
	Admin services: /var/lib/pki/pki-tomcat/ocsp/webapps/ocsp/admin/

Setting	Value
[a] Linked to /etc/pki/pki-tomcat/ocsp/	
[b] The subsystem certificate is always issued by the security domain so that domain-level operations that require client authentication are based on this subsystem certificate.	
[c] Note that all subsystem certificates are stored in the instance security database	

12.1.5. TKS Subsystem Information

This section contains details about the TKS subsystem, which is one of the possible subsystems that can be installed as a web application in a Certificate Server instance.

Table 12.6. TKS Subsystem Information for the Default Instance (pki-tomcat)

Setting	Value
Main directory	/var/lib/pki/pki-tomcat/tks/
Configuration directory	/var/lib/pki/pki-tomcat/tks/conf/ [a]
Configuration file	/var/lib/pki/pki-tomcat/tks/conf/CS.cfg
Subsystem certificates	Transport certificate
	Storage certificate
	SSL server certificate
	Audit log signing certificate
	Subsystem certificate [b]
Security databases	/var/lib/pki/pki-tomcat/alias/ [c]
Log files	/var/lib/pki/pki-tomcat/tks/logs/
Install log	/var/log/pki/pki-tks-spawn-*date*.log
Uninstall log	/var/log/pki/pki-tks-destroy-*date*.log
Audit logs	/var/log/pki/pki-tomcat/tks/signedAudit/
Web services files	*Agent services:* /var/lib/pki/pki-tomcat/tks/webapps/tks/agent/
	Admin services: /var/lib/pki/pki-tomcat/tks/webapps/tks/admin/

[a] Linked to /etc/pki/pki-tomcat/tks/

[b] The subsystem certificate is always issued by the security domain so that domain-level operations that require client authentication are based on this subsystem certificate.

[c] Note that all subsystem certificates are stored in the instance security database

12.1.6. TPS Subsystem Information

This section contains details about the TPS subsystem, which is one of the possible subsystems that can be installed as a web application in a Certificate Server instance.

Table 12.7. TPS Subsystem Information for the Default Instance (pki-tomcat)

Setting	Value
Main directory	/var/lib/pki/pki-tomcat/tps/
Configuration directory	/var/lib/pki/pki-tomcat/tps/conf/ [a]
Configuration file	/var/lib/pki/pki-tomcat/tps/conf/CS.cfg
Subsystem certificates	Transport certificate
	Storage certificate
	SSL server certificate
	Audit log signing certificate

Setting	Value
	Subsystem certificate [b]
Security databases	/var/lib/pki/pki-tomcat/alias/ [c]
Log files	/var/lib/pki/pki-tomcat/tps/logs/
Install log	/var/log/pki/pki-tps-spawn-*date*.log
Uninstall log	/var/log/pki/pki-tps-destroy-*date*.log
Audit logs	/var/log/pki/pki-tomcat/tps/signedAudit/
Web services files	*Agent services:* /var/lib/pki/pki-tomcat/tps/webapps/tps/agent/
	Admin services: /var/lib/pki/pki-tomcat/tps/webapps/tps/admin/

[a] Linked to /etc/pki/pki-tomcat/tps/

[b] The subsystem certificate is always issued by the security domain so that domain-level operations that require client authentication are based on this subsystem certificate.

[c] Note that all subsystem certificates are stored in the instance security database

12.1.7. Shared Certificate System Subsystem File Locations

There are some directories used by or common to all Certificate System subsystem instances for general server operations, listed in Table 12.8, “Subsystem File Locations”.

Table 12.8. Subsystem File Locations

Directory Location	Contents
/var/lib/*instance_name*	Contains the main instance directory, which is the location for user-specific directory locations and customized configuration files, profiles, certificate databases, web files, and other files for the subsystem instance.
/usr/share/java/pki	Contains Java archive files shared by the Certificate System subsystems. Along with shared files for all subsystems, there are subsystem-specific files in subfolders: pki/ca/ (CA) pki/kra/ (KRA) pki/ocsp/ (OCSP) pki/tks/ (TKS) *Not used by the TPS subsystem.*

Directory Location	Contents
/usr/share/pki	Contains common files and templates used to create Certificate System instances. Along with shared files for all subsystems, there are subsystem-specific files in subfolders: pki/ca/ (CA) pki/kra/ (KRA) pki/ocsp/ (OCSP) pki/tks/ (TKS) pki/tps (TPS)
/usr/bin	Contains the **pkicreate** and **pkiremove** instance configuration scripts and tools (Java, native, and security) shared by the Certificate System subsystems.
/var/lib/tomcat5/common/lib	Contains links to Java archive files shared by local Tomcat web applications and shared by the Certificate System subsystems. *Not used by the TPS subsystem.*
/var/lib/tomcat5/server/lib	Contains links to Java archive files used by the local Tomcat web server and shared by the Certificate System subsystems. *Not used by the TPS subsystem.*
/usr/shared/pki	Contains the Java archive files used by the Tomcat server and applications used by the Certificate System instances. *Not used by the TPS subsystem.*
/usr/lib/httpd/modules /usr/lib64/httpd/modules	Contains Apache modules used by the TPS subsystem. *Not used by the CA, KRA, OCSP, or TKS subsystems.*
/usr/lib/mozldap /usr/lib64/mozldap	Mozilla LDAP SDK tools used by the TPS subsystem. *Not used by the CA, KRA, OCSP, or TKS subsystems.*

12.2. CS.cfg Files

The runtime properties of a Certificate System subsystem are governed by a set of configuration parameters. These parameters are stored in a file that is read by the server during startup, **CS.cfg**.

The **CS.cfg**, an ASCII file, is created and populated with the appropriate configuration parameters when a subsystem is first installed. The way the instance functions are modified is by making changes through the subsystem console, which is the recommended method. The changes made in the administrative console are reflected in the configuration file.

It is also possible to edit the **CS.cfg** configuration file directly, and in some cases this is the easiest way to manage the subsystem.

12.2.1. Locating the CS.cfg File

Each instance of a Certificate System subsystem has its own configuration file, **CS.cfg**. The contents of the file for each subsystem instance is different depending on the way the subsystem was configured, additional settings and configuration (like adding new profiles or enabling self-tests), and the type of subsystem.

The **CS.cfg** file is located in the configuration directory for the instance.

```
/var/lib/pki/instance_name/conf
```

For example:

```
/var/lib/pki/instance_name/conf/ca
```

12.2.2. Overview of the CS.cfg Configuration File

Each subsystem instances has its own main configuration file, **CS.cfg**, which contains all of the settings for the instance, such as plug-ins and Java classes for configuration. The parameters and specific settings are different depending on the type of subsystem, but, in a general sense, the **CS.cfg** file defines these parts of the subsystem instance:

- Basic subsystem instance information, like its name, port assignments, instance directory, and hostname
- Logging
- Plug-ins and methods to authenticate to the instance's user directory (authorization)
- The security domain to which the instance belongs
- Subsystem certificates
- Other subsystems used by the subsystem instance
- Database types and instances used by the subsystem
- Settings for PKI-related tasks, like the key profiles in the TKS, the certificate profiles in the CA, and the required agents for key recovery in the KRA

Many of the configuration parameters (aside from the ones for PKI tasks) are very much the same between the CA, OCSP, KRA, and TKS because they all use a Java-based console, so configuration settings which can be managed in the console have similar parameters.

The **CS.cfg** file a basic *parameter=value* format.

```
#comment
parameter=value
```

In the **CS.cfg** file, many of the parameter blocks have descriptive comments, commented out with a pound (#) character. Comments, blank lines, unknown parameters, or misspelled parameters are ignored by the server.

> **Note**
>
> A bug in the TPS prevents it from ignoring lines which are commented out in the **CS.cfg** file. Rather than commenting out lines in the TPS **CS.cfg** file, simply delete those lines.

Parameters that configure the same area of the instance tend to be grouped together into the same block.

Example 12.1. Logging Settings in the CS.cfg File

```
log.instance.System._000=##
log.instance.System._001=## System Logging
log.instance.System._002=##
log.instance.System.bufferSize=512
log.instance.System.enable=true
log.instance.System.expirationTime=0
log.instance.System.fileName=/var/lib/pki-ca/logs/system
log.instance.System.flushInterval=5
log.instance.System.level=3
log.instance.System.maxFileSize=2000
log.instance.System.pluginName=file
log.instance.System.rolloverInterval=2592000
log.instance.System.type=system
```

Some areas of functionality are implemented through plug-ins, such as self-tests, jobs, and authorization to access the subsystem. For those parameters, the plug-in instance has a unique identifier (since there can be multiple instances of even the same plug-in called for a subsystem), the implementation plug-in name, and the Java class.

Example 12.2. Subsystem Authorization Settings

```
authz.impl._000=##
authz.impl._001=## authorization manager implementations
authz.impl._002=##
authz.impl.BasicAclAuthz.class=com.netscape.cms.authorization.BasicAcl
Authz
authz.instance.BasicAclAuthz.pluginName=BasicAclAuthz
```

> **Note**
>
> The values for configuration parameters must be properly formatted, so they must obey two rules:
>
> - The values that need to be localized must be in UTF8 characters.
> - The **CS.cfg** file supports forward slashes (/) in parameter values. If a back slash (\) is required in a value, it must be escaped with a back slash, meaning that two back slashes in a row must be used.

The following sections are snapshots of **CS.cfg** file settings and parameters. These are not exhaustive references or examples of **CS.cfg** file parameters. Also, the parameters available and used in each subsystem configuration file is very different, although there are similarities.

12.2.2.1. Basic Subsystem Settings

Basic settings are specific to the instance itself, without directly relating to the functionality or behavior of the subsystem. This includes settings for the instance name, root directory, the user ID for the process, and port numbers. Many of the settings assigned when the instance is first installed or configured are prefaced with **pkicreate**.

Example 12.3. Basic Instance Parameters for the CA

```
authType=pwd
installDate=Mon Jul 13 08:13:39 2009
instanceId=pki-ca
instanceRoot=/var/lib/pki-ca
machineName=server.example.com
multiroles=true
passwordClass=com.netscape.cmsutil.password.PlainPasswordFile
passwordFile=/var/lib/pki-ca/conf/password.conf
...
admin.interface.uri=ca/admin/console/config/wizard
agent.interface.uri=ca/agent/ca
...
os.userid=nobody
pkicreate.admin_secure_port=9445
pkicreate.agent_secure_port=9443
pkicreate.ee_secure_port=9444
pkicreate.pki_instance_name=pki-ca
pkicreate.pki_instance_root=/var/lib
pkicreate.secure_port=9443
pkicreate.subsystem_type=ca
pkicreate.tomcat_server_port=9701
pkicreate.unsecure_port=9180
pkicreate.user=pkiuser
pkicreate.arg11.group=pkiuser
```

Many of these configuration options are covered in Chapter 13, *Basic Subsystem Management*.

Important

While information like the port settings is *included* in the **CS.cfg** file, it is not *set* in the **CS.cfg**. The server configuration for the CA, OCSP, TKS, and KRA is set in the **server.xml** file.

12.2.2.2. Logging Settings

There are several different types of logs that can be configured, depending on the type of subsystem. Each type of log has its own configuration entry in the **CS.cfg** file.

For example, the CA has this entry for transaction logs, which allows log rotation, buffered logging, and log levels, among other settings:

```
log.instance.Transactions._000=##
log.instance.Transactions._001=## Transaction Logging
log.instance.Transactions._002=##
log.instance.Transactions.bufferSize=512
log.instance.Transactions.enable=true
log.instance.Transactions.expirationTime=0
log.instance.Transactions.fileName=/var/lib/pki/pki-
tomcat/ca/logs/transactions
log.instance.Transactions.flushInterval=5
log.instance.Transactions.level=1
log.instance.Transactions.maxFileSize=2000
log.instance.Transactions.pluginName=file
log.instance.Transactions.rolloverInterval=2592000
log.instance.Transactions.type=transaction
```

Logging is covered in Chapter 15, *Configuring Subsystem Logs*.

12.2.2.3. Authorization and Authentication Settings

The **CS.cfg** file sets how users are approved to access a subsystem instance (authorization) and how requests to a subsystem are approved (authentication).

The CA, OCSP, TKS, and KRA use authorization plug-ins to define the settings for logging into the subsystem. For some authorization settings, that is all that is required. It is also possible to select an authorization method that uses an LDAP database to store user entries, in which case the database settings are configured along with the plug-in.

```
authz.impl.DirAclAuthz.class=com.netscape.cms.authorization.DirAclAuthz
authz.instance.DirAclAuthz.ldap=internaldb
authz.instance.DirAclAuthz.pluginName=DirAclAuthz
authz.instance.DirAclAuthz.ldap._000=##
authz.instance.DirAclAuthz.ldap._001=## Internal Database
authz.instance.DirAclAuthz.ldap._002=##
authz.instance.DirAclAuthz.ldap.basedn=dc=server.example.com-pki-ca
authz.instance.DirAclAuthz.ldap.database=server.example.com-pki-ca
authz.instance.DirAclAuthz.ldap.maxConns=15
authz.instance.DirAclAuthz.ldap.minConns=3
authz.instance.DirAclAuthz.ldap.ldapauth.authtype=BasicAuth
authz.instance.DirAclAuthz.ldap.ldapauth.bindDN=cn=Directory Manager
```

```
authz.instance.DirAclAuthz.ldap.ldapauth.bindPWPrompt=Internal LDAP
Database
authz.instance.DirAclAuthz.ldap.ldapauth.clientCertNickname=
authz.instance.DirAclAuthz.ldap.ldapconn.host=localhost
authz.instance.DirAclAuthz.ldap.ldapconn.port=389
authz.instance.DirAclAuthz.ldap.ldapconn.secureConn=false
authz.instance.DirAclAuthz.ldap.multipleSuffix.enable=false
```

The TPS, for example, uses the **auth.instance** settings to configure the user directory it uses to authenticate users who try to access the TPS.

```
auth.instance.0.SSLOn=false
auth.instance.0.attributes=mail,cn,uid
auth.instance.0.attributes._001=########################################
######
auth.instance.0.attributes._002=# attributes will be available
auth.instance.0.attributes._003=# as $auth.<attribute>$
auth.instance.0.attributes._004=########################################
######
auth.instance.0.authId=ldap1
auth.instance.0.baseDN=dc=example,dc=com
auth.instance.0.hostport=localhost:389
auth.instance.0.libraryFactory=GetAuthentication
auth.instance.0.libraryName=/usr/lib64/libldapauth.so
auth.instance.0.retries=1
auth.instance.0.retryConnect=3
auth.instance.0.ssl=false
auth.instance.0.type=LDAP_Authentication
auth.instance.0.ui.description.en=This authenticates user against the
LDAP directory.
auth.instance.0.ui.id.PASSWORD.description.en=LDAP Password
auth.instance.0.ui.id.PASSWORD.name.en=LDAP Password
auth.instance.0.ui.id.UID.description.en=LDAP User ID
auth.instance.0.ui.id.UID.name.en=LDAP User ID
auth.instance.0.ui.title.en=LDAP Authentication
```

The CA also has to have a mechanism for approving user requests. As with configuring authorization, this is done by identifying the appropriate authentication plug-in and configuring an instance for it:

```
auths.impl.AgentCertAuth.class=com.netscape.cms.authentication.AgentCert
Authentication
auths.instance.AgentCertAuth.agentGroup=Certificate Manager Agents
auths.instance.AgentCertAuth.pluginName=AgentCertAuth
```

12.2.2.4. Security Domain Settings

Every instance must belong to a security domain, so every instance has a **securitydomain** definition block.

```
securitydomain.flushinterval=86400000
securitydomain.host=server.example.com
securitydomain.httpport=9180
securitydomain.httpsadminport=9445
securitydomain.httpsagentport=9443
```

```
securitydomain.httpseeport=9444
securitydomain.name=Example Domain
securitydomain.select=new
securitydomain.store=ldap
```

For the CA hosting the domain, that is the only configuration necessary. All subsystems which belong to the security domain also have a setting block for the security domain URLs.

```
config.sdomainAdminURL=https://server.example.com:8443
config.sdomainAgentURL=https://server.example.com:8443
config.sdomainEEURL=https://server.example.com:9443
config.sdomainHttpURL=https://server.example.com:8443
```

12.2.2.5. Subsystem Certificate Settings

Several of the subsystems have entries for each subsystem certificate in the configuration file.

```
ca.sslserver.cert=MIIDmDCCAoCgAwIBAgIBAzANBgkqhkiG9w0BAQUFADBAMR4wHAYDVQ
QKExVSZWR...
ca.sslserver.certreq=MIICizCCAXMCAQAwRjEeMBwGA1UEChMVUmVkYnVkY29tcHV0ZXI
gRG9tYWluMSQwIgYDV...
ca.sslserver.nickname=Server-Cert cert-pki-ca
ca.sslserver.tokenname=Internal Key Storage Token
```

12.2.2.6. Settings for Required Subsystems

At a minimum, each subsystem depends on a CA, which means that the CA (and any other required subsystem) has to be configured in the subsystem's settings. Any connection to another subsystem is prefaced by **conn.** and then the subsystem type and number.

```
conn.ca1.clientNickname=subsystemCert cert-pki-tps
conn.ca1.hostadminport=server.example.com:8443
conn.ca1.hostagentport=server.example.com:8443
conn.ca1.hostport=server.example.com:9443
conn.ca1.keepAlive=true
conn.ca1.retryConnect=3
conn.ca1.servlet.enrollment=/ca/ee/ca/profileSubmitSSLClient
conn.ca1.servlet.renewal=/ca/ee/ca/profileSubmitSSLClient
conn.ca1.servlet.revoke=/ca/subsystem/ca/doRevoke
conn.ca1.servlet.unrevoke=/ca/subsystem/ca/doUnrevoke
conn.ca1.timeout=100
```

12.2.2.7. Database Settings

All of the subsystems use an LDAP directory to store their information. This internal database is configured in the **internaldb** parameters, except for the TPS which configured it in the **tokendb** parameters with a lot of other configuration settings.

```
internaldb._000=##
internaldb._001=## Internal Database
internaldb._002=##
```

```
internaldb.basedn=dc=server.example.com-pki-ca
internaldb.database=server.example.com-pki-ca
internaldb.maxConns=15
internaldb.minConns=3
internaldb.ldapauth.authtype=BasicAuth
internaldb.ldapauth.bindDN=cn=Directory Manager
internaldb.ldapauth.bindPWPrompt=Internal LDAP Database
internaldb.ldapauth.clientCertNickname=
internaldb.ldapconn.host=localhost
internaldb.ldapconn.port=389
internaldb.ldapconn.secureConn=false
internaldb.multipleSuffix.enable=false
```

12.2.2.8. Settings for PKI Tasks

The **CS.cfg** file is used to configure the PKI tasks for every subsystem. The parameters are different for every single subsystem, without any overlap.

For example, the KRA has settings for storing and recovering keys

```
kra.keySplitting=false
kra.noOfRequiredRecoveryAgents=1
```

Review the **CS.cfg** file for each subsystem to become familiar with its PKI task settings; the comments in the file are a decent guide for learning what the different parameters are.

- The CA configuration file lists all of the certificate profiles and policy settings, as well as rules for generating CRLs.
- The TPS configures different token operations.
- The TKS lists profiles for deriving keys from different key types.
- The OCSP sets key information for different key sets.

12.2.3. Editing the Configuration File

Warning

Do not edit the configuration file directly without being familiar with the configuration parameters or without being sure that the changes are acceptable to the server. The Certificate System fails to start if the configuration file is modified incorrectly. Incorrect configuration can also result in data loss.

To modify the **CS.cfg** file:

1. Stop the subsystem instance.

   ```
   systemctl stop pki-tomcatd@instance_name.service
   ```

   The configuration file is stored in the cache when the instance is started. Any changes made to the instance through the Console are changed in the cached version of the file. When the server is stopped or restarted, the configuration file stored in the cache is written to disk. Stop the server before editing the configuration file or the changes will be overwritten by the cached version when the server is stopped.

2. Open the **/var/lib/pki/*instance_name*/conf** directory.
3. Open the **CS.cfg** file in a text editor.
4. Edit the parameters in the file, and save the changes.
5. Start the subsystem instance.

```
systemctl start pki-tomcatd@instance_name.service
```

12.3. Managing System Passwords

The Certificate System stores passwords used to bind to servers or to unlock tokens when the server starts in a plain text file, **password.conf**.

Passwords for the internal database and other database-related passwords for optional features are stored in a plain text file, **password.conf**, in the subsystem **conf/** directory. The passwords stored within it are used to bind to the various Certificate System services. Since the **password.conf** file is in clear text, it is possible to modify them simply through a text editor.

The list of passwords stored in this file includes the following:

- The bind password used by the Certificate System instance to access and update the internal database.
- The bind password used by the Certificate System instance to access and remove PINs from the authentication directory, if the Certificate System is configured to remove PINs from the authentication directory.
- The bind password used by the subsystem to access and update the LDAP directory; this is required only if the Certificate System instance is configured for publishing certificates and CRLs to an LDAP-compliant directory.
- For a TPS instance, the bind password used to access and update the token database.

The **password.conf** file also contains the token passwords needed to open the private keys of the subsystem.

12.3.1. Configuring the password.conf File

The name and location password file to use for the subsystem is configured in the **CS.cfg** file:

```
passwordFile=/var/lib/pki/instance_name/conf/password.conf
```

By default, the passwords to access the instance's internal password store (**internal**, also called its NSS certificate database), its internal LDAP directory (**internaldb**), and its replication database. The internal password store and replication database have randomly-generated PINs which were set when the subsystem was configured; the internal LDAP database password was defined by the administrator when the instance was configured.

```
internal=376577078151
internaldb=secret12
replicationdb=1535106826
```

The **password.conf** file stores system passwords in plaintext, and some administrators prefer to enter system passwords manually and to remove the password file entirely.

Each subsystem is started by the **nuxwdog** daemon. When a Certificate System instance starts, the subsystem automatically checks for the **password.conf** file. If the file exists, then it uses those passwords to connect to other services, like the internal LDAP database. If that file does not exist, then the watchdog daemon prompts for all of the passwords required by the subsystem.

> **Note**
>
> If the **password.conf** file is present, the subsystem assumes that *all* the required passwords are present and properly formatted in clear text. If any passwords are missing or wrongly formatted, then the system prompts for that password.

The passwords that are required are listed in the ***cms.passwordlist*** parameter in the **CS.cfg** file:

```
cms.passwordlist=internaldb,replicationdb,CA LDAP Publishing
cms.password.ignore.publishing.failure=true
```

> **Note**
>
> The ***cms.password.ignore.publishing.failure*** parameter allows a CA subsystem to start up successfully even if it has a failed connection to one of its LDAP publishing directories.

For the CA, KRA, OCSP, and TKS subsystems, the default expected passwords are:

- **internal** for the NSS database
- **internaldb** for the internal LDAP database
- **replicationdb** for the replication password
- Any passwords to access external LDAP databases for publishing (CA only)

> **Note**
>
> If a publisher is configured after the **password.conf** file is removed, nothing is written to the **password.conf** file. The server simply prompts for the new publishing password the next time that the instance restarts.

- Any external hardware token passwords

For the TPS, this prompts for three passwords:

- **internal** for the NSS database
- **tokendbpass** for the internal LDAP database
- Any external hardware token passwords

12.3.2. Requiring System Password Prompts

The **password.conf** file stores system passwords in plaintext, and some administrators prefer to enter system passwords manually and to remove the password file entirely.

Each subsystem is started by the **nuxwdog** daemon. When a Certificate System instance starts, the subsystem automatically checks for the **password.conf** file. If the file exists, then it uses those passwords to connect to other services, like the internal LDAP database. If that file does not exist, then the watchdog daemon prompts for all of the passwords required by the subsystem.

> **Note**
>
> If the **password.conf** file is present, the subsystem assumes that *all* the required passwords are present and properly formatted in clear text. If any passwords are missing or wrongly formatted, then the system will not start.

The passwords that are required are listed in the ***cms.passwordlist*** parameter in the **CS.cfg** file:

```
cms.passwordlist=internaldb,replicationdb,CA LDAP Publishing
cms.password.ignore.publishing.failure=true
```

> **Note**
>
> The ***cms.password.ignore.publishing.failure*** parameter allows a CA subsystem to start up successfully even if it has a failed connection to one of its LDAP publishing directories.

For the CA, KRA, OCSP, and TKS subsystems, the expected passwords are:

- **internal** for the NSS database
- **internaldb** for the internal LDAP database
- **replicationdb** for the replication password
- Any passwords to access external LDAP databases for publishing (CA only)

> **Note**
>
> If a publisher is configured after the **password.conf** file is removed, nothing is written to the **password.conf** file. The server simply prompts for the new publishing password the next time that the instance restarts.

- Any external hardware token passwords

For the TPS, this prompts for three passwords:

- **internal** for the NSS database
- **tokendbpass** for the internal LDAP database
- Any external hardware token passwords

All of the passwords which will be prompted for when the subsystem instance starts are listed in the ***cms.passwordlist*** in the **CS.cfg** file for the instance.

12.3.2.1. Configuring New Instances to Prompt for Passwords

To configure subsystem password prompts for a new CA, KRA, OCSP, or TKS instance, simply remove the **password.conf** file in the **/var/lib/pki/*instance_name*/conf** directory.

For the TPS:

1. Remove the **password.conf** file.
2. Edit the **nss.conf** file to change the **NSSPassPhraseDialog** from the password file to **builtin**.

```
 ... original ...
NSSPassPhraseDialog  defer:/var/lib/pki/pki-
tomcat/tps/conf//password.conf

 ... updates ...
# commenting out this line to enable password prompts
# NSSPassPhraseDialog  defer:/var/lib/pki/pki-
tomcat/tps/conf//password.conf

# adding this line to enable password prompts
NSSPassPhraseDialog  builtin
```

12.3.2.2. Configuring Existing CA, KRA, TKS, and OCSP Instances to Prompt for Passwords

Existing subsystem instances can be configured to prompt for passwords rather than using **password.conf**. This requires a few additional steps to set up.

1. Make sure all of the Certificate System packages have been installed and updated.
2. Stop the instance.

```
systemctl stop pki-tomcatd@instance_name.service
```

3. Back up the instance. For example:

```
cp -R /var/lib/pki-ca-old /var/lib/pki-ca-old.bkup
```

4. Add the ***cms.passwordlist*** parameter to the instance's **CS.cfg** file.

```
vim /var/lib/pki/instance_name/conf/CS.cfg

cms.passwordlist=internaldb,replicationdb
```

If publishing has been enabled, then make sure the LDAP publishing password is listed. For example:

```
cms.passwordlist=internaldb,replicationdb,CA LDAP Publishing
cms.password.ignore.publishing.failure=true
```

> **Note**
>
> The ***cms.password.ignore.publishing.failure*** parameter allows a CA subsystem to start up successfully even if it has a failed connection to one of its LDAP publishing directories.

5. Create a new **dtomcat5** file for the instance.

   a. Copy the current file in **/usr/share/pki/***type***/conf**. For example:

   ```
   /usr/share/pki/ca/conf/dtomcat5 /tmp/dtomcat5-pki-old
   ```

   b. Edit the copied **dtomcat5-***name* file to supply the subsystem information. For example:

   ```
   sed -i 's/\[PKI_SUBSYSTEM_TYPE\]/ca/g' /tmp/dtomcat5-pki-old
   sed -i 's/\[PKI_INSTANCE_PATH\]/\/var\/lib\/pki-old/g'
   /tmp/dtomcat5-pki-old
   sed -i 's/\[PKI_INSTANCE_ID\]/pki-old/g' /tmp/dtomcat5-pki-
   old
   ```

   c. Copy the file into the **/usr/bin/** directory.

   ```
   cp /tmp/dtomcat5-pki-old /usr/bin
   ```

   d. Set the proper file owner and permissions for the file.

   ```
   chown pkiuser: /usr/bin/dtomcat5-pki-old
   chmod 770 /usr/bin/dtomcat5-pki-old
   ```

   e. Remove the temporary file.

   ```
   rm -rf /tmp/dtomcat5-pki-old
   ```

6. Create a new HTTP init.d file for the instance.

a. Copy the current **httpd** file in **/usr/share/pki/***type***/etc/init.d**. For example:

```
cp /usr/share/pki/ca/etc/init.d/httpd /tmp/pki-ca-old
```

b. Edit the copied **httpd** (such as **/tmp/pki-ca-old**) to supply the subsystem information. For example:

```
sed -i 's/\[PKI_SUBSYSTEM_TYPE\]/ca/g' /tmp/pki-ca-old
sed -i 's/\[PKI_INSTANCE_PATH\]/\/var\/lib\/pki-ca-old/g'
/tmp/pki-ca-old
sed -i 's/\[PKI_INSTANCE_ID\]/pki-old/g' /tmp/pki-ca-old
sed -i 's/\[PKI_FLAVOR\]/pki/g' /tmp/pki-ca-old
sed -i 's/\[PKI_USER\]/pkiuser/g' /tmp/pki-ca-old
sed -i 's/\[PKI_GROUP\]/pkiuser/g' /tmp/pki-ca-old
sed -i 's/\[PKI_SERVER_XML_CONF\]/\/var\/lib\/pki-ca-
old\/conf\/server.xml/g' /tmp/pki-ca-old
```

c. Copy the file into the **/etc/init.d/** directory.

```
cp /tmp/pki-ca-old /etc/init.d
```

d. Set the proper file owner and permissions for the file.

```
chown pkiuser: /etc/init.d/pki-ca-old
chmod 770 /etc/init.d/pki-ca-old
```

e. Remove the temporary file.

```
crm -rf /tmp/pki-ca-old
```

7. Edit the **server.xml** file. For each configured connector, add the ***configFile*** attribute:

```
configFile="/var/lib/pki/instance_name/conf/CS.cfg"
```

The CA, KRA, TKS, and OCSP subsystems have three connectors each. A quick way to edit the file is to add the ***configFile*** attribute after every ***passwordFile*** attribute.

8. Note the contents of the **password.conf** file, and then delete it.

```
rm -rf /var/lib/pki/instance_name/conf/password.conf
```

12.3.2.3. Configuring Existing TPS Instances to Prompt for Passwords

> **Important**
>
> If the TPS is configured to prompt for passwords and the incorrect password is given, then the TPS still starts, unlike the other subsystems which will prompt again for the password. This means that the incorrect password error is not caught and communicated to the administrator.
>
> If the incorrect password is given to the prompt for the token database, then all token operations will fail. However, the TPS will start correctly and will appear to run correctly; the problem exhibits in token operations.
>
> If TPS commands or operations are failing inexplicably, then try restarting the TPS and re-entering the token database password.

1. Make sure all of the Certificate System packages have been installed and updated.
2. Stop the instance. For example:

   ```
   systemctl stop pki-tomcatd@instance_name.service
   ```

3. Back up the instance. For example:

   ```
   cp -R /var/lib/pki-tps-old /var/lib/pki-tps-old.bkup
   ```

4. Update the **perl.conf** file.

   a. Copy the template **perl.conf** file.

   ```
   cp /usr/share/pki/tps/conf/perl.conf /tmp/perl.conf
   ```

   b. Edit the temporary **perl.conf** file to point to the appropriate Apache instance.

   ```
   sed -i 's/\[FORTITUDE_LIB_DIR\]/\/etc\/httpd/g'
   /tmp/perl.conf
   sed -i 's/\[FORTITUDE_APACHE\]/Apache2/g' /tmp/perl.conf
   sed -i 's/\[SERVER_ROOT\]/\/var\/lib\/pki-tps-old/g'
   /tmp/perl.conf
   ```

   c. Copy the temporary file into the TPS's **conf/** directory.

   ```
   cp /tmp/perl.conf /var/lib/pki-tps-old/conf
   ```

   d. Set the proper file owner and permissions for the file.

   ```
   chown pkiuser: /var/lib/pki-tps-old/conf
   chmod 660 /var/lib/pki-tps-old/conf
   ```

   e. Remove the temporary file.

   ```
   rm /tmp/perl.conf
   ```

f. Edit the **nss.conf** file to change the **NSSPassPhraseDialog** from the password file to **builtin**.

```
 ... original ...
NSSPassPhraseDialog  defer:/var/lib/pki/pki-
tomcat/tps/conf//password.conf

 ... updates ...
# commenting out this line to enable password prompts
# NSSPassPhraseDialog  defer:/var/lib/pki/pki-
tomcat/tps/conf//password.conf

# adding this line to enable password prompts
NSSPassPhraseDialog  builtin
```

5. Replace the security officer CGI scripts. There are different procedures to use, depending on whether the scripts have been customized.

   If the CGI scripts have not been customized, then do the following:

   a. Create a temporary directory and copy the CGI scripts into it.

   ```
   mkdir /tmp/sow
   cp /usr/share/pki/tps/cgi-bin/sow/*.cgi /tmp/sow
   ```

   b. Create a temporary directory and copy the CGI scripts into it.

   c. Edit the CGI files, using the appropriate server root for the TPS instance. For example:

   ```
   pushd /tmp/sow
   for i in `ls *.cgi`; do
   sed -i 's/\[SERVER_ROOT\]/\/var\/lib\/pki-tps-old/g' $i
   done
   cp -f *.cgi /var/lib/pki-tps-old/cgi-bin/sow
   popd
   ```

   d. Remove the temporary directory.

   ```
   rm -f /tmp/sow
   ```

   e. Set the proper file owner and permissions for the files.

   ```
   chown pkiuser: /var/lib/pki-tps-old/cgi-bin/sow/*.cgi
   chmod 755 /var/lib/pki-tps-old/cgi-bin/sow/*.cgi
   ```

6. If the security officer scripts have been customized, then the files need to be updated so that they properly run under **mod_perl::PerlRun** instead of **mod_cgi**.

   The primary change is to replace any relative file paths with full paths. For example, replace this line:

   ```
   require "./cfg.pl"
   ```

   With:

```
require "/var/lib/pki-tps/cgi-bin/sow/cfg.pl"
```

Other changes may be needed to eliminate warnings in the error_log.

7. Create a new HTTP init.d file for the instance. THe easiest way to do this is to create a temporary TPS instance, copy its init.d file, and then edit it to point to the original instance.

   a. Run **pkicreate** to create a TPS instance.

   b. Copy the new instance's init.d file.

   ```
   cp /etc/init.d/pki-temp-tps /tmp/pki-tps-old
   ```

   c. Replace the new instance name with the original TPS instance name. For example:

   ```
   sed -i 's/pki-temp-tps/pki-tps-old/g' /tmp/pki-tps-old
   ```

   d. Copy the file into the **/etc/init.d/** directory.

   ```
   cp /tmp/pki-tps-old /etc/init.d
   ```

   e. Set the proper file owner and permissions for the file.

   ```
   chown pkiuser: /etc/init.d/pki-tps-old
   chmod 770 /etc/init.d/pki-tps-old
   ```

   f. Remove the temporary file.

   ```
   rm -rf /tmp/pki-tps-old
   ```

   g. Use **pkiremove** to remove the temporary TPS instance.

8. Note the contents of the **password.conf** file, and then delete it.

```
rm -rf /var/lib/pki/instance_name/conf/password.conf
```

12.3.3. Changing System Passwords

Subsystem passwords are used by the subsystem instance to connect to a necessary service, like its internal database. These passwords are set in the service, so for them to change, they are changed on the external service. Then, any password changes need to be carried back to the Certificate System subsystem configuration.

The way that subsystem passwords can be changed depends on the type of password:

- The **internal** password can be changed using the **certutil** command to update the NSS security database or in the subsystem's administrative interface, such as the console.

- LDAP-related passwords, such as **internaldb** and **tokendbpass** for the internal database, can be changed in the LDAP server directly (using the Directory Server console or tools like **ldapmodify**).

- LDAP publishing passwords are *changed* in the LDAP server, but that change means that the password must be updated in the Certificate System CA configuration. The publishing password is reset in the CA console; this automatically updates the **password.conf** file, if it exists.
- Hardware token passwords can be changed on the hardware token itself, using its native tools.

The passwords must then be manually updated in the **password.conf** file or in the subsystem console. If the password file has been removed, then the new passwords can simply be entered when prompted at server startup.

12.4. Configuration Files for Web Services

All of the agent and administrative services for the subsystems are accessed over web protocols. The CA, OCSP, KRA, and TKS use Tomcat as their web server, while the TPS uses Apache. For information on configuring and customizing these web services, see the relevant documentation for Tomcat at http://tomcat.apache.org/ and for Apache at http://apache.org/.

The CA, OCSP, TKS, and KRA primarily configure their web-based services in the **server.xml** file, though they have other files in the **/var/lib/pki/*instance_name*/conf** directory for configuring their Tomcat engine. The **server.xml** file sets the files and ports to use to access all of their end user, agent, and even administrative services.

```
<Connector name="Agent" port="9443" maxHttpHeaderSize="8192"
        maxThreads="150" minSpareThreads="25" maxSpareThreads="75"
        enableLookups="false" disableUploadTimeout="true"
        acceptCount="100" scheme="https" secure="true"
        clientAuth="true" sslProtocol="SSL"
        sslOptions="ssl2=true,ssl3=true,tls=true"
        ssl2Ciphers="-SSL2_RC4_128_WITH_MD5...
        ssl3Ciphers="-SSL3_FORTEZZA_DMS_WITH_NULL_SHA,...
        tls3Ciphers="-SSL3_FORTEZZA_DMS_WITH_NULL_SHA,...

SSLImplementation="org.apache.tomcat.util.net.jss.JSSImplementation"
        serverCertNickFile="/var/lib/pki-ca/conf/serverCertNick.conf"
        passwordFile="/var/lib/pki-ca/conf/password.conf"
        passwordClass="org.apache.tomcat.util.net.jss.PlainPasswordFile"
        certdbDir="/var/lib/pki-ca/alias"/>
```

The TPS uses two files:

- nss.conf
- httpd.conf

As with the **server.xml** file, the **nss.conf** file is used to configure the instance ports and SSL/TLS and certificate settings, while the **httpd.conf** file is used to configure the docroots for the different interfaces.

12.5. Removing Unused Interfaces from web.xml (CA Only)

Several legacy interfaces (for features like bulk issuance or the policy framework) are still included in the CA's **web.xml** file. However, since these features are deprecated and no longer in use, then they can be removed from the CA configuration to increase security.

1. Stop the CA.

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Open the web files directory for the CA. For example:

```
cd /var/lib/pki/instance_name/ca/webapps/ca/WEB-INF
```

3. Back up the current **web.xml** file.

```
cp web.xml web.xml.servlets
```

4. Edit the **web.xml** file and remove the entire **<servlet>** entries for each of the following deprecated servlets:

   - caadminEnroll
   - cabulkissuance
   - cacertbasedenrollment
   - caenrollment
   - caProxyBulkIssuance

   For example, remove the **caadminEnroll** servlet entry:

```
<servlet>
      <servlet-name>  caadminEnroll  </servlet-name>
      <servlet-class> com.netscape.cms.servlet.cert.EnrollServlet
</servlet-class>
             <init-param><param-name>  GetClientCert  </param-
name>
                         <param-value> false       </param-value>
</init-param>
             <init-param><param-name>  successTemplate  </param-
name>
                         <param-value>
/admin/ca/EnrollSuccess.template
</param-value> </init-param>
             <init-param><param-name>  AuthzMgr    </param-name>
                         <param-value> BasicAclAuthz </param-
value>
</init-param>
             <init-param><param-name>  authority   </param-name>
                         <param-value> ca          </param-value>
</init-param>
             <init-param><param-name>  interface   </param-name>
                         <param-value> admin          </param-
value>
</init-param>
             <init-param><param-name>  ID          </param-name>
```

```
                         <param-value> caadminEnroll </param-
value>
</init-param>
             <init-param><param-name>  resourceID  </param-name>
                         <param-value>
certServer.admin.request.enrollment
</param-value> </init-param>
             <init-param><param-name>  AuthMgr     </param-name>
                         <param-value> passwdUserDBAuthMgr
</param-value>
</init-param>
   </servlet>
```

5. After removing the servlet entries, remove the corresponding **<servlet-mapping>** entries.

```
<servlet-mapping>
      <servlet-name>  caadminEnroll  </servlet-name>
      <url-pattern>   /admin/ca/adminEnroll  </url-pattern>
</servlet-mapping>
```

6. Remove three **<filter-mapping>** entries for an end-entity request interface.

```
   <filter-mapping>
      <filter-name>  EERequestFilter              </filter-name>
      <url-pattern>  /certbasedenrollment         </url-pattern>
   </filter-mapping>

   <filter-mapping>
      <filter-name>  EERequestFilter              </filter-name>
      <url-pattern>  /enrollment                  </url-pattern>
   </filter-mapping>

   <filter-mapping>
      <filter-name>  EERequestFilter              </filter-name>
      <url-pattern>  /profileSubmit               </url-pattern>
   </filter-mapping>
```

7. Start the CA again.

```
systemctl start pki-tomcatd@instance_name.service
```

12.6. Restoring Configuration in web.xml

Much of the configuration for the web-based services of a subsystem is set in its **web.xml** file. There are actually three **web.xml** files used by the subsystem:

1. **web.xml.runtime** is created by **pkicreate** when the instance is created and is the default version of **web.xml**, without all the configuration servlets used by the configuration wizard.

2. **web.xml.configuration** is a copy of **web.xml** that is created by the start/stop script immediately after the setup of the instance is complete. This exists only for the configuration wizard, since it contains servlets used by the configuration wizard.

3. **web.xml** is the real file with all its configuration, including custom settings. This is the file used by the subsystem and which administrators can edit.

There is a basic process, where all of the **web.xml*** files are created in a daisy chain immediately after the configuration is complete.

```
... pkicreate ...
web.xml  => web.xml.runtime

... after the configuration wizard ...
web.xml  => web.xml.configuration
web.xml.runtime => web.xml
```

1. The **pkicreate** process creates **web.xml**.
2. The **pkicreate** process the uses **web.xml** to create **web.xml.runtime**.
3. *After* the configuration wizard is completed, the start/stop scripts move the original **web.xml** to **web.xml.configuration**, and then copy **web.xml.runtime** to **web.xml**.

The **web.xml** is the one used by the subsystem for normal operation. If for some reason that file is lost or corrupted, then the **web.xml.runtime** can be used to restore the original, unmodified file.

Important

Never modify **web.xml.runtime**.

Warning

Even though **web.xml.configuration** is only used by the configuration wizard, if this file does not exist, then the server will copy **web.xml.runtime** over to **web.xml** and overwrite the existing **web.xml** file, including any modifications.

Chapter 13. Basic Subsystem Management

This chapter discusses the Certificate System administrative console, the configuration files, and other basic administrative tasks such as starting and stopping the server, managing logs, changing port assignments, and changing the internal database.

13.1. PKI Instances

This version of the Certificate System continues to support *separate PKI instances* for all subsystems.

Separate PKI instances

- run as a single Java-based Apache Tomcat instance,
- contain a single PKI subsystem (CA, KRA, OCSP, TKS, or TPS), and
- must utilize unique ports if co-located on the same physical machine or virtual machine (VM).

Additionally, this version of the Certificate System introduces the notion of a *shared PKI instance*.

Shared PKI instances

- run as a single Java-based Apache Tomcat instance,
- can contain a single PKI subsystem that is identical to a separate PKI instance,
- can contain any combination of up to one of each type of PKI subsystem:
  - CA
  - TKS
  - CA, KRA
  - CA, OCSP
  - TKS, TPS
  - CA, KRA, TKS, TPS
  - CA, KRA, OCSP, TKS, TPS
  - and so on.
- allow all of their subsystems contained within that instance to share the same ports, and
- must utilize unique ports if more than one is co-located on the same physical machine or VM.

13.2. PKI Instance Execution Management

The act of starting, stopping, restarting, or obtaining the status of a PKI instance is known as execution management. Each PKI instance, separate or shared, is started, stopped, restarted, and has its status obtained separately. This section describes the execution management for any PKI instance.

13.2.1. Starting, Stopping, and Restarting a PKI Instance

A PKI instance is started, stopped, and restarted like other system programs, using **systemd**.

1. Log in to the server machine as **root**.
2. Run the **systemctl** command, specifying the action and the instance name:

   ```
   systemctl start|stop|restart pki-tomcatd@instance_name.service
   ```

   For example:

   ```
   systemctl restart pki-tomcatd@pki-tomcat.service
   ```

13.2.2. Restarting a PKI Instance after a Machine Restart

If a computer running one or more PKI instances is shut down unexpectedly, more services than just the PKI instances must be restarted, in the proper order, for the subsystem to be available both through the HTML services page and the administrative console.

1. If the Directory Server instance used by the subsystem is installed on the local machine, restart the Administration Server and the Directory Server processes.

   ```
   systemctl start dirsrv-admin.service
   systemctl start dirsrv@instance_name.service
   ```

2. Start the Certificate System subsystem instances.

   ```
   systemctl start pki-tomcatd@instance_name.service
   ```

13.2.3. Checking the PKI Instance Status

The **systemctl** command can be used to check the status of a process, showing whether it is running or stopped. For example:

```
systemctl -l status pki-tomcatd@pki-tomcat.service
pki-tomcatd@pki-tomcat.service - PKI Tomcat Server pki-tomcat
   Loaded: loaded (/lib/systemd/system/pki-tomcatd@.service; enabled)
   Active: inactive (dead) since Fri 2015-11-20 19:04:11 MST; 12s ago
  Process: 8728 ExecStop=/usr/libexec/tomcat/server stop (code=exited,
status=0/SUCCESS)
  Process: 8465 ExecStart=/usr/libexec/tomcat/server start (code=exited,
status=143)
  Process: 8316 ExecStartPre=/usr/bin/pkidaemon start tomcat %i
(code=exited, status=0/SUCCESS)
 Main PID: 8465 (code=exited, status=143)

Nov 20 19:04:10 pki.example.com server[8728]: options used: -
Dcatalina.base=/var/lib/pki/pki-tomcat -Dcatalina.home=/usr/share/tomcat
```

```
-Djava.endorsed.dirs= -Djava.io.tmpdir=/var/lib/pki/pki-tomcat/temp -
Djava.util.logging.config.file=/var/lib/pki/pki-
tomcat/conf/logging.properties -
Djava.util.logging.manager=org.apache.juli.ClassLoaderLogManager
Nov 20 19:04:10 pki.example.com server[8728]: arguments used: stop
Nov 20 19:04:11 pki.example.com server[8465]: Nov 20, 2015 7:04:11 PM
org.apache.catalina.core.StandardServer await
Nov 20 19:04:11 pki.example.com server[8465]: INFO: A valid shutdown
command was received via the shutdown port. Stopping the Server
instance.
Nov 20 19:04:11 pki.example.com server[8465]: PKIListener:
org.apache.catalina.core.StandardServer[before_stop]
Nov 20 19:04:11 pki.example.com server[8465]: PKIListener:
org.apache.catalina.core.StandardServer[stop]
Nov 20 19:04:11 pki.example.com server[8465]: PKIListener:
org.apache.catalina.core.StandardServer[configure_stop]
Nov 20 19:04:11 pki.example.com server[8465]: Nov 20, 2015 7:04:11 PM
org.apache.coyote.AbstractProtocol pause
Nov 20 19:04:11 pki.example.com server[8465]: INFO: Pausing
ProtocolHandler ["http-bio-8080"]
Nov 20 19:04:11 pki.example.com systemd[1]: Stopped PKI Tomcat Server
pki-tomcat.
```

If the instance is running, the status check returns information similar to the following example:

```
systemctl -l status pki-tomcatd@pki-tomcat.service
pki-tomcatd@pki-tomcat.service - PKI Tomcat Server pki-tomcat
   Loaded: loaded (/lib/systemd/system/pki-tomcatd@.service; enabled)
   Active: active (running) since Fri 2015-11-20 19:09:09 MST; 3s ago
  Process: 8728 ExecStop=/usr/libexec/tomcat/server stop (code=exited,
status=0/SUCCESS)
  Process: 9154 ExecStartPre=/usr/bin/pkidaemon start tomcat %i
(code=exited, status=0/SUCCESS)
 Main PID: 9293 (java)
   CGroup: /system.slice/system-pki\x2dtomcatd.slice/pki-tomcatd@pki-
tomcat.service
          ������9293 java -DRESTEASY_LIB=/usr/share/java/resteasy-base
-Djava.library.path=/usr/lib64/nuxwdog-jni -classpath
/usr/share/tomcat/bin/bootstrap.jar:/usr/share/tomcat/bin/tomcat-
juli.jar:/usr/share/java/commons-daemon.jar -
Dcatalina.base=/var/lib/pki/pki-tomcat -Dcatalina.home=/usr/share/tomcat
-Djava.endorsed.dirs= -Djava.io.tmpdir=/var/lib/pki/pki-tomcat/temp -
Djava.util.logging.config.file=/var/lib/pki/pki-
tomcat/conf/logging.properties -
Djava.util.logging.manager=org.apache.juli.ClassLoaderLogManager -
Djava.security.manager -Djava.security.policy==/var/lib/pki/pki-
tomcat/conf/catalina.policy org.apache.catalina.startup.Bootstrap start

Nov 20 19:09:10 pki.example.com server[9293]: Nov 20, 2015 7:09:10 PM
org.apache.catalina.core.StandardService startInternal
Nov 20 19:09:10 pki.example.com server[9293]: INFO: Starting service
Catalina
Nov 20 19:09:10 pki.example.com server[9293]: Nov 20, 2015 7:09:10 PM
org.apache.catalina.core.StandardEngine startInternal
Nov 20 19:09:10 pki.example.com server[9293]: INFO: Starting Servlet
```

```
Engine: Apache Tomcat/7.0.54
Nov 20 19:09:10 pki.example.com server[9293]: Nov 20, 2015 7:09:10 PM
org.apache.catalina.startup.HostConfig deployDescriptor
Nov 20 19:09:10 pki.example.com server[9293]: INFO: Deploying
configuration descriptor /etc/pki/pki-tomcat/Catalina/localhost/ROOT.xml
Nov 20 19:09:12 pki.example.com server[9293]: Nov 20, 2015 7:09:12 PM
org.apache.catalina.startup.HostConfig deployDescriptor
Nov 20 19:09:12 pki.example.com server[9293]: INFO: Deployment of
configuration descriptor /etc/pki/pki-tomcat/Catalina/localhost/ROOT.xml
has finished in 2,071 ms
Nov 20 19:09:12 pki.example.com server[9293]: Nov 20, 2015 7:09:12 PM
org.apache.catalina.startup.HostConfig deployDescriptor
Nov 20 19:09:12 pki.example.com server[9293]: INFO: Deploying
configuration descriptor /etc/pki/pki-
tomcat/Catalina/localhost/pki#admin.xml
```

13.2.4. Configuring a PKI Instance to Automatically Start Upon Reboot

The **systemctl** command can be used to automatically start instances upon reboot. For example, the following commands automatically start the Red Hat Administration Server, Directory Server, and a CA upon reboot:

```
# systemctl enable dirsrv-admin.service
# systemctl enable dirsrv.target
# systemctl enable pki-tomcatd@pki-tomcat.service
```

> **Note**
>
> The default PKI instance installation and configuration using the **pkispawn** command automatically enables the instance to start upon reboot.

To disable this behavior (that is, to prevent PKI instances from automatically starting upon reboot), issue the following commands:

```
# systemctl disable pki-tomcatd@pki-tomcat.service
# systemctl disable dirsrv.target
# systemctl disable dirsrv-admin.service
```

13.2.5. Setting sudo Permissions for Certificate System Services

For both simplicity of administration and security, the Certificate System and Directory Server processes can be configured so that PKI administrators (instead of only root) can start and stop the services.

A recommended option when setting up subsystems is to use a **pkiadmin** system group. (Details are in the *Planning, Installation, and Deployment Guide*.) All of the operating system users which will be Certificate System administrators are then added to this group. If this **pkiadmin** system group exists, then it can be granted sudo access to perform certain tasks.

1. Edit the **/etc/sudoers** file; on Red Hat Enterprise Linux 5.6, this can be done using the **visudo** command:

   ```
   # visudo
   ```

2. Depending on what is installed on the machine, add a line for the Directory Server, the Administration Server, PKI management tools, and each PKI subsystem instance, granting **sudo** rights to the **pkiadmin** group:

   ```
   # For Directory Server services
   %pkiadmin ALL = PASSWD: /usr/bin/systemctl * dirsrv.target
   %pkiadmin ALL = PASSWD: /usr/bin/systemctl * dirsrv-admin.service

   # For PKI instance management
   %pkiadmin ALL = PASSWD: /usr/sbin/pkispawn *
   %pkiadmin ALL = PASSWD: /usr/sbin/pkidestroy *

   # For PKI instance services
   %pkiadmin ALL = PASSWD: /usr/bin/systemctl * pki-
   tomcatd@instance_name.service
   ```

Important

Make sure to set sudo permissions for every Certificate System, Directory Server, and Administration Server on the machine — and *only* for those instances on the machine. There could be multiple instances of the same subsystem type on a machine or no instance of a subsystem type. It depends on the deployment.

13.3. Opening Subsystem Consoles and Services

Each subsystem has different interfaces for different user types to access. All subsystems have some kind of web services page for agents, administrators, or end users (or all three), with the exception of the TKS. Additionally, the CA, KRA, OCSP, and TKS all have a Java-based Console, which must be installed on a server, to perform administrative tasks to manage the subsystem itself.

The appearance and, to a limited extent, functionality of the subsystem's web-based services pages can be customized to better integrate with an organization's existing websites. See Section 13.4, “Customizing Web Services”.

13.3.1. Finding the Subsystem Web Services Pages

The CA, KRA, OCSP, TKS, and TPS subsystems have web services pages for agents, regular users, and administrators. These menu of web services can be accessed by opening the URL to the subsystem host over the subsystem's secure end user's port. For example, for the CA:

```
https://server.example.com:8443/ca/services
```

The main web services page for each subsystem has a list of available services pages; these are summarized in Table 13.1, “Default Web Services Pages”. To access any service specifically, access the appropriate port and append the appropriate directory to the URL. For example, to access the CA's end entities (regular users) web services:

```
https://server.example.com:8443/ca/ee/ca
```

If DNS is properly configured, then an IPv4 or IPv6 address can be used to connect to the services pages. For example:

```
https://1.2.3.4:8443/ca/services
https://[00:00:00:00:123:456:789:00:]:8443/ca/services
```

Some subsystem interfaces require client authentication to access them, usually interfaces associated with agent or administrator roles. Other interfaces, even those that run over secure (SSL connections) do not require client authentication. Some of these interfaces (such as end entities services) can be configured to require client authentication, but others cannot be configured to support client authentication. These differences are noted in Table 13.1, “Default Web Services Pages”.

> **Note**
>
> Anyone can access the end user pages for a subsystem, but accessing agent or admin web services pages requires that an agent or administrator certificate be issued and installed in the web browser, or authentication to the web services fails.

Table 13.1. Default Web Services Pages

Used for SSL	Used for Client Authentication [a]	Web Services	Web Service Location
Certificate Manager			
No		End Entities	ca/ee/ca/
Yes	No	End Entities	ca/ee/ca
Yes	Yes	Agents	ca/agent/ca
Yes	No	Services	ca/services
Yes	No	Console	pkiconsole https://*host*:*port*/ca
Key Recovery Authority			
Yes	Yes	Agents	kra/agent/kra
Yes	No	Services	kra/services
Yes	No	Console	pkiconsole https://*host*:*port*/kra
Online Certificate Status Manager			
Yes	Yes	Agents	ocsp/agent/ocsp
Yes	No	Services	ocsp/services

Used for SSL	Used for Client Authentication	Web Services	Web Service Location
Yes	No	Console	pkiconsole https://*host:port*/ocsp
Token Key Service			
Yes	No	Services	tks/services
Yes	No	Console	pkiconsole https://*host:port*/tks
Token Processing System			
Yes		Services	index.cgi

[a] Services with a client authentication value of **No** can be reconfigured to require client authentication. Services which do not have either a **Yes** or **No** value cannot be configured to use client authentication.

13.3.2. Starting the Certificate System Administrative Console

The Console is opened by connecting to the subsystem instance over its SSL port using the **pkiconsole** command. This command has the format:

```
pkiconsole https://server.example.com:admin_port/subsystem_type
```

The *subsystem_type* can be **ca**, **kra**, **ocsp**, or **tks**. For example, this opens the KRA console:

```
pkiconsole https://server.example.com:8443/kra
```

If DNS is properly configured, then an IPv4 or IPv6 address can be used to connect to the console. For example:

```
pkiconsole https://1.2.3.4:8443/ca
pkiconsole https://[00:00:00:00:123:456:789:00:]:8443/ca
```

13.3.3. Enabling SSL for the Java Administrative Console

Certificate-based authentication to the Certificate System Console can be enabled so that administrators must authenticate using a client certificate before logging into the Certificate System Console. Store the administrators' certificates before enabling certificate-based authentication.

To enable SSL in the Console, configure both the client and the server.

> **Important**
>
> If a CA is configured for client authentication over the admin port and that CA is a security domain manager, then **no new PKI subsystems can be configured that use that CA for its security domain**. New PKI instances register themselves to the security domain CA over the admin port but without using client authentication. If the CA requires client authentication, then the registration attempt fails.

First, set up the Certificate System server to use SSL client authentication:

1. Store the certificates for any administrator using this system. The certificate should be either from the CA itself or from whichever CA signed the certificate for the subsystem.

   a. Open the subsystem console.

   b. Select the **Users and Groups** option on the left.

   c. In the **Users** tab, select the administrative user, and click **Manage Certificates**.

   d. Click **Import**.

   e. Paste in the base-64 encoded SSL client certificate, such as the administrator certificate stored in the web browser.

   Make sure the client certificate is good for SSL client authentication; otherwise, the server will not accept the client certificate and will post an error message in the error log in the **/var/log/***instanceID***/system**:

   ```
   failure (14290): Error receiving connection
   SEC_ERROR_INADEQUATE_CERT_TYPE - Certificate type not approved for
   application.)
   ```

2. Stop the subsystem.

   ```
   systemctl stop pki-tomcatd@instance_name.service
   ```

3. Open the instance configuration directory, **/var/lib/pki/***instance_name***/conf**.

4. Open the file **CS.cfg**.

5. Change the value of the **authType** parameter from **pwd** to **sslclientauth**:

   ```
   authType=sslclientauth
   ```

6. Save the file.

7. Open the **server.xml** file.

8. Change the **clientAuth="false"** attribute to **clientAuth="want"** in the admin interface connector section:

   ```
   <Connector port="8443" maxHttpHeaderSize="8192"
   ```

```
        maxThreads="150" minSpareThreads="25" maxSpareThreads="75"
        enableLookups="false" disableUploadTimeout="true"
        acceptCount="100" scheme="https" secure="true"
        clientAuth="want" sslProtocol="SSL"
.....
        serverCertFile="/var/lib/pki/pki-
tomcat/conf/serverCertNick.conf"
        passwordFile="/var/lib/pki/pki-tomcat/conf/password.conf"

passwordClass="org.apache.tomcat.util.net.jss.PlainPasswordFile"
        certdbDir="/var/lib/pki/pki-tomcat/alias"/>
```

The **want** value means that client authentication is preferred, but not required. This allows client authentication through interfaces that can easily use it (like the Console) while still allowing clients which do not easily support client authentication (other subsystems within the security domain) to connect using regular connections.

9. Start the subsystem.

```
systemctl start pki-tomcatd@instance_name.service
```

After setting up the server, then configure the client to use SSL client authentication.

The Console must have access to the administrator certificate and keys used for SSL client authentication to the server. The Console's default certificate and key databases are stored in the **.redhat-idm-console** directory.

To provide access to the administrator certificate and keys, either export them from the administrator's browser into a **.p12** file and then import it by using **pk12util**, or copy the browser's certificate and key databases into the **.redhat-idm-console** directory. (This procedure assumes that the certificates are exported from the browser into a **.p12** file.)

1. Export the administrator user certificate and keys from the browser into a file, such as **admin.p12**.

2. Open the user's console directory.

```
/user-directory/.redhat-idm-console
```

3. If necessary, create new security databases.

```
certutil -N -d .
```

4. Stop the Certificate System instance.

```
systemctl stop pki-tomcatd@instance_name.service
```

5. Use **pk12util** to import the certificates.

```
# pk12util -i /tmp/admin.p12 -d /user-directory/.redhat-idm-
console -W [p12filepassword]
```

If the procedure is successful, the command prints the following:

```
pk12util: PKCS12 IMPORT SUCCESSFUL
```

6. Export the 64-bit blob of the issuing CA certificate from the browser and save it to a file like **ca.crt**.

7. Import the CA certificate from the base 64-blob associated with the admin user cert.

```
certutil -A -d . -n ca -t CT,C,C -i ./ca.crt
```

8. Start the Certificate System instance.

```
systemctl start pki-tomcatd@instance_name.service
```

9. Start the Console; now, it prompts for a certificate.

13.4. Customizing Web Services

All of the subsystems (with the exception of the TKS) have some kind of a web-based services page for agents and some for other user types, like administrators or end entities. These web-based services pages use basic HTML and JavaScript, which can be customized to use different colors, logos, and other design elements to fit in with an existing site or intranet.

13.4.1. Customizing Subsystem Web Applications

Each PKI subsystem has a corresponding web application, which contains:

- HTML pages containing texts, JavaScript codes, page layout, CSS formatting, and so on
- A **web.xml** file, which defines servlets, paths, security constraints, and other
- Links to PKI libraries.

The subsystem web applications are deployed using context files located in the **/var/lib/pki/pki-tomcat/conf/Catalina/localhost/** direcotry, for example, the **ca.xml** file:

```
<Context docBase="/usr/share/pki/ca/webapps/ca" crossContext="true"
allowLinking="true">
    ...
</Context>
```

The **docBase** points to the location of the default web application directory, **/usr/share/pki/**.

To customize the web application, copy the web application directory into the instance's **webapps** directory:

```
$ cp -r /usr/share/pki/ca/webapps/ca /var/lib/pki/pki-tomcat/webapps
```

Then change the **docBase** to point to the custom web application directory relative from the **webapps** directory:

```
<Context docBase="ca" crossContext="true" allowLinking="true">
    ...
</Context>
```

The change will be effective immediately without the need to restart the server.

To remove the custom web application, simply revert the **docBase** and delete the custom web application directory:

```
$ rm -rf /var/lib/pki/pki-tomcat/webapps/ca
```

13.4.2. Customizing the Web UI Theme

The subsystem web applications in the same instance share the same theme, which contains:

- CSS files, which determine the global appearance
- Image files including logo, icons, and other
- Branding properties, which determine the page title, logo link, title color, and other.

The Web UI theme is deployed using the **pki.xml** context file in the **/var/lib/pki/pki-tomcat/conf/Catalina/localhost/** directory:

```
<Context docBase="/usr/share/pki/common-ui" crossContext="true"
allowLinking="true">
    ...
</Context>
```

The docBase points to the location of the default theme directory, **/usr/share/pki/**.

To customize the theme, copy the default theme directory into the **pki** directory in the instance's **webapps** directory:

```
$ cp -r /usr/share/pki/common-ui /var/lib/pki/pki-tomcat/webapps/pki
```

Then change the **docBase** to point to the custom theme directory relative from the **webapps** directory:

```
<Context docBase="pki" crossContext="true" allowLinking="true">
    ...
</Context>
```

The change will be effective immediately without the need to restart the server.

To remove the custom theme, simply revert the **docBase** and delete the custom theme directory:

```
$ rm -rf /var/lib/pki/pki-tomcat/webapps/pki
```

13.4.3. Customizing TPS Token State Labels

The default token state labels are stored in the **/usr/share/pki/tps/conf/token-states.properties** file:

```
# Token states
UNINITIALIZED       = Uninitialized
ACTIVE              = Active
TEMP_LOST           = Temporarily lost
PERM_LOST           = Permanently lost
DAMAGED             = Physically damaged
TEMP_LOST_PERM_LOST = Temporarily lost then permanently lost
TERMINATED          = Terminated

# Token state transitions
UNINITIALIZED.DAMAGED    = This token has been physically damaged.
UNINITIALIZED.PERM_LOST  = This token has been permanently lost.
UNINITIALIZED.TEMP_LOST  = This token has been temporarily lost.
UNINITIALIZED.TERMINATED = This token has been terminated.
TEMP_LOST.ACTIVE         = This temporarily lost token has been found.
TEMP_LOST.PERM_LOST      = This temporarily lost token has become
permanently lost.
TEMP_LOST.TERMINATED     = This temporarily lost token has been
terminated.
ACTIVE.DAMAGED           = This token has been physically damaged.
ACTIVE.PERM_LOST         = This token has been permanently lost.
ACTIVE.TEMP_LOST         = This token has been temporarily lost.
ACTIVE.TERMINATED        = This token has been terminated.
```

To customize the labels, copy the file into the instance directory:

```
$ cp /usr/share/pki/tps/conf/token-states.properties /var/lib/pki/pki-
tomcat/tps/conf
```

The change will be effective immediately without the need to restart the server.

To remove the customized labels, simply delete the customized file:

```
$ rm /var/lib/pki/pki-tomcat/tps/conf/token-states.properties
```

13.4.4. Setting Limits on Searches through the CA End-Entities Pages

Large PKIs can have tens of thousands, even millions, of certificates, keys, and requests maintained in its databases. When users search for their certificates or agents list requests, then, it is possible for thousands or millions of entries to be returned. Large search results can significantly affect CA performance, so it is possible to limit the number of results returned for a search or the amount of time that searches can take.

There are two files that can manage search limits for the CA end-entities pages:

- The **CS.cfg** file in the **/var/lib/pki/*instance_name*/conf/ca** directory
- The **web.xml** file in the **/usr/share/pki/ca/webapps/ca/WEB-INF/** directory (default), or if configured, the customized one under **/var/lib/pki/*instance-name*/webapps/**.

The **CS.cfg** file has a single parameter which can set the maximum number of returned results for all user interfaces for all search types. To set this value:

1. Stop the CA instance. For example:

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Open the **CS.cfg** file.

```
vim /var/lib/pki/instance_name/conf/ca/CS.cfg
```

3. Change the ***ca.maxSearchReturns*** line to set the number of entries to return. The default is 1000.

```
# maxSearchReturns - limits number of search results returned by
SearchReqs and SrchCerts

ca.maxSearchReturns=1000
```

4. Start the CA instance. For example:

```
systemctl start pki-tomcatd@instance_name.service
```

The **web.xml** file provides more control over the results settings:

- For one thing, both the number of results and the time limit for searches can be set, as opposed to
- Additionally, each interface — admin, agents, and end-entities — can be configured with a different result limit and time limit.
- Each operation can be configured with a different result limit and time limit. This means that searching for certificate requests can have different search limits than searching for certificates or CRLs.

The two parameters in the **web.xml** file which set the search limits are **maxResults** and **timeLimits**. These parameters are added as **<param-value>** lines to a servlet entry. Either one or both can be set for each entry.

Each servlet entry is identified in **<servlet-name>** tags and the interface (web services pages) that the servlet is used for is identified in the **<param-name>interface</param-name>** parameter.

Example 13.1, “web.xml Search Limit Settings” shows the setting for a time limit for searching for requests in the agent interface and the setting for a maximum number of results limit for the listing certificates search in the end-entities interface.

Example 13.1. web.xml Search Limit Settings

```
      <servlet-name>  casearchReqs  </servlet-name>
...
             <init-param><param-name>  interface  </param-name>
                        <param-value> agent      </param-value>
</init-param>
...
             <init-param><param-name>  timeLimits  </param-name>
                        <param-value> 10 </param-value> </init-param>
```

```
     <servlet-name>  caListCerts  </servlet-name>
...
             <init-param><param-name>  interface   </param-name>
                         <param-value> ee          </param-value>
</init-param>
             <init-param><param-name>  maxResults  </param-name>
                         <param-value> 1000 </param-value> </init-
param>
```

13.4.5. Setting SSL Session Timeouts

All of the PKI subsystem instances have a default SSL session timeout period of 30 minutes. This timeout removes data from the session cache when the timeout period (meaning, the inactive period) is reached, which decreases the ability of unauthorized users to access that information.

Each CA, KRA, OCSP, TKS, and TPS instance has its own Tomcat service which powers its web services pages. The configuration for the web services is in the **/usr/share/pki/*subsystem_type*/webapps/*subsystem_type*/WEB-INF/web.xml** file in the **<session-timeout>** tag.

To change the session timeout for a particular instance, follow the instructions in Section 13.4.1, “Customizing Subsystem Web Applications”, stop the instance, edit the appropriate **web.xml** file(s), and restart the instance.

13.5. Running Subsystems under a Java Security Manager

Java services have the option of having a Security Manager which defines unsafe and safe operations for applications to perform. When the subsystems are installed, they have the Security Manager enabled automatically, meaning each Tomcat instance starts with the Security Manager running.

13.5.1. About the Security Manager Policy Files

When the five Java subsystems (the CA, OCSP, KRA, TKS, and TPS) run within the Java Security Manager, they use a combination of three sets of policies:

- The **catalina.policy** file from the default Tomcat policy located in the **/usr/share/tomcat/conf** directory; this is updated whenever the general Tomcat files are updated.
- A **pki.policy** file, in the **/var/lib/pki/*instance_name*/conf** directory, that is supplied with the subsystem instance.
- A **custom.policy** file, in the **/var/lib/pki/*instance_name*/conf** directory, that contains user-defined security policies.

These three files are concatenated together whenever the Tomcat service starts to create a revised **catalina.policy** file, also in the **/var/lib/pki/*instance_name*/conf** directory, which is used for the instance.

The default **pki.policy** file contains permissions that grant unrestricted access to the Tomcat, LDAP, and symkey services used by the PKI subsystems. For example:

```
    // These permissions apply to Tomcat java as utilized by PKI
instances
   grant codeBase "file:/usr/share/java/tomcat/-" {
        permission java.security.AllPermission;
    };
```

The **custom.policy** file is empty by default; administrators can write policies in that file which will be used in addition to the given PKI policies and Tomcat policies.

13.5.2. Starting a Subsystem Instance without the Java Security Manager

All Java subsystems configured under a PKI Tomcat instance are automatically run under a Java Security Manager (unless the instance was created by overriding **pki_security_manager=true** under the [Tomcat] section in the **/etc/pki/default.cfg** file). However, it is possible to start or restart an instance and run it *without* starting the Java Security Manager, as shown below.

Procedure 13.1. Starting an Instance Without the Java Security Manager

1. Stop the instance.

   ```
   # systemctl stop pki-tomcatd@instance_name.service
   ```

2. Edit the **/etc/sysconfig/*instance_name*** file and turn off the security manager:

   ```
   SECURITY_MANAGER="false"
   ```

3. Start the instance.

   ```
   # systemctl start pki-tomcatd@instance_name.service
   ```

13.6. Configuring the LDAP Database

The Certificate System performs certificate- and key-management functions in response to the requests it receives. These functions include the following:

- Storing and retrieving certificate requests
- Storing and retrieving certificate records
- Storing CRLs
- Storing ACLs
- Storing privileged user and role information
- Storing and retrieving end users' encryption private key records

To fulfill these functions, the Certificate System is incorporated with a Red Hat Directory Server, referred to as the *internal database* or *local database*. The Directory Server is referenced as part of the Certificate System configuration; when the Certificate System subsystem is configured, a new database is created within the Directory Server. This database is used as an embedded database exclusively by the Certificate System instance and can be managed using directory management tools that come with the Directory Server.

The Certificate System instance database is listed with the other Directory Server databases in the *serverRoot*/**slapd-***DS_name*/**db/** directory. These databases are named by the value determined by the value of the **pki_ds_database** variable under the specified subsystem section within the **/etc/pki/default.cfg** file (*CS_instance_name-CA*, *CS_instance_name-KRA*, *CS_instance_name-OCSP*, *CS_instance_name-TKS*, and *CS_instance_name-TPS* by default), which is the default format given during the instance configuration. For example, for a Certificate Manager named **ca1**, the database name would be **ca1-CA**. Similarly, the database name is determined by the value of the **pki_ds_base_dn** variable under the specified subsystem section within the **/etc/pki/default.cfg** file ((o=CS_instance_name-CA, o=CS_instance_name-KRA, o=CS_instance_name-OCSP, o=CS_instance_name-TKS, or o=CS_instance_name-TPS by default), and is also set during the configuration.

The subsystems use the database for storing different objects. A Certificate Manager stores all the data, certificate requests, certificates, CRLs, and related information, while a KRA only stores key records and related data.

Warning

The internal database schema are configured to store only Certificate System data. Do not make any changes to it or configure the Certificate System to use any other LDAP directory. Doing so can result in data loss.

Additionally, do not use the internal LDAP database for any other purpose.

13.6.1. Changing the Internal Database Configuration

To change the Directory Server instance that a subsystem instance uses as its internal database:

1. Log into the subsystem administrative console.

   ```
   pkiconsole https://server.example.com:admin_port/subsystem_type
   ```

2. In the **Configuration** tab, select the **Internal Database** tab.

3. Change the Directory Server instance by changing the hostname, port, and bind DN fields.

   The hostname is the fully qualified hostname of the machine on which the Directory Server is installed, such as **certificates.example.com**. The Certificate System uses this name to access the directory.

   By default, the hostname of the Directory Server instance used as the internal database is shown as **localhost** instead of the actual hostname. This is done to insulate the internal database from being visible outside the system since a server on **localhost** can only be accessed from the local machine. Thus, the default configuration minimizes the risk of someone connecting to this Directory Server instance from outside the local machine.

The hostname can be changed to something other than **localhost** if the visibility of the internal database can be limited to a local subnet. For example, if the Certificate System and Directory Server are installed on separate machines for load balancing, specify the hostname of the machine in which the Directory Server is installed.

The port number is the TCP/IP port used for non-SSL communications with the Directory Server.

The DN should be the Directory Manager DN. The Certificate System subsystem uses this DN when it accesses the directory tree to communicate with the directory.

4. Click **Save**.

   The configuration is modified. If the changes require restarting the server, a prompt appears with that message. In that case, restart the server.

13.6.2. Enabling SSL/TLS Client Authentication with the Internal Database

Client authentication allows one entity to authenticate to another entity by presenting a certificate. This method of authentication is used by Certificate System agents to log into agent services pages, for example.

To use an SSL/TLS connection between a Certificate System instance and the LDAP directory instance that it uses as its internal database, client authentication must be enabled to allow the Certificate System instance to authenticate and bind to the LDAP directory.

There are two parts to setting up client authentication. The first is configuring the LDAP directory, such as setting up SSL/TLS and setting ACIs to control the Certificate System instance access. The second is creating a user on the Certificate System instance which it will use to bind to the LDAP directory and setting up its certificate.

To configure LDAPS for a PKI instance, see the pkispawn(8) man page (Example: Installing a PKI subsystem with a secure LDAP connection).

13.6.3. Restricting Access to the Internal Database

The Red Hat Directory Server Console displays an entry or icon for the Directory Server instance that the Certificate System uses as its internal database.

Unlike the Certificate System Console, in which access is restricted to users with Certificate System administrator privileges, the Directory Server Console can be accessed by any user. The user can open the Directory Server Console for the internal database and change to the data stored there, such as deleting users from the Certificate System administrators group or adding his own entry to the group.

Access can be restricted to the internal database to only those users who know the Directory Manager DN and password. This password can be changed by modifying the single sign-on password cache.

1. Log into the Directory Server Console.

2. Select the Certificate System internal database entry, and click **Open**.

3. Select the **Configuration** tab.

4. In the navigation tree, expand **Plug-ins**, and select **Pass-Through Authentication**.

5. In the right pane, deselect the **Enable plugin** checkbox.

6. Click **Save**.

   The server prompts to restart the server.

7. Click the **Tasks** tab, and click **Restart the Directory Server**.

8. Close the Directory Server Console.

9. When the server is restarted, open the Directory Server Console for the internal database instance.

   The **Login to Directory** dialog box appears; the **Distinguished Name** field displays the Directory Manager DN; enter the password.

   The Directory Server Console for the internal database opens only if the correct password is entered.

13.7. Viewing Security Domain Configuration

A *security domain* is a registry of PKI services. PKI services, such as CAs, register information about themselves in these domains so users of PKI services can find other services by inspecting the registry. The security domain service in Certificate System manages both the registration of PKI services for Certificate System subsystems and a set of shared trust policies.

The security domain manages the trust relationships between subsystems automatically, so if a TPS, TKS, and KRA are within the same security domain, they can communicate securely.

> **Note**
>
> The security domain is used during subsystem configuration. When a subsystem is being set up, it can check the security domain registry to see available instances. If it needs to create a trusted relationship with another instance — like a TPS which uses a TKS and KRA for its operations — then the security domain is used to create a TPS agent user on the selected TKS and KRA instances.

The registry provides a complete view of all PKI services provided by the subsystems within that domain. Each Certificate System subsystem must be either a host or a member of a security domain.

Only a CA can host and manage a security domain. Each CA has its own LDAP entry, and the security domain is an organizational group underneath that CA entry:

```
ou=Security Domain,dc=example,dc=com
```

Then there is a list of each subsystem type beneath the security domain organizational group, with a special object class (**pkiSecurityGroup**) to identify the group type:

```
cn=KRAList,ou=Security Domain,dc=example,dc=com
objectClass: top
objectClass: pkiSecurityGroup
cn: KRAList
```

Each subsystem instance is then stored as a member of that group, with a special **pkiSubsystem**object class to identify the entry type:

```
dn: cn=server.example.com:8443,cn=KRAList,ou=Security
Domain,dc=example,dc=com
objectClass: top
objectClass: pkiSubsystem
cn: kra.example.com:8443
host: server.example.com
SecurePort: 8443
SecureAgentPort: 8443
SecureAdminPort: 8443
UnSecurePort: 8080
DomainManager: false
Clone: false
SubsystemName: KRA server.example.com 8443
```

13.8. Managing the SELinux Policies for Subsystems

SELinux is a collection of mandatory access control rules which are enforced across a system to restrict unauthorized access and tampering. For more information about SELinux, see the SELinux User's and Administrator's Guide.

13.8.1. About SELinux

Basically, SELinux identifies *objects* on a system, which can be files, directories, users, processes, sockets, or any other thing on a Linux host. These objects correspond to the Linux API objects. Each object is then mapped to a *security context*, which defines the type of object it is and how it is allowed to function on the Linux server.

System processes run within SELinux domains. Each domain has a set of rules that defines how the SELinux domain interacts with other SELinux objects on the system. This set of rules, then, determines which resources a process may access and what operations it may perform on those resources.

For Certificate System, each subsystem type runs within a specific domain for that subsystem type. Every instance of that subsystem type belongs to the same SELinux domain, regardless of how many instances are on the system For example, if there are three CAs installed on a server, all three belong to the **http_port_t** SELinux domain.

The rules and definitions for all the subsystems comprise the overall Certificate System SELinux policy. Certificate System SELinux policies are already configured when the subsystems are installed, and all SELinux policies are updated every time a subsystem is added with **pkispawn** or removed with **pkidestroy**.

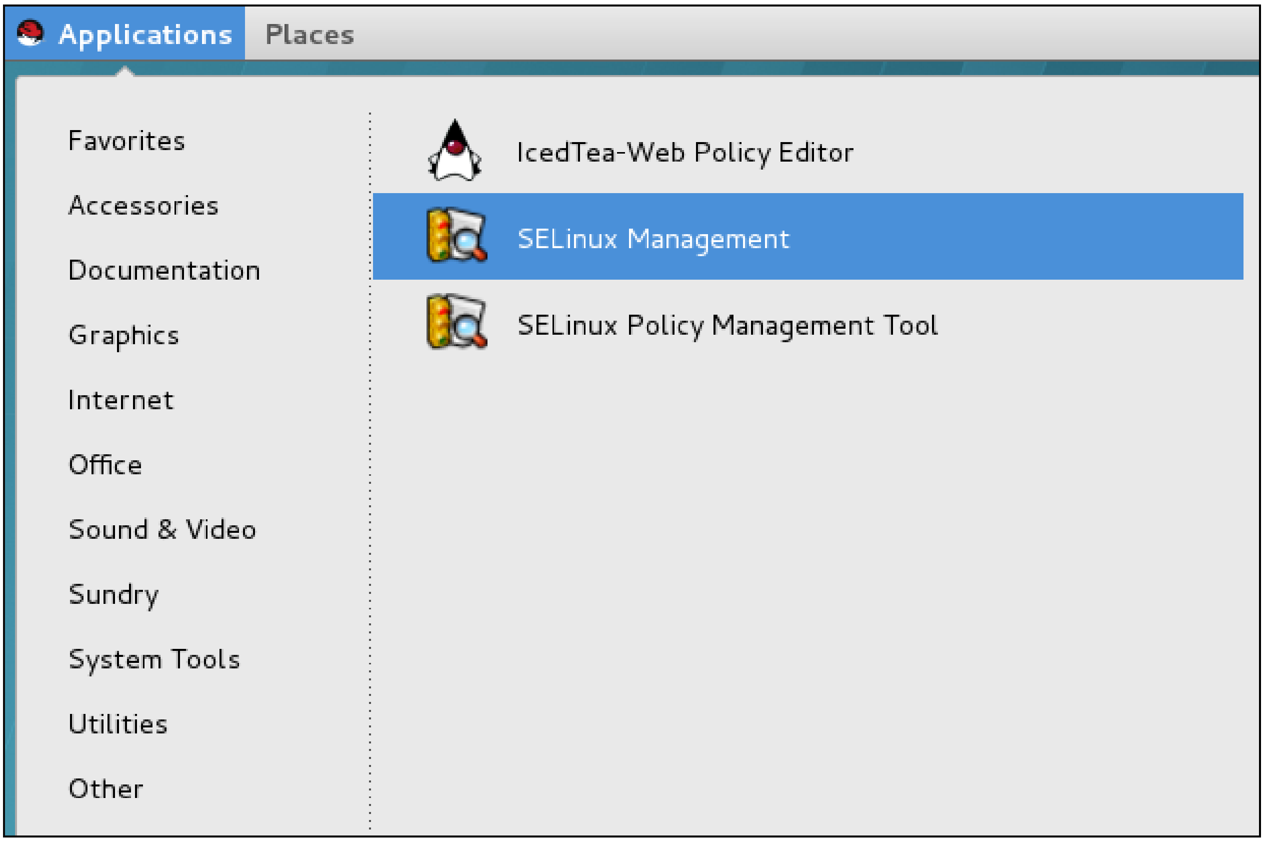
The Certificate System subsystems run with SELinux set in enforcing mode, meaning that Certificate System operations can be successfully performed even when all SELinux rules are required to be followed.

By default, the Certificate System subsystems run confined by SELinux policies.

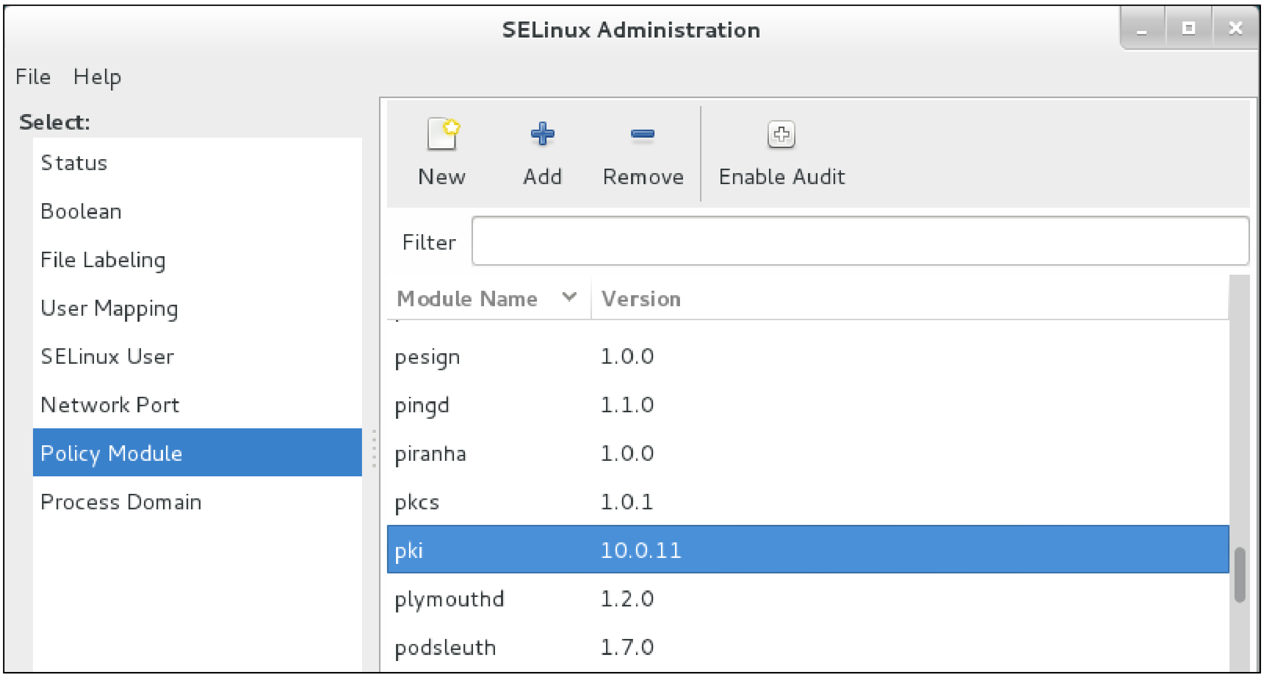
13.8.2. Viewing SELinux Policies for Subsystems

All Certificate System policies are are part of the system SELinux policy. The configured policies can be viewed using the SELinux Administration GUI, which you can get by installing the *policycoreutils-gui* package.

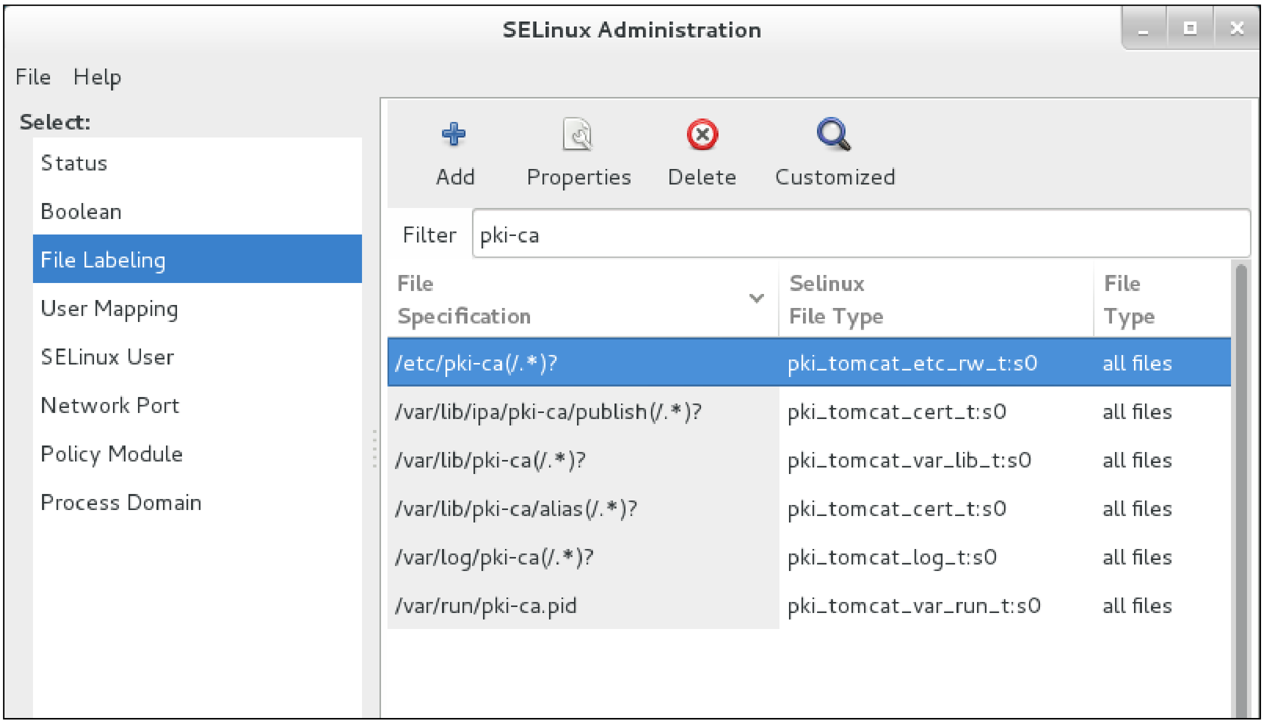
1. Either run the **`system-config-selinux`** command or open the utility by accessing **Applications** → **Other** → **SELinux Management** for the main system menu.



2. To check the version of the Certificate System SELinux policy installed, click the **`Policy Module`** section in the left bar.



3. To view the policies set on the individual files and processes, click the **File Labeling** section. To view the policies for the port assignments for the subsystems, click the **Network Port** section.



13.8.3. Relabeling nCipher netHSM Contexts

The nCipher netHSM software does not come with its own SELinux policy, so the Certificate System contains a default netHSM policy, shown in Example 13.2, "netHSM SELinux Policy".

Example 13.2. netHSM SELinux Policy

```
# default labeling for nCipher
/opt/nfast/scripts/init.d/(.*)
gen_context(system_u:object_r:initrc_exec_t,s0)
/opt/nfast/sbin/init.d-ncipher
gen_context(system_u:object_r:initrc_exec_t,s0)
/opt/nfast(/.*)?
gen_context(system_u:object_r:pki_common_t, s0)
/dev/nfast(/.*)?
gen_context(system_u:object_r:pki_common_dev_t,0)
```

Other rules allow the **pki_*_t** domain to talk to files that are labeled **pki_common_t** and **pki_common_dev_t**.

If any of the nCipher configuration is changed (even if it is in the default directory, **/opt/nfast**), run the **restorecon** to make sure all files are properly labeled:

```
restorecon -R /dev/nfast
restorecon -R /opt/nfast
```

If the nCipher software is installed in a different location or if a different HSM is used, the default Certificate System HSM policy needs to be relabelled using **semanage**.

13.9. Backing up and Restoring Certificate System

Backup and restore tools are not included with the Certificate System. However, the Certificate System components can still be archived and restored manually, and this can be necessary for deployments where information cannot be accessed if certificate or key information is lost. There are three major parts of the Certificate System which need backed up routinely in case of data loss or hardware failure:

- *Internal database.* Subsystems use an LDAP database to store their data. The Directory Server provides its own back up scripts and procedures.
- *Security databases.* The security databases store the certificate and key material. If these are stored on an HSM, then consult the HSM vendor documentation for information on how to back up the data. If the information is stored in the default directories in the instance **alias** directory, then it is backed up with the instance directory. To back it up separately, use a utility such as **tar** or **zip**.
- *Instance directory.* The instance directory contains all configuration files, security databases, and other instance files. This can be backed up using a utility such as **tar** or **zip**.

13.9.1. Backing up and Restoring the LDAP Internal Database

The Red Hat Directory Server documentation contains more details information on backing up and restoring the databases.

There are two tools that are used to back up Directory Server instance: **db2ldif** and **db2bak** command. Using **db2ldif** with the **-n** option backs up a single, specific subsystem database.

```
db2ldif -n slapd-pki-ca1 -a pki-ca1-backup.ldif
```

Using **db2bak** command backs up all Certificate System subsystem databases for that Directory Server (and any other databases maintained by that Directory Server instance):

```
db2bak /my/backup/directory
```

To restore an LDIF file, use the **ldif2db** command to import the LDIF. It is possible to specify a single database to restore from the backup.

```
ldif2db -n slapd-pki-ca1 -i pki-ca1-backup.ldif
```

To restore a backup file, use the **bak2db** file; it is possible to specify a single database to restore from the backup.

```
bak2db /var/lib/dirsrv/slapd-instance_name/bak/backup_file -n slapd-pki-ca1
```

13.9.2. Backing up and Restoring the Instance Directory

The instance directory has all of the configuration information for the subsystem instance, so backing up the instance directory preserves the configuration information not contained in the internal database.

1. Stop the subsystem instance.

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Save the directory to a compressed file. For example:

```
cd /var/lib/pki

tar -chvf /export/archives/pki/instance_name.tar instance_name/
```

3. Restart the subsystem instance.

```
systemctl start instance_name
```

Note

Stop the subsystem instance before backing up the instance or the security databases.

The Certificate System backup files, both the **alias** database backups and the full instance directory backups, can be used to replace the current directories if the data are corrupted or hardware is damaged. To restore the data, uncompress the archive file using the **unzip** or **tar** tool, and copy the archive over the existing files.

To restore the instance directory:

1. Uncompress the archive; for example, untar a ***instance_name*** directory archive:

```
cd /export/archives/pki/

tar -xvf instance_name.tar
```

2. Stop the subsystem instance if it has not already been stopped.

```
systemctl stop pki-tomcatd@instance_name.service
```

3. Copy the archived files to the directory. For example, restore the instance directory:

```
cp -r /export/archives/pki/instance_name
/var/lib/pki/instance_name
```

4. Restart the subsystem instance.

```
systemctl start pki-tomcatd@instance_name.service
```

Note

Stop the subsystem instance before restoring the instance or the security databases.

13.10. Running Self-Tests

The Certificate System has the added functionality to allow self-tests of the server. The self-tests are run at start up and can also be run on demand. The startup self-tests run when the server starts and keep the server from starting if a critical self-test fails. The on-demand self-tests are run by clicking the self-tests button in the subsystem console.

13.10.1. Running Self-Tests

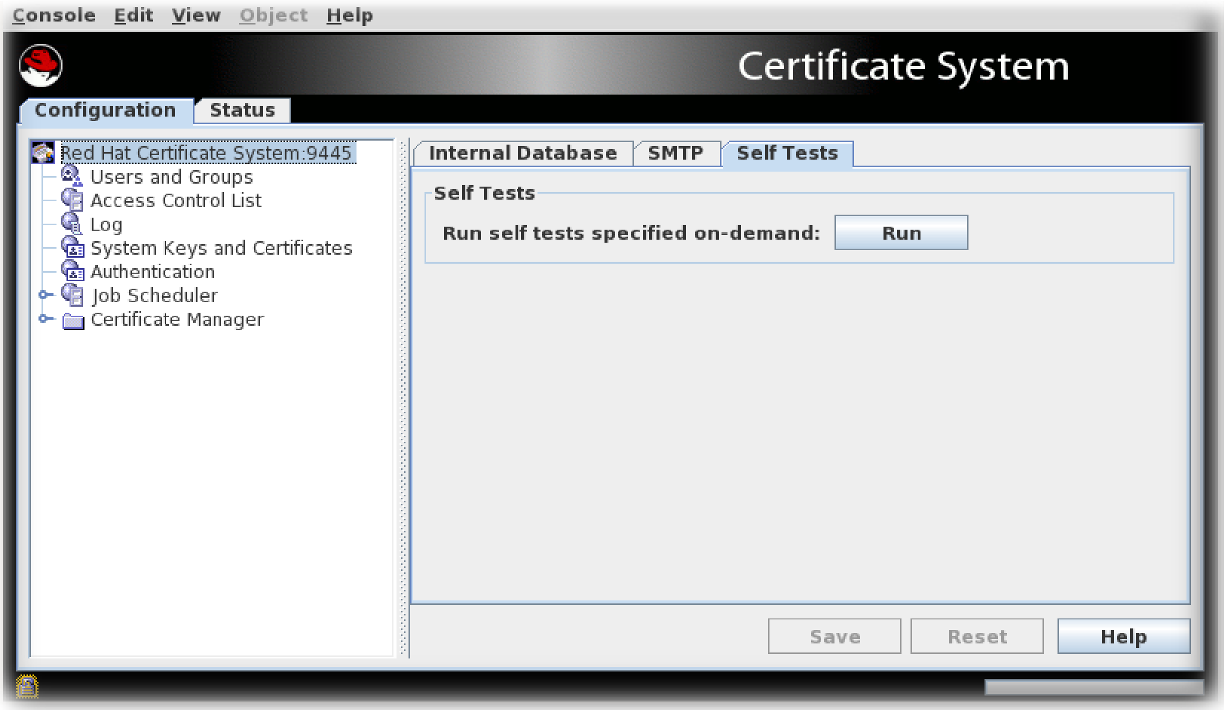
The on-demand self-test for the CA, OCSP, KRA, or TKS subsystems are run from the console. The on-demand self-tests for the TPS system are run from the web services page.

13.10.1.1. Running Self-Tests from the Console

1. Log into the Console.

```
pkiconsole https://server.example.com:admin_port/subsystem_type
```

2. Select the subsystem name at the top of the left pane.



3. Select the **Self Tests** tab.

4. Click **Run**.

The self-tests that are configured for the subsystem will run. If any critical self-tests fail, the server will stop.

5. The **On-Demand Self Tests Results** window appears, showing the logged events for this run of the self-tests.

13.10.1.2. Running TPS Self-Tests

To run TPS self-tests from the command-line interface (CLI):

- **pki tps-selftest-find**
- **pki tps-selftest-run**
- **pki tps-selftest-show**

13.10.2. Self-Test Logging

A separate log, **selftest.log**, is added to the log directory that contains reports for both the start up self-tests and the on-demand self-tests. This log is configured by changing the setting for the log in the **CS.cfg** file. See Section 13.10.4, “Modifying Self-Test Configuration” for details.

13.10.3. Configuring Self-Tests

The self-tests feature and individual self-tests are registered and configured in the **CS.cfg** file. If a self-test is enabled, that self-test is listed for either on-demand or start up and is either empty or set as **critical**.

Critical self-tests have a colon and the word **critical** after the name of the self-test. Otherwise, nothing is in this place. The server shuts down when a critical self-test fails during on demand self-tests; the server will not start when a critical self-test fails during start up.

The implemented self-tests are automatically registered and configured when the instance was installed. The self-tests that are registered and configured are those associated with the subsystem type.

Self-tests are turned off or the criticality is changed by changing those setting in the **CS.cfg** file. To turn a self-test off, remove is from the list of self-tests.

13.10.4. Modifying Self-Test Configuration

To modify the configuration settings for self-tests:

1. Stop the subsystem instance.
2. Open the **CS.cfg** file located in the instance's **conf/** directory.
3. To edit the settings for the self-test log, edit the entries that begin with **selftests.container.logger**. These include the following parameters:
   - **bufferSize** — Specify the buffer size in kilobytes (KB) for the log. The default size is 512 KB. For more information, see Section 15.2.1.3, “Buffered and Unbuffered Logging”. Once the buffer reaches this size, the contents of the buffer are flushed out and copied to the log file.

- **enable** — Specify **true** to enable; **false** to disable. Only enabled logs actually record events.
- **fileName** — Specify the full path, including the filename, to the file to write messages. The server must have read/write permission to the file.
- **flushInterval** — Specify the interval, in seconds, to flush the buffer to the file. The default interval is 5 seconds. The **flushInterval** is the amount of time before the contents of the buffer are flushed out and added to the log file.
- **level** — The default selection is 1; this log is not set up for any level beside 1.
- **maxFileSize** — Specify the file size in kilobytes (KB) for the error log. The default size is 100 KB. The **maxFileSize** determines how large a log file can become before it is rotated. Once it reaches this size, the file is copied to a rotated file, and a new log file is started. For more information, see Section 15.2.1.4, “Log File Rotation”.
- **register** — If this variable is set to **false** (the default value), the self-test messages are only logged to the log file specified by **selftests.container.logger.fileName**. If this variable is set to **true**, then the self-test messages are written to both the log file specified by **selftests.container.logger.fileName** and the log file specified by **log.instance.Transactions.fileName**.
- **rolloverInterval** — Specify the frequency at which the server rotates the active error log file. The choices are hourly, daily, weekly, monthly, and yearly. The default selection is monthly. For more information, see Section 15.2.1.4, “Log File Rotation”.
- **type** — Set to **transaction**; do not change this.

4. To edit the order in which the self-test are run, specify the order by listing any of the self-test as the value of the following parameters separated by a comma and a space.

   To mark a self-test critical, add a colon and the word critical to the name of the self-test in the list.

   To disable a self-test, remove it as the value of either the **selftests.container.order.onDemand** or **selftests.container.order.startup** parameters.

5. Save the file.

6. Start the subsystem.

13.11. Configuring POSIX System ACLs

POSIX system access control rules provide finer granularity over system user permissions. These ACLs must be set for each instance after it is fully configured. For more details on ACLs, see the corresponding chapter in the Red Hat Enterprise Linux Storage Administration Guide.

13.11.1. Setting POSIX System ACLs for the CA, KRA, OCSP, TKS, and TPS

Modern file systems like ext4 and XFS enable ACLs by default, and are most likely used on modern Red Hat Enterprise Linux installations.

1. Stop the instance.

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Set the group readability to the pkiadmin group for the instance's directories and files.

```
# setfacl -R -L -m g:pkiadmin:r,d:g:pkiadmin:r
/var/lib/pki/instance_name
```

3. Apply execute (x) ACL permissions on all directories:

```
# find -L /var/lib/pki/instance_name -type d -exec setfacl -L -n -
m g:pkiadmin:rx,d:g:pkiadmin:rx {} \;
```

4. Remove group readability for the pkiadmin group from the instance's signedAudit/ directory and its associated files:

```
# setfacl -R -L -x g:pkiadmin,d:g:pkiadmin
/var/lib/pki/instance_name/logs/signedAudit
```

5. Set group readability for the pkiaudit group for the instance's signedAudit/ directory and its associated files:

```
# setfacl -R -L -m g:pkiaudit:r,d:g:pkiaudit:r
/var/lib/pki/instance_name/logs/signedAudit
```

6. Re-apply execute (x) ACL permissions on the signedAudit/ directory and all of its subdirectories:

```
# find -L /var/lib/pki/instance_name/logs/signedAudit -type d -
exec setfacl -L -n -m g:pkiaudit:rx,d:g:pkiaudit:rx {} \;
```

7. Start the instance.

```
systemctl start pki-tomcatd@instance_name.service
```

8. Confirm that the file access controls were properly applied by using the **getfacl** command to show the current ACL settings:

```
# getfacl /var/lib/pki/instance_name
/var/lib/pki/instance_name/logs/signedAudit/
getfacl: Removing leading '/' from absolute path names
# file: var/lib/pki/instance_name
# owner: pkiuser
# group: pkiuser
user::rwx
group::rwx
group:pkiadmin:r-x
mask::rwx
```

```
other::r-x
default:user::rwx
default:group::rwx
default:group:pkiadmin:r-x
default:mask::rwx
default:other::r-x

# file: var/lib/pki/instance_name/logs/signedAudit
# owner: pkiuser
# group: pkiaudit
user::rwx
group::rwx
group:pkiaudit:r-x
mask::rwx
other::---
default:user::rwx
default:group::rwx
default:group:pkiaudit:r-x
default:mask::rwx
default:other::---
```

Chapter 14. Managing Certificate System Users and Groups

This chapter explains how to set up authorization for access to the administrative, agent services, and end-entities pages.

14.1. About Authorization

Authorization is the process of allowing access to certain tasks associated with the Certificate System. Access can be limited to allow certain tasks to certain areas of the subsystem for certain users or groups and different tasks to different users and groups.

Users are specific to the subsystem in which they are created. Each subsystem has its own set of users independent of any other subsystem installed. The users are placed in groups, which can be predefined or user-created. Privileges are assigned to a group through *access control lists* (ACLs). There are ACLs associated with areas in the administrative console, agent services interface, and end-entities page that perform an authorization check before allowing an operation to proceed. *Access control instructions* (ACIs) in each of the ACLs are created that specifically allow or deny possible operations for that ACL to specified users, groups, or IP addresses.

The ACLs contain a default set of ACIs for the default groups that are created. These ACIs can be modified to change the privileges of predefined groups or to assign privileges to newly-created groups.

Authorization goes through the following process:

1. The users authenticate to the interface using either the Certificate System user ID and password or a certificate.

2. The server authenticates the user either by matching the user ID and password with the one stored in the database or by checking the certificate against one stored in the database. With certificate-based authentication, the server also checks that the certificate is valid and finds the group membership of the user by associating the DN of the certificate with a user and checking the user entry. With password-based authentication, the server checks the password against the user ID and then finds the group membership of the user by associating that user ID with the user ID contained in the group.

3. When the user tries to perform an operation, the authorization mechanism compares the user ID of the user, the group in which the user belongs, or the IP address of the user to the ACLs set for that user, group, or IP address. If an ACL exists that allows that operation, then the operation proceeds.

14.2. Default Groups

A user's privileges are determined by the group membership of the user. The default subsystem setting allows users to belong to more than one group. The following groups are created by default:

- *Administrators.* This group is given full access to all of the tasks available in the administrative interface.

- *Agents.* This group is given full access to all of the tasks available in the agent services interface.

- *Auditors.* This group is given access to view the signed audit logs. This group does not have any other privileges.
- *Enterprise administrators.* Each subsystem instance is automatically assigned a subsystem-specific role as an enterprise administrator when it is joined to a security domain during configuration. These roles automatically provide trusted relationships among subsystems in the security domain, so that each subsystem can efficiently carry out interactions with other subsystems.

14.2.1. Administrators

Administrators have permissions to perform all administrative tasks. A user is designated or identified as being an administrator by being added to the **`Administrators`** group for the group. Every member of that group has administrative privileges for that instance of Certificate System.

At least one administrator must be defined for each Certificate System instance, but there is no limit to the number of administrators an instance can have. The first administrator entry is created when the instance is configured.

Administrators are authenticated with a simple bind using their Certificate System user ID and password.

Table 14.1. Security Domain User Roles

Role	Description
Security Domain Administrators	• Add and modify users in the security domain's user and group database. • Manage the shared trust policies. • Manage the access controls on the domain services. By default, the CA administrator of the CA hosting the domain is assigned as the security domain administrator.
Enterprise CA Administrators	• Automatically approve any sub-CA, server, and subsystem certificate from any CA in the domain. • Register and unregister CA subsystem information in the security domain.
Enterprise KRA Administrators	• Automatically approve any transport, storage, server, and subsystem certificate from any CA in the domain. • Register and unregister KRA subsystem information in the security domain. • Push KRA connector information to any CA.

Role	Description
Enterprise OCSP Administrators	- Automatically approve any OCSP, server, and subsystem certificate from any CA in the domain. - Register and unregister OCSP subsystem information in the security domain. - Push CRL publishing information to any CA.
Enterprise TKS Administrators	- Automatically approve any server and subsystem certificate from any CA in the domain. - Register and unregister TKS subsystem information in the security domain.
Enterprise TPS Administrators	- Automatically approve any server and subsystem certificate from any CA in the domain. - Register and unregister TPS subsystem information in the security domain.

As necessary, the security domain administrator can manage access controls on the security domain and on the individual subsystems. For example, the security domain administrator can restrict access so that only finance department KRA administrators can set up finance department KRAs.

Enterprise subsystem administrators are given enough privileges to perform operations on the subsystems in the domain. For example, an enterprise CA administrator has the privileges to have sub-CA certificates approved automatically during configuration. Alternatively, a security domain administrator can restrict this right if necessary.

14.2.2. Auditors

An auditor can view the signed audit logs and is created to audit the operation of the system. The auditor cannot administer the server in any way.

An auditor is created by adding a user to the **`Auditors`** group and storing the auditor's certificate in the user entry. The auditor's certificate is used to encrypt the private key of the key pair used to sign the audit log.

The **`Auditors`** group is set when the subsystem is configured. No auditors are assigned to this group during configuration.

Auditors are authenticated into the administrative console with a simple bind using their UID and password. Once authenticated, auditors can only view the audit logs. They cannot edit other parts of the system.

14.2.3. Agents

Agents are users who have been assigned end-entity certificate and key-management privileges. Agents can access the agent services interface. For a complete list of agent tasks, see the *Certificate System Agents Guide*.

Agents are created by assigning a user to the appropriate subsystem agent group and identifying certificates that the agents must use for SSL client authentication to the subsystem for it to service requests from the agents. Each subsystem has its own agent group:

- The Certificate Manager Agents group.
- The Key Recovery Authority Agents group.
- The Online Certificate Status Manager Agents group.
- The Token Key Service Agents group.
- The Token Processing System Agents group.

Each Certificate System subsystem has its own agents with roles defined by the subsystem. Each subsystem must have at least one agent, but there is no limit to the number of agents a subsystem can have.

Certificate System identifies and authenticates a user with agent privileges by checking the user's SSL client certificate in its internal database.

14.2.4. Enterprise Groups

During subsystem configuration, every subsystem instance is joined to a security domain. Each subsystem instance is automatically assigned a subsystem-specific role as an enterprise administrator. These roles automatically provide trusted relationships among subsystems in the security domain, so that each subsystem can efficiently carry out interactions with other subsystems. For example, this allows OCSPs to push CRL publishing publishing information to all CAs in the domain, KRAs to push KRA connector information, and CAs to approve certificates generated within the CA automatically.

Enterprise subsystem administrators are given enough privileges to perform operations on the subsystems in the domain. Each subsystem has its own security domain role:

- Enterprise CA Administrators
- Enterprise KRA Administrators
- Enterprise OCSP Administrators
- Enterprise TKS Administrators
- Enterprise TPS Administrators

Additionally, there is a Security Domain Administrators group for the CA instance which manages the security domain, access control, users, and trust relationships within the domain.

Each subsystem administrator authenticates to the other subsystems using SSL client authentication with the subsystem certificate issued during configuration by the security domain CA.

14.3. Disabling Multi-Roles Support

By the default, users can belong to more than one subsystem group at once, allowing the user to act as more than one role. For example, John Smith could belong to both an agent and an administrator group. However, for highly secure environments, the subsystem roles should be restricted so that a user can only belong to one role. This can be done by disabling the ***multirole*** attribute in the instance's configuration.

For all subsystems:

1. Stop the server:

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Open the **CS.cfg** file:

```
vim /var/lib/pki/instance_name/ca/conf/CS.cfg
```

3. Change the ***multiroles.enable*** parameter value from **true** to **false**.

4. Restart the server:

```
systemctl start pki-tomcatd@instance_name.service
```

14.4. Managing Users and Groups for a CA, OCSP, KRA, or TKS

Many of the operations that users can perform are dictated by the groups that they belong to; for instance, agents for the CA manage certificates and profiles, while administrators manage CA server configuration.

Four subsystems — the CA, OCSP, KRA, and TKS — use the Java administrative console to manage groups and users. The TPS has web-based admin services, and users and groups are configured through its web service page.

14.4.1. Managing Groups

14.4.1.1. Creating a New Group

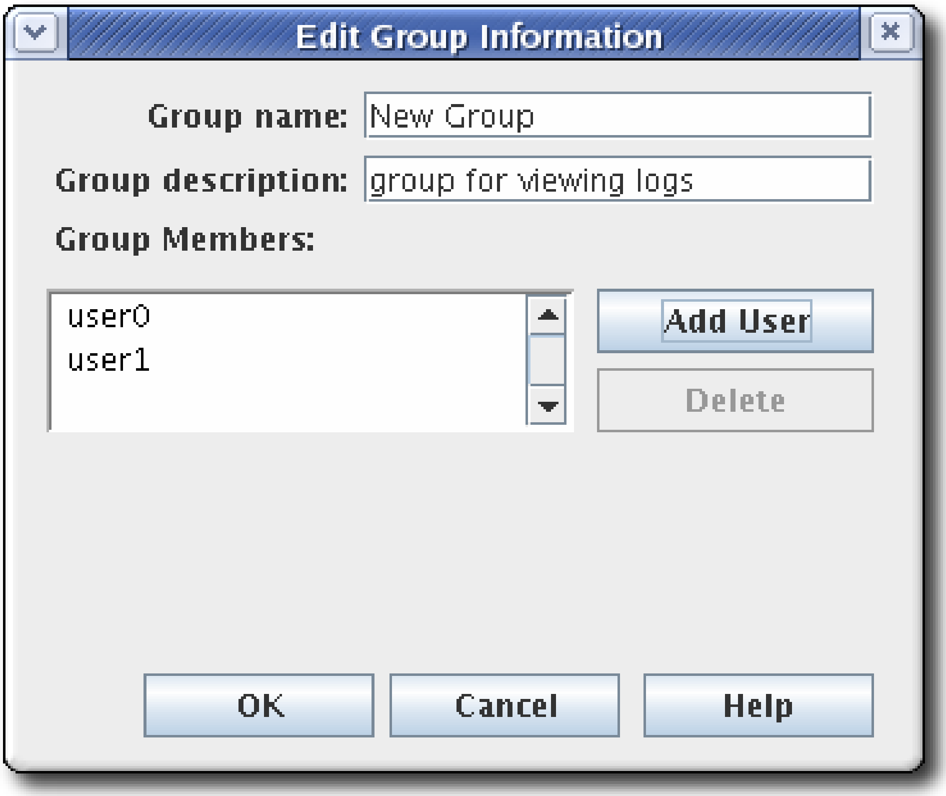
1. Log into the administrative console.

```
pkiconsole https://server.example.com:8443/subsystem_type
```

2. Select **Users and Groups** from the navigation menu on the left.

3. Select the **Groups** tab.

4. Click **Edit**, and fill in the group information.



It is only possible to add users who already exist in the internal database.

5. Edit the ACLs to grant the group privileges. See Section 14.6.3, “Editing ACLs” for more information. If no ACls are added to the ACLs for the group, the group will have no access permissions to any part of Certificate System.

14.4.1.2. Changing Members in a Group

Members can be added or deleted from all groups. The group for administrators must have at least one user entry.

1. Log into the administrative console.
2. Select **Users and Groups** from the navigation tree on the left.
3. Click the **Groups** tab.
4. Select the group from the list of names, and click **Edit**.
5. Make the appropriate changes.
   - To change the group description, type a new description in the **Group description** field.
   - To remove a user from the group, select the user, and click **Delete**.
   - To add users, click **Add User**. Select the users to add from the dialog box, and click **OK**.

14.4.2. Managing Users (Administrators, Agents, and Auditors)

The users for each subsystem are maintained separately. Just because a person is an administrator in one subsystem does not mean that person has any rights (or even a user entry) for another subsystem. Users can be configured and, with their user certificates, trusted as agents, administrators, or auditors for a subsystem.

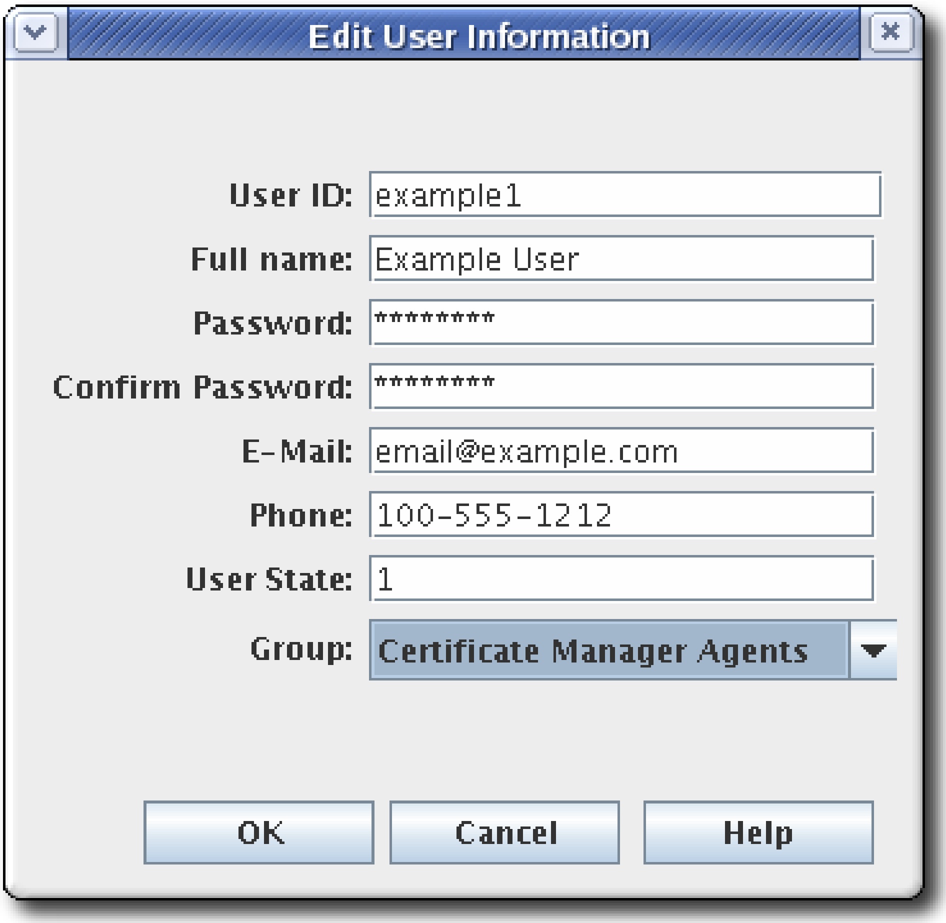
14.4.2.1. Creating Users

1. Log into the administrative console.

```
pkiconsole https://server.example.com:8443/subsystem_type
```

2. In the **Configuration** tab, select **Users and Groups**. Click **Add**.

3. Fill in the information in the **Edit User Information** dialog.



   Most of the information is standard user information, such as the user's name, email address, and password. This window also contains a field called **User State**, which can contain any string, which is used to add additional information about the user; most basically, this field can show whether this is an active user.

4. Select the group to which the user will belong. The user's group membership determines what privileges the user has. Assign agents, administrators, and auditors to the appropriate subsystem group.

5. Store the user's certificate.

   a. Request a user certificate through the CA end-entities service page.

   b. If auto-enrollment is not configured for the user profile, then approve the certificate request.

c. Retrieve the certificate using the URL provided in the notification email, and copy the base-64 encoded certificate to a local file or to the clipboard.

d. Select the new user entry, and click **Certificates**.

e. Click **Import**, and paste in the base-64 encoded certificate.

14.4.2.2. Changing a Certificate System User's Certificate

1. Log into the administrative console.
2. Select **Users and Groups**.
3. Select the user to edit from the list of user IDs, and click **Certificates**.
4. Click **Import** to add the new certificate.
5. In the **Import Certificate** window, paste the new certificate in the text area. Include the **-----BEGIN CERTIFICATE-----** and **-----END CERTIFICATE-----** marker lines.

14.4.2.3. Renewing Administrator, Agent, and Auditor User Certificates

There are two methods of renewing a certificate. *Regenerating* the certificate takes its original key and its original profile and request, and recreates an identical key with a new validity period and expiration date. *Re-keying* a certificate resubmits the initial certificate request to the original profile, but generates a new key pair. Administrator certificates can be renewed by being re-keyed.

Each subsystem has a default administrative user that was created at the time the subsystem was created. A new certificate can be requested for this user before their original one expires, using one of the default renewal profiles.

Certificates for administrative users can be renewed directly in the end user enrollment forms, using the serial number of the original certificate.

1. Renew the admin user certificates in the CA's end users forms, as described in Section 4.7.2, "Certificate-Based Renewal". This must be the same CA as first issued the certificate (or a clone of it).

   Agent certificates can be renewed by using the certificate-based renewal form in the end entities page. **Self-renew user SSL client certificate**. This form recognizes and updates the certificate stored in the browser's certificate store directly.

   > **Note**
   >
   > It is also possible to renew the certificate using **certutil**, as described in Section 16.3.3, "Renewing Certificates Using certutil". Rather than using the certificate stored in a browser to initiate renewal, **certutil** uses an input file with the original key.

2. Add the renewed user certificate to the user entry in the internal LDAP database.

   a. Open the console for the subsystem.

```
pkiconsole
https://server.example.com:admin_port/subsystem_type
```

b. Configuration | Users and Groups | Users | admin | Certificates | Import

c. In the **Configuration** tab, select **Users and Groups**.

d. In the **Users** tab, double-click the user entry with the renewed certificate, and click **Certificates**.

e. Click **Import**, and paste in the base-64 encoded certificate.

This can also be done by using **ldapmodify** to add the renewed certification directly to the user entry in the internal LDAP database, by replacing the ***userCertificate*** attribute in the user entry, such as **uid=admin,ou=people,dc=***subsystem-base-DN*.

14.4.2.4. Deleting a Certificate System User

Users can be deleted from the internal database. Deleting a user from the internal database deletes that user from all groups to which the user belongs. To remove the user from specific groups, modify the group membership.

Delete a privileged user from the internal database by doing the following:

1. Log into the administrative console.
2. Select **Users and Groups** from the navigation menu on the left.
3. Select the user from the list of user IDs, and click **Delete**.
4. Confirm the delete when prompted.

14.4.3. Preventing Users from Belonging to Multiple Roles

Each group is configured to perform one of three *roles*: administrator, agent, or auditor. There may be multiple groups in the same role, but there are only those three roles for users of a subsystem.

In many security contexts, it is critical for users to belong to only one type of role (even if they belong to multiple groups). An auditor, for example, should never belong to an administrator or agent group. By default, Certificate System allows users to belong to multiple roles, but this behavior can be restricted by disabling multi-roles and by setting the list of roles which are controlled by the multi-roles setting.

1. Stop the instance.

   ```
   systemctl stop pki-tomcatd@instance_name.service
   ```

   Always stop a subsystem before editing the subsystem configuration files.

2. Open the **CS.cfg** file.

   ```
   vim /var/lib/pki/instance_name/subsystem_name/conf/CS.cfg
   ```

3. Add or edit the ***multiroles.enable*** parameter to set whether to allow users to belong to multiple roles. For security, disable multi-roles by setting the value to **false**.

```
multiroles.enable=false
```

4. Add or edit the list of default roles in Certificate System that are affected by the multi-roles setting. If multi-roles is disabled and a user belongs to *one* of the roles listed in the ***multiroles.false.groupEnforceList*** parameter, then the user cannot be added to any group for any of the other roles in the list.

```
multiroles.false.groupEnforceList=Administrators,Auditors,Trusted
Managers,Certificate Manager Agents,Registration Manager
Agents,Key Recovery Authority Agents,Online Certificate Status
Manager Agents,Token Key Service Manager Agents,Enterprise CA
Administrators,Enterprise KRA Adminstrators,Enterprise OCSP
Administrators,Enterprise RA Administrators,Enterprise TKS
Administrators,Enterprise TPS Administrators,Security Domain
Administrators,Subsystem Group
```

5. Start the instance.

```
systemctl start pki-tomcatd@instance_name.service
```

14.5. Creating and Managing Users for a TPS

There are three defined *roles* for TPS users, which function as groups for the TPS:

- *Agents*, who perform actual token management operations, such setting the token status and changing token policies
- *Administrators*, who manage users for the TPS subsystem and have limited control over tokens
- *Operators*, who have no management control but are able to view and list tokens, certificates, and activities performed through the TPS

Additional groups cannot be added for the TPS.

All of the TPS subsystem users are authenticated against an LDAP directory database that contains their certificate (because accessing the TPS's web services requires certificate-based authentication), and the authentication process checks the TPS group entries — **ou=TUS Agents**, **ou=TUS Administrators**, and **ou=TUS Operators** — to see to which roles the user belongs, using Apache's **mod_tokendb** module.

Users for the TPS are added and managed through the Web UI or the CLI. The Web UI is accessible at **https://*server.example.com*:8443/tps/ui/**.

To use the Web UI or the CLI, the TPS administrator has to authenticate using a user certificate.

14.5.1. Listing and Searching for Users

14.5.1.1. From the Web UI

To list users from the Web UI:

1. Click the **Accounts** tab.
2. Click the **Users** menu item. The list of users appears on the page.
3. To search for certain users, write the keyword in the search field and press **Enter**. To list all users again, remove the keyword and press **Enter**.

14.5.1.2. From the Command Line

To list users from the CLI, run:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-user-find
```

To view user details from the CLI, run:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-user-show username
```

14.5.2. Adding Users

14.5.2.1. From the Web UI

To add a user from the Web UI:

1. Click the **Accounts** tab.
2. Click the **Users** menu item.
3. Click the **Add** button on the **Users** page.
4. Fill in the user ID, full name, and TPS profile.
5. Click the **Save** button.

14.5.2.1.1. From the Command Line

To add a user from the CLI, run:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-user-add username --fullName full_name
```

14.5.3. Setting Profiles for Users

A TPS profile is much like a CA profile; it defines rules for processing different types of tokens. The profile is assigned automatically to a token based on some characteristic of the token, like the CUID. Users can only see tokens for the profiles which are assigned to them.

> **Note**
>
> A user can only see entries relating to the profile configured for it, including both token operations and tokens themselves. For an administrator to be able to search and manage all tokens configured in the TPS, the administrator user entry should be set to **`All profiles`**. Setting specific profiles for users is a simple way to control access for operators and agents to specific users or token types.

Token profiles are sets of policies and configurations that are applied to a token. Token profiles are mapped to tokens automatically based on some kind of attribute in the token itself, such as a CCUID range. Token profiles are created as other certificate profiles (as in Section 2.4.2, “Creating Custom TPS Profiles”) in the CA profile directory and are then added to the TPS configuration file, **`CS.cfg`**, to map the CA's token profile to the token type. Configuring token mapping is covered in Section 5.2.2, “Mapping Token Types to Smart Card Operation Policies”.

To manage user profiles from the Web UI:

1. Click the **`Accounts`** tab.
2. Click the **`Users`** menu item.
3. Click the user name of the user you want to modify.
4. Click the **`Edit`** link.
5. In the **`TPS Profile`** field, enter the profile names separated by commas, or enter **`All Profiles`**.
6. Click the **`Save`** button.

14.5.4. Managing User Roles

A role is just a group within the TPS. Each role can view different tabs of the TPS services pages. The group is editable, so it is possible to add and remove role assignments for a user.

A user can belong to more than one role or group. The default admin user, for example, belongs to all three groups.

14.5.4.1. From the Web UI

To manage group members from the Web UI:

1. Click the **`Accounts`** tab.
2. Click the **`Groups`** menu item.
3. Click the name of the group that you want to change, for example TPS Agents.
4. To add a user to this group:
   a. Click the **`Add`** button.
   b. Enter the user ID.
   c. Click the **`Add`** button.

5. To remove a user from this group:

   a. Select the check box next to the user.

   b. Click the **Remove** button.

   c. Click the **OK** button.

14.5.4.2. From the Command Line

To list groups from the CLI, run:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-
group-find
```

To list group members from the CLI, run:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-
group-member-find group_name
```

To add a user to a group from the CLI, run:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-
group-member-add group_name user_name
```

To delete a user from a group from the CLI, run:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-
group-member-del group_name user_name
```

14.5.5. Managing User Certificates

User certificates can be managed from the CLI:

- To list user certificates, run:

  ```
  pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-
  user-cert-find user_name
  ```

- To add a certificate to a user:

  1. Obtain a user certificate for the new user. Requesting and submitting certificates is explained in Chapter 4, *Requesting, Enrolling, and Managing Certificates*.

     Important

     A TPS administrator must have a signing certificate. The recommended profile to use is Manual User Signing and Encryption Certificates Enrollment.

  2. Run the following command:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname
tps-user-cert-add user_name --serial cert_serial_number
```

- To remove a certificate from a user, run:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-
user-cert-del user_name cert_id
```

14.5.6. Renewing TPS Agent and Administrator Certificates

Regenerating the certificate takes its original key and its original profile and request, and recreates an identical key with a new validity period and expiration date.

The TPS has a default administrative user that was created at the time the subsystem was created. A new certificate can be requested for this user when their original one expires, using one of the default renewal profiles.

Certificates for administrative users can be renewed directly in the end user enrollment forms, using the serial number of the original certificate.

1. Renew the user certificates through the CA's end users forms, as described in Section 4.7.2, “Certificate-Based Renewal”. This must be the same CA as first issued the certificate (or a clone of it).

   Agent certificates can be renewed by using the certificate-based renewal form in the end entities page, **Self-renew user SSL client certificate**. This form recognizes and updates the certificate stored in the browser's certificate store directly.

   > **Note**
   >
   > It is also possible to renew the certificate using **certutil**, as described in Section 16.3.3, “Renewing Certificates Using certutil”. Rather than using the certificate stored in a browser to initiate renewal, **certutil** uses an input file with the original key.

2. Add the new certificate to the user and remove the old certificate as described in Section 14.5.5, “Managing User Certificates”.

14.5.7. Deleting Users

> **Warning**
>
> It is possible to delete the *last* user account, and the operation cannot be undone. Be very careful about the user which is selected to be deleted.

To delete users from the Web UI:

1. Click the **Accounts** tab.

2. Click the **Users** menu item.

3. Select the check box next to the users to be deleted.
4. Click the **Remove** button.
5. Click the **OK** button.

To delete a user from the CLI, run:

```
pki -d client_db_dir -c client_db_password -n admin_cert_nickname tps-
user-del user_name
```

14.6. Configuring Access Control for Users

Authorization is the mechanism that checks whether a user is allowed to perform an operation. Authorization points are defined in certain groups of operations that require an authorization check.

14.6.1. About Access Control

Access control lists (ACLs) are the mechanisms that specify the authorization to server operations. An ACL exists for each set of operations where an authorization check occurs. Additional operations can be added to a ACL.

The ACL contains *access control instructions* (ACIs) which specifically allow or deny operations, such as read or modify. The ACI also contains an evaluator expression. The default implementation of ACLs specifies only users, groups, and IP addresses as possible evaluator types. Each ACI in an ACL specifies whether access is allowed or denied, what the specific operator is being allowed or denied, and which users, groups, or IP addresses are being allowed or denied to perform the operation.

The privileges of Certificate System users are changed by changing the access control lists (ACL) that are associated with the group in which the user is a member, for the users themselves, or for the IP address of the user. New groups are assigned access control by adding that group to the access control lists. For example, a new group for administrators who are only authorized to view logs, **LogAdmins**, can be added to the ACLs relevant to logs to allow read or modify access to this group. If this group is not added to any other ACLs, members of this group only have access to the logs.

The access for a user, group, or IP address is changed by editing the ACI entries in the ACLs. In the ACL interface, each ACI is shown on a line of its own. In this interface window, the ACI has the following syntax:

```
allow|deny (operation) user|group|IP="name"
```

Note

The IP address can be an IPv4 or IPv6 address. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*.

For example, the following is an ACI that allows administrators to perform read operations:

```
allow (read) group="Administrators"
```

An ACI can have more than one operation or action configured. The operations are separated with a comma with no space on either side. For example:

```
allow (read,modify) group="Administrators"
```

An ACI can have more than one group, user, or IP address by separating them with two pipe symbols (**||**) with a space on either side. For example:

```
allow (read) group="Administrators" || group="Auditors"
```

The administrative console can create or modify ACIs. The interface sets whether to allow or deny the operation in the **Allow and Deny** field, sets which operations are possible in the **Operations** field, and then lists the groups, users, or IP addresses being granted or denied access in the **Syntax** field.

An ACI can either allow or deny an operation for the specified group, user ID, or IP address. Generally, ACIs do not need to be created to deny access. If there are no allow ACIs that include a user ID, group, or IP address, then the group, user ID, or IP address is denied access.

> **Note**
>
> If a user is not explicitly allowed access to any of the operations for a resource, then this user is considered denied; he does not specifically need to be denied access.

For example, user JohnB is a member of the **Administrators** group. If an ACL has only the following ACL, JohnB is denied any access since he does not match any of the allow ACIs:

```
Allow (read,modify) group="Auditors" || user="BrianC"
```

There usually is no need to include a deny statement. Some situations can arise, however, when it is useful to specify one. For example, **JohnB**, a member of the **Administrators** group, has just been fired. It may be necessary to deny access specifically to **JohnB** if the user cannot be deleted immediately. Another situation is that a user, **BrianC**, is an administrator, but he should not have the ability to change some resource. Since the **Administrators** group must access this resource, **BrianC** can be specifically denied access by creating an ACI that denies this user access.

The allowed rights are the operations which the ACI controls, either by allowing or denying permission to perform the operation. The actions that can be set for an ACL vary depending on the ACL and subsystem. Two common operations that can be defined are read and modify.

The syntax field of the ACI editor sets the evaluator for the expression. The evaluator can specify group, name, and IP address (both IPv4 and IPv6 addresses). These are specified along with the name of the entity set as equals (**=**) or does not equal (**!=**).

The syntax to include a group in the ACL is **group="groupname"**. The syntax to exclude a group is **group!="groupname"**, which allows any group except for the group named. For example:

```
group="Administrators" || group!="Auditors"
```

It is also possible to use regular expressions to specify the group, such as using wildcard characters like an asterisk (*). For example:

```
group="* Managers"
```

For more information on supported regular expression patterns, see http://java.sun.com/j2se/1.4.2/docs/api/java/util/regex/Pattern.html#sum.

The syntax to include a user in the ACL is **user="userID"**. The syntax to exclude the user is **user!="userID"**, which allows any user ID except for the user ID named. For example:

```
user="BobC" || user!="JaneK"
```

To specify all users, provide the value **anybody**. For example:

```
user="anybody"
```

It is also possible to use regular expressions to specify the user names, such as using wildcard characters like an asterisk (*). For example:

```
user="*johnson"
```

For more information on supported regular expression patterns, see http://java.sun.com/j2se/1.4.2/docs/api/java/util/regex/Pattern.html#sum.

The syntax to include an IP address in the ACL is **ipaddress="ipaddress"**. The syntax to exclude an ID address from the ACL is **ipaddress!="ipaddress"**. An IP address is specified using its numeric value; DNS values are not permitted. For example:

```
ipaddress="12.33.45.99"
ipaddress!="23.99.09.88"
```

The IP address can be an IPv4 address, as shown above, or IPv6 address. An IPv4 address has the format *n.n.n.n* or *n.n.n.n,m.m.m.m* with the netmask. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example:

```
ipaddress="0:0:0:0:0:0:13.1.68.3"
```

It is also possible to use regular expressions to specify the IP address, such as using wildcard characters like an asterisk (*). For example:

```
ipaddress="12.33.45.*"
```

For more information on supported regular expression patterns, see http://java.sun.com/j2se/1.4.2/docs/api/java/util/regex/Pattern.html#sum.

It is possible to create a string with more than one value by separating each value with two pipe characters (||) with a space on either side. For example:

```
user="BobC" || group="Auditors" || group="Administrators"
```

14.6.2. Changing the Access Control Settings for the Subsystem

By default, access control rules are applied by evaluating deny rules first and then by evaluating allow rules. To change the order, change the ***authz.evaluateOrder*** parameter in the **CS.cfg**.

```
authz.evaluateOrder=deny,allow
```

Additionally, access control rules can be evaluated from the local **web.xml** file (basic ACLs) or more complex ACLs can be accessed by checking the LDAP database. The ***authz.sourceType*** parameter identifies what type of authorization to use.

```
authz.sourceType=web.xml
```

> **Note**
>
> Always restart the subsystem after editing the **CS.cfg** file to load the updated settings.

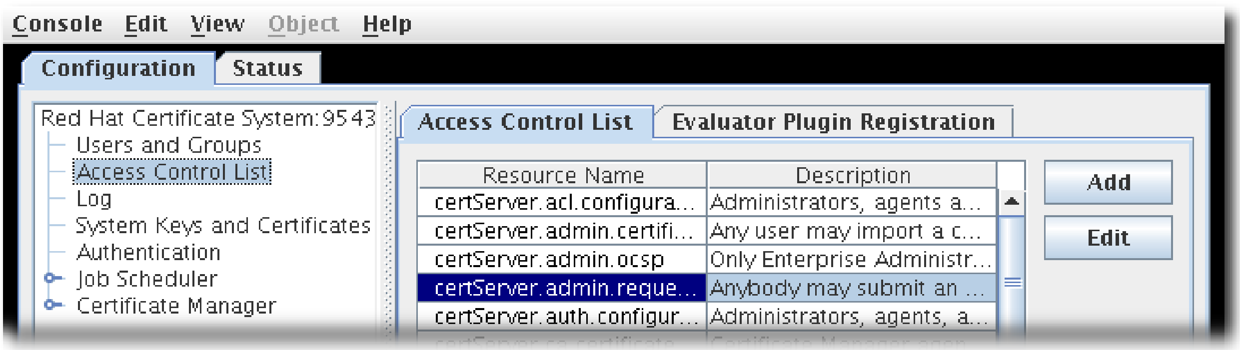
14.6.3. Editing ACLs

ACLs are stored in the internal database and can only be modified in the administrative console.

To edit the existing ACLs:

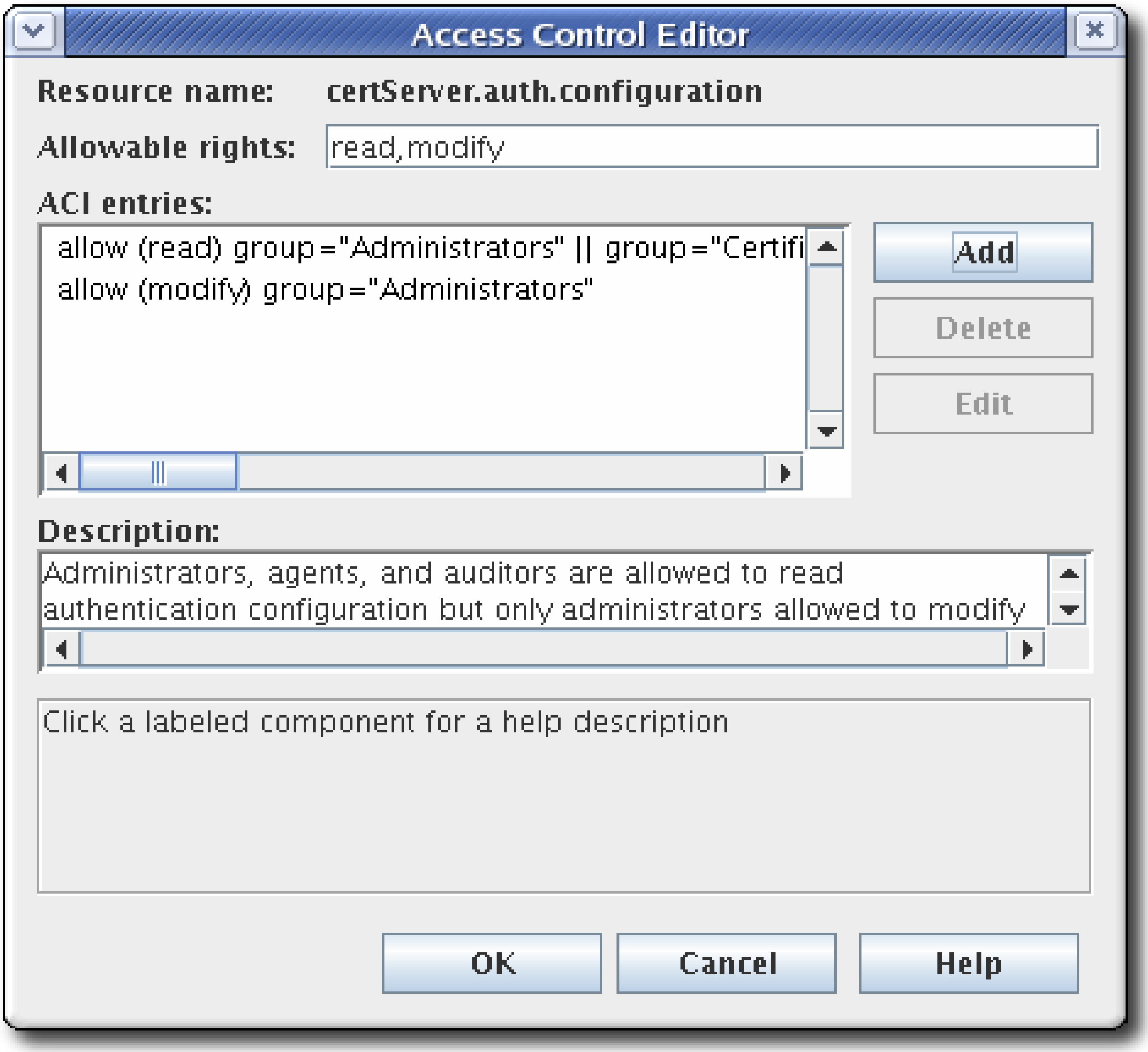
1. Log into the administrative console.

2. Select **Access Control List** in the left navigation menu.



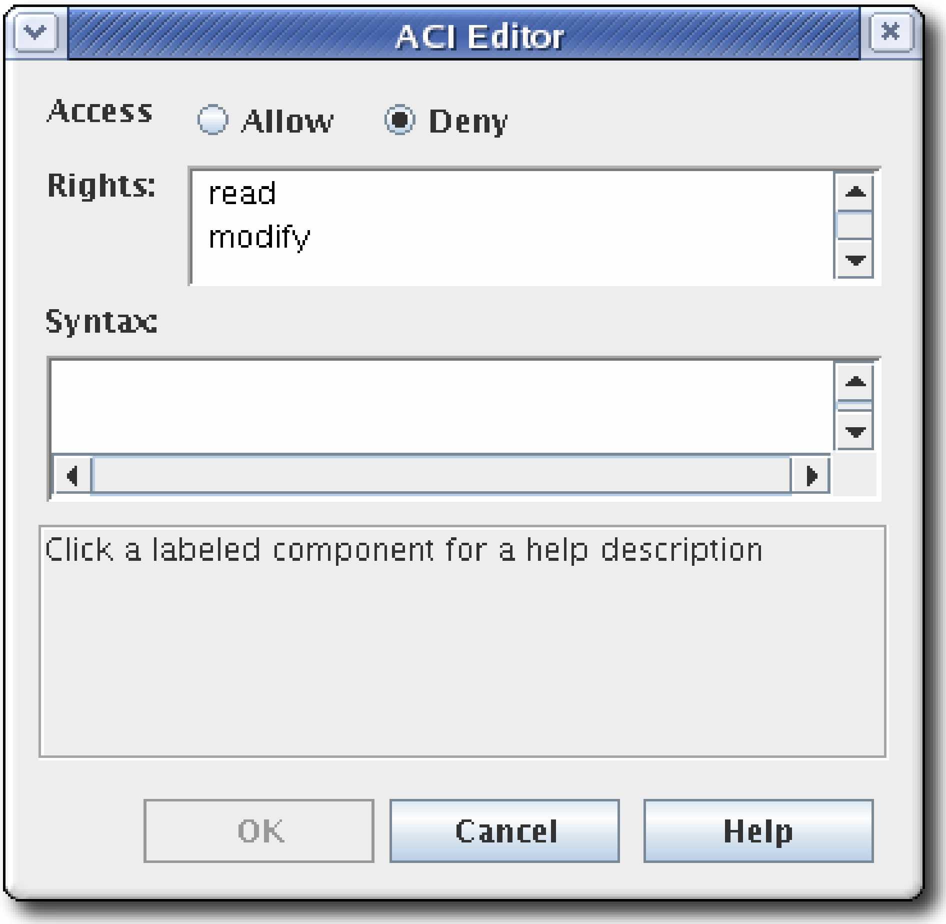
3. Select the ACL to edit from the list, and click **Edit**.

   The ACL opens in the **Access Control Editor** window.



4. To add an ACI, click **Add**, and supply the ACI information.

   To edit an ACI, select the ACI from the list in the **ACI entries** text area of the **ACL Editor** window. Click **Edit**.



a. Select the allow or deny radio button from the **Access** field to allow or deny the operation to the groups, users, or IP addresses specified. For more information about allowing or denying access, see Section 14.6.1, "About Access Control".

b. Set the rights for the access control. The options are **read** and **modify**. To set both, use the **Ctrl** or **Shift** buttons.

c. Specify the user, group, or IP address that will be granted or denied access in the **Syntax** field. See Section 14.6.1, "About Access Control" for details on syntax.

Chapter 15. Configuring Subsystem Logs

The Certificate System subsystems create log files that record events related to activities, such as administration, communications using any of the protocols the server supports, and various other processes employed by the subsystems. While a subsystem instance is running, it keeps a log of information and error messages on all the components it manages. Additionally, the Apache and Tomcat web servers generate error and access logs.

Each subsystem instance maintains its own log files for installation, audit, and other logged functions.

Log plug-in modules are listeners which are implemented as Java™ classes and are registered in the configuration framework.

All the log files and rotated log files, except for audit logs, are located in whatever directory was specified in **pki_subsystem_log_path** when the instance was created with **pkispawn**. Regular audit logs are located in the log directory with other types of logs, while signed audit logs are written to **/var/log/pki/*instance_name*/*subsystem_name*/signedAudit**. The default location for logs can be changed by modifying the configuration.

15.1. About Certificate System Logs

Certificate System subsystems keep several different kinds of logs, which provide specific information depending on the type of subsystem, types of services, and individual log settings. The kinds of logs that can be kept for an instance depend on the kind of subsystem that it is.

15.1.1. System Log

Subsystem logs are kept for the CA, OCSP, KRA, and TKS subsystems.

This log, **system**, records information about requests to the server (all HTTP and HTTPS requests) and the responses from the server. Information recorded in this log includes the IP address (both IPv4 and IPv6) of the client machine that accessed the server; operations performed, such as search, add, and edit; and the result of the access, such as the number of entries returned:

```
id_number processor - [date:time] [number_of_operations] [result]
servlet: message
```

Example 15.1. TKS System Log

```
10439.http-13443-Processor25 - [19/May/2016:14:16:51 CDT] [11] [3]
UGSubsystem: Get User Error User not found
```

This log is on by default.

15.1.2. Transactions Log

Transaction logs are kept for the CA, OCSP, KRA, and TKS subsystems.

This log, **transactions**, records any kind of operation performed or submitted to the subsystem.

```
id_number.processor - [date:time] [number_of_operations] [result]
servlet: message
```

These messages are specific to the certificate service, such as the CA receiving certificate requests, the KRA archiving or retrieving keys, and the TKS registering a new TPS. This log can also be used to detect any unauthorized access or activity.

Example 15.2. Transactions Log

```
11438.http-8443-Processor25 - [27/May/2016:07:56:18 CDT] [1] [1]
archival reqID 4 fromAgent agentID: CA-server.example.com-8443
authenticated by noAuthManager is completed DN requested:
UID=recoverykey,E=recoverykey@email.com,CN=recover key serial number:
0x3
```

This log is on by default.

15.1.3. Debug Logs

Debug logs are maintained for all five subsystems, with varying degrees and types of information.

Debug logs for each subsystem record much more detailed information than system, transaction, and access logs. Debug logs contain very specific information for every operation performed by the subsystem, including plug-ins and servlets which are run, connection information, and server request and response messages.

The general types of services which are recorded to the debug log are briefly discussed in Section 15.2.1.1, “Services That Are Logged”. These services include authorization requests, processing certificate requests, certificate status checks, and archiving and recovering keys, and access to web services.

The debug logs for the CA, OCSP, KRA, and TKS record detailed information about the processes for the subsystem. Each log entry has the following format:

```
[date:time] [processor]: servlet: message
```

The *message* can be a return message from the subsystem or contain values submitted to the subsystem.

For example, the TKS records this message for connecting to an LDAP server:

```
[10/Jun/2016:05:14:51][main]: Established LDAP connection using basic
authentication to host localhost port 389 as cn=Directory Manager
```

The *processor* is **main**, and the *message* is the message from the server about the LDAP connection, and there is no servlet.

The CA, on the other hand, records information about certificate operations as well as subsystem connections:

```
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.requestowner$ value=KRA-server.example.com-8443
```

In this case, the *processor* is the HTTP protocol over the CA's agent port, while it specifies the servlet for handling profiles and contains a *message* giving a profile parameter (the subsystem owner of a request) and its value (that the KRA initiated the request).

Example 15.3. CA Certificate Request Log Messages

```
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.profileapprovedby$ value=admin
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.cert_request$
value=MIIBozCCAZ8wggEFAgQqTfoHMIHHgAECpQ4wDDEKMAgGA1UEAxMBeKaBnzANBgkq
hkiG9w0BAQEFAAOB...
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.profile$ value=true
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.cert_request_type$ value=crmf
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.requestversion$ value=1.0.0
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.req_locale$ value=en
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.requestowner$ value=KRA-server.example.com-8443
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.dbstatus$ value=NOT_UPDATED
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.subject$ value=uid=jsmith, e=jsmith@example.com
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.requeststatus$ value=begin
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.auth_token.user$ value=uid=KRA-server.example.com-
8443,ou=People,dc=example,dc=com
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.req_key$
value=MIGfMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQDreuEsBWq9WuZ2MaBwtNYxvkLP
^M
HcN0cusY7gxLzB+XwQ/VsWEoObGldg6WwJPOcBdvLiKKfC605wFdynbEgKs0fChV^M
k9HYDhmJ8hX6+PaquiHJSVNhsv5tOshZkCfMBbyxwrKd8yZ5G5I+2gE9PUznxJaM^M
HTmlOqm4HwFxzy0RRQIDAQAB
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.auth_token.authmgrinstname$ value=raCertAuth
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.auth_token.uid$ value=KRA-server.example.com-8443
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.auth_token.userid$ value=KRA-server.example.com-8443
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.requestor_name$ value=
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.profileid$ value=caUserCert
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.auth_token.userdn$ value=uid=KRA-server.example.com-
4747,ou=People,dc=example,dc=com
```

```
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.requestid$ value=20
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.auth_token.authtime$ value=1212782378071
[06/Jun/2016:14:59:38][http-8443;-Processor24]: ProfileSubmitServlet:
key=$request.req_x509info$
value=MIICIKADAgECAgEAMA0GCSqGSIb3DQEBBQUAMEAxHjAcBgNVBAoTFVJlZGJ1ZGNv
^M
bXB1dGVyIERvbWFpbjEeMBwGA1UEAxMVQ2VydGlmaWNhdGUgQXV0aG9yaXR5MB4X^M
DTA4MDYwNjE5NTkzOFoXDTA4MTIwMzE5NTkzOFowOzEhMB8GCSqGSIb3DQEJARYS^M
anNtaXRoQGV4YW1wbGUuY29tMRYwFAYKCZImiZPyLGQBARMGanNtaXRoMIGfMA0G^M
CSqGSIb3DQEBAQUAA4GNADCBiQKBgQDreuEsBWq9WuZ2MaBwtNYxvkLPHcN0cusY^M
7gxLzB+XwQ/VsWEoObGldg6WwJPOcBdvLiKKfC605wFdynbEgKs0fChVk9HYDhmJ^M
8hX6+PaquiHJSVNhsv5tOshZkCfMBbyxwrKd8yZ5G5I+2gE9PUznxJaMHTmlOqm4^M
HwFxzy0RRQIDAQABo4HFMIHCMB8GA1UdIwQYMBaAFG8gWeOJIMt+aO8VuQTMzPBU^M
78k8MEoGCCsGAQUFBwEBBD4wPDA6BggrBgEFBQcwAYYuaHR0cDovL3Rlc3Q0LnJl^M
ZGJ1ZGNvbXB1dGVyLmxvY2FsOjkwODAvY2Evb2NzcDAOBgNVHQ8BAf8EBAMCBeAw^M
HQYDVR0lBBYwFAYIKwYBBQUHAwIGCCsGAQUFBwMEMCQGA1UdEQQdMBuBGSRyZXF1^M
ZXN0LnJlcXVlc3Rvcl9lbWFpbCQ=
```

Likewise, the OCSP shows OCSP request information:

```
[07/Jul/2016:06:25:40][http-11180-Processor25]: OCSPServlet: OCSP
Request:
[07/Jul/2016:06:25:40][http-11180-Processor25]: OCSPServlet:
MEUwQwIBADA+MDwwOjAJBgUrDgMCGgUABBSEWjCarLE6/BiSiENSsV9kHjqB3QQU
```

15.1.4. Installation Logs

All subsystems keep an install log.

Every time a subsystem is created either through the initial installation or creating additional instances with **pkispawn**, an installation file with the complete debug output from the installation, including any errors and, if the installation is successful, the URL and PIN to the configuration interface for the instance. The file is created in the **/var/log/pki/** directory for the instance with a name in the form **pki-*subsystem_name*-spawn.*timestamp*.log**.

Each line in the install log follows a step in the installation process.

Example 15.4. CA Install Log

```
...
2015-07-22 20:43:13 pkispawn    : INFO     ... finalizing
'pki.server.deployment.scriptlets.finalization'
2015-07-22 20:43:13 pkispawn    : INFO     ....... cp -p
/etc/sysconfig/pki/tomcat/pki-tomcat/ca/deployment.cfg
/var/log/pki/pki-tomcat/ca/archive/spawn_deployment.cfg.20150722204136
2015-07-22 20:43:13 pkispawn    : DEBUG    ........... chmod 660
/var/log/pki/pki-tomcat/ca/archive/spawn_deployment.cfg.20150722204136
2015-07-22 20:43:13 pkispawn    : DEBUG    ........... chown
26445:26445 /var/log/pki/pki-
tomcat/ca/archive/spawn_deployment.cfg.20150722204136
```

```
2015-07-22 20:43:13 pkispawn    : INFO     ....... generating manifest
file called '/etc/sysconfig/pki/tomcat/pki-tomcat/ca/manifest'
2015-07-22 20:43:13 pkispawn    : INFO     ....... cp -p
/etc/sysconfig/pki/tomcat/pki-tomcat/ca/manifest /var/log/pki/pki-
tomcat/ca/archive/spawn_manifest.20150722204136
2015-07-22 20:43:13 pkispawn    : DEBUG    ........... chmod 660
/var/log/pki/pki-tomcat/ca/archive/spawn_manifest.20150722204136
2015-07-22 20:43:13 pkispawn    : DEBUG    ........... chown
26445:26445 /var/log/pki/pki-
tomcat/ca/archive/spawn_manifest.20150722204136
2015-07-22 20:43:13 pkispawn    : INFO     ....... executing
'systemctl enable pki-tomcatd.target'
2015-07-22 20:43:13 pkispawn    : INFO     ....... executing
'systemctl daemon-reload'
2015-07-22 20:43:13 pkispawn    : INFO     ....... executing
'systemctl restart pki-tomcatd@pki-tomcat.service'
2015-07-22 20:43:14 pkispawn    : INFO     END spawning subsystem 'CA'
of instance 'pki-tomcat'
2015-07-22 20:43:14 pkispawn    : DEBUG
```

15.1.5. Tomcat Error and Access Logs

The CA, KRA, OCSP, TKS, and TPS subsystems use a Tomcat web server instance for their agent and end-entities' interfaces.

Error and access logs are created by the Tomcat web server, which are installed with the Certificate System and provide HTTP services. The error log contains the HTTP error messages the server has encountered. The access log lists access activity through the HTTP interface.

Logs created by Tomcat:

- admin.*timestamp*
- catalina.*timestamp*
- catalina.out
- host-manager.*timestamp*
- localhost.*timestamp*
- localhost_access_log.*timestamp*
- manager.*timestamp*

These logs are not available or configurable within the Certificate System; they are only configurable within Apache or Tomcat. See the Apache documentation for information about configuring these logs.

15.1.6. Self-Tests Log

The self-tests log records information obtained during the self-tests run when the server starts or when the self-tests are manually run. The tests can be viewed by opening this log. This log is not configurable through the Console. This log can only be configured by changing settings in the **CS.cfg** file. The information about logs in this section does not pertain to this log. See Section 13.10, “Running Self-Tests” for more information about self-tests.

15.2. Managing Logs

The Certificate System subsystem log files record events related to operations within that specific subsystem instance. For each subsystem, different logs are kept for issues such as installation, access, and web servers.

All subsystems have similar log configuration, options, and administrative paths.

15.2.1. An Overview of Log Settings

The way that logs are configured can affect Certificate System performance. For example, log file rotation keeps logs from becoming too large, which slows down subsystem performance. This section explains the different kinds of logs recorded by Certificate System subsystems and covers important concepts such as log file rotation, buffered logging, and available log levels.

15.2.1.1. Services That Are Logged

All major components and protocols of Certificate System log messages to log files. Table 15.1, “Services Logged” lists services that are logged by default. To view messages logged by a specific service, customize log settings accordingly. For details, see Section 15.2.2, “Viewing Logs”.

Table 15.1. Services Logged

Service	Description
ACLs	Logs events related to access control lists.
Administration	Logs events related to administration activities, such as HTTPS communication between the Console and the instance.
All	Logs events related to all the services.
Authentication	Logs events related to activity with the authentication module.
Certificate Authority	Logs events related to the Certificate Manager.
Database	Logs events related to activity with the internal database.
HTTP	Logs events related to the HTTP activity of the server. Note that HTTP events are actually logged to the errors log belonging to the Apache server incorporated with the Certificate System to provide HTTP services.
Key Recovery Authority	Logs events related to the KRA.
LDAP	Logs events related to activity with the LDAP directory, which is used for publishing certificates and CRLs.
OCSP	Logs events related to OCSP, such as OCSP status GET requests.
Others	Logs events related to other activities, such as command-line utilities and other processes.
Request Queue	Logs events related to the request queue activity.
User and Group	Logs events related to users and groups of the instance.

15.2.1.2. Log Levels (Message Categories)

The different events logged by Certificate System services are determined by the log levels, which makes identifying and filtering events simpler. The different Certificate System log levels are listed in Table 15.2, “Log Levels and Corresponding Log Messages”.

Log levels are represented by numbers **0** to **10**, each number indicating the level of logging to be performed by the server. The level sets how detailed the logging should be.

A higher priority level means less detail because only events of high priority are logged.

Table 15.2. Log Levels and Corresponding Log Messages

Log level	Message category	Description
0	Debugging	These messages contain debugging information. This level is not recommended for regular use because it generates too much information.
1	Informational (default selection for audit log)	These messages provide general information about the state of the Certificate System, including status messages such as *Certificate System initialization complete* and *Request for operation succeeded*.
2	Warning	These messages are warnings only and do not indicate any failure in the normal operation of the server.
3	Failure; the default selection for system and error logs	These messages indicate errors and failures that prevent the server from operating normally, including failures to perform a certificate service operation (*User authentication failed* or *Certificate revoked*) and unexpected situations that can cause irrevocable errors (*The server cannot send back the request it processed for a client through the same channel the request came from the client*).
4	Misconfiguration	These messages indicate that a misconfiguration in the server is causing an error.
5	Catastrophic failure	These messages indicate that, because of an error, the service cannot continue running.
6	Security-related events	These messages identify occurrences that affect the security of the server. For example, **`Privileged access attempted by user with revoked or unlisted certificate`**.
7	PDU-related events (debugging)	These messages contain debugging information for PDU events. This level is not recommended for regular use because it generates more information than is normally useful.
8	PDU-related events	These messages relate transactions and rules processed on a PDU, such as creating MAC tokens.
9	PDU-related events	This log levels provides verbose log messages for events processed on a PDU, such as creating MAC tokens.
10	All logging levels	This log level enables all logging levels.

Log levels can be used to filter log entries based on the severity of an event. By default, log level 3 (Failure) is set for all services.

The log level is successive; specifying a value of 3 causes levels 4, 5, and 6 to be logged. Log data can be extensive, especially at lower (more verbose) logging levels. Make sure that the host machine has sufficient disk space for all the log files. It is also important to define the logging level, log rotation, and server-backup policies appropriately so that all the log files are backed up and the host system does not get overloaded; otherwise, information can be lost.

15.2.1.3. Buffered and Unbuffered Logging

The Java subsystems support buffered logging for all types of logs. The server can be configured for either buffered or unbuffered logging.

If buffered logging is configured, the server creates buffers for the corresponding logs and holds the messages in the buffers for as long as possible. The server flushes out the messages to the log files only when one of the following conditions occurs:

- The buffer gets full. The buffer is full when the buffer size is equal to or greater than the value specified by the **bufferSize** configuration parameter. The default value for this parameter is 512 KB.
- The flush interval for the buffer is reached. The flush interval is reached when the time interval since the last buffer flush is equal to or greater than the value specified by the **flushInterval** configuration parameter. The default value for this parameter is 5 seconds.
- When current logs are read from Console. The server retrieves the latest log when it is queried for current logs.

If the server is configured for unbuffered logging, the server flushes out messages as they are generated to the log files. Because the server performs an I/O operation (writing to the log file) each time a message is generated, configuring the server for unbuffered logging decreases performance.

Setting log parameters is described in Section 15.2.3, “Configuring Logs in the Console”.

15.2.1.4. Log File Rotation

The subsystem logs have an optional log setting that allows them to be rotated and start a new log file instead of letting log files grow indefinitely. Log files are rotated when either of the following occur:

- The size limit for the corresponding file is reached. The size of the corresponding log file is equal to or greater than the value specified by the **maxFileSize** configuration parameter. The default value for this parameter is 100 KB.
- The age limit for the corresponding file is reached. The corresponding log file is equal to or older than the interval specified by the **rolloverInterval** configuration parameter. The default value for this parameter is 2592000 seconds (every thirty days).

When a log file is rotated, the old file is named using the name of the file with an appended time stamp. The appended time stamp is an integer that indicates the date and time the corresponding active log file was rotated. The date and time have the forms YYYYMMDD (year, month, day) and HHMMSS (hour, minute, second).

Log files, especially the audit log file, contain critical information. These files should be periodically archived to some backup medium by copying the entire **log** directory to an archive medium.

> **Note**
>
> The Certificate System does not provide any tool or utility for archiving log files.

The Certificate System provides a command-line utility, **signtool**, that signs log files before archiving them as a means of tamper detection. For details, see Section 15.2.5.5, "Signing Log Files".

Signing log files is an alternative to the signed audit logs feature. Signed audit logs create audit logs that are automatically signed with a subsystem signing certificate. See Section 15.2.5.3, "Configuring a Signed Audit Log in the Console" for details about signed audit logs.

By default, rotated log files are not deleted.

15.2.2. Viewing Logs

To troubleshoot the subsystem, check the error or informational messages that the server has logged. Examining the log files can also monitor many aspects of the server's operation. Some log files can be viewed through the Console or by opening the files directly.

To view the contents of an active or rotated system log file:

1. Log into the Console.
2. Select the **Status** tab.
3. Under **Logs**, select the log to view.
4. Set the viewing preferences in the **Display Options** section.
   - **Entries** — The maximum number of entries to be displayed. When this limit is reached, the Certificate System returns any entries that match the search request. Zero (0) means no messages are returned. If the field is blank, the server returns every matching entry, regardless of the number found.
   - **Source** — Select the Certificate System component or service for which log messages are to be displayed. Choosing **All** means messages logged by all components that log to this file are displayed. For more information, see Section 15.2.1.1, "Services That Are Logged".
   - **Level** — Select a message category that represents the log level for filtering messages. For more information on log levels, see Section 15.2.1.2, "Log Levels (Message Categories)".
   - **Filename** — Select the log file to view. Choose **Current** to view the currently active system log file.
5. Click **Refresh**.

   The table displays the system log entries. The entries are in reverse chronological order, with the most current entry placed at the top. Use the scroll arrows on the right edge of the panel to scroll through the log entries.

   Each entry has the following information shown:

- **Source** — The component or resource that logged the message.
- **Level** — The severity of the corresponding entry; see Table 15.2, “Log Levels and Corresponding Log Messages” for more information.
- **Date** — The date on which the entry was logged.
- **Time** — The time at which the entry was logged.
- **Details** — A brief description of the log.

6. To view a full entry, double-click it, or select the entry, and click **View**.

15.2.3. Configuring Logs in the Console

Logs can be configured through both the subsystem Console and through the subsystem's **CS.cfg** file. Specialized logs, such as signed audit logs and custom logs, can also be created through the Console or configuration file.

System, transaction, and audit logs can be configured through the subsystem Console for the CA, OCSP, TKS, and KRA subsystems. TPS logs are only configured through the configuration file.

1. In the navigation tree of the **Configuration** tab, select **Log**.
2. The **Log Event Listener Management** tab lists the currently configured listeners.

   To create a new log instance, click **Add**, and select a module plug-in from the list in the **Select Log Event Listener Plug-in Implementation** window.
3. Set or modify the fields in the **Log Event Listener Editor** window. The different parameters are listed in Table 15.3, “Log Event Listener Fields”.

Table 15.3. Log Event Listener Fields

Field	Description
Log Event Listener ID	Gives the unique name that identifies the listener. The names can have any combination of letters (aA to zZ), digits (0 to 9), an underscore (_), and a hyphen (-), but it cannot contain other characters or spaces.
type	Gives the type of log file. **system** creates error and system logs; **transaction** records audit logs.
enabled	Sets whether the log is active. Only enabled logs actually record events. The value is either **true** or **false**.
level	Sets the log level in the text field. The level must be manually entered in the field; there is no selection menu. The choices are **Debug**, **Information**, **Warning**, **Failure**, **Misconfiguration**, **Catastrophe**, and **Security**. For more information, see Section 15.2.1.2, “Log Levels (Message Categories)”.
fileName	Gives the full path, including the file name, to the log file. The subsystem user should have read/write permission to the file.
bufferSize	Sets the buffer size in kilobytes (KB) for the log. Once the buffer reaches this size, the contents of the buffer are flushed out and copied to the log file. The default size is 512 KB. For more information on buffered logging, see Section 15.2.1.3, “Buffered and Unbuffered Logging”.

Field	Description
flushInterval	Sets the amount of time before the contents of the buffer are flushed out and added to the log file. The default interval is 5 seconds.
maxFileSize	Sets the size, in kilobytes (KB), a log file can become before it is rotated. Once it reaches this size, the file is copied to a rotated file, and the log file is started new. For more information on log file rotation, see Section 15.2.1.4, “Log File Rotation”. The default size is 2000 KB.
rolloverInterval	Sets the frequency for the server to rotate the active log file. The available options are hourly, daily, weekly, monthly, and yearly. The default is monthly. For more information, see Section 15.2.1.4, “Log File Rotation”.

15.2.4. Configuring Logs in the CS.cfg File

Along with configuring subsystem logging through the Console, logging can be configured by directory editing the **CS.cfg** for the instance. This may be a convenience for the CA, OCSP, KRA, and TKS. For the TPS, this is the only way to configure logging because, with the exception of TPS audit logging, there is no way to configure logging in the TPS administrator web services.

1. Stop the subsystem instance.

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Open the **CS.cfg** file in the **/var/lib/pki/*instance_name*/*subsystem_name*/conf/** directory.

3. To create a new log, copy all of the entries for either the system or transactions log. These are the parameters that begin with **log.instance.Transactions** or **log.instance.System**. Paste all entries at the bottom of the logging section and change the name of this instance by changing the word **Transactions** or **System** in each parameter to the new name.

4. To configure a log instance, modify the parameters associated with that log. These parameters begin with **log.instance**.

Table 15.4. Log Entry Parameters

Parameter	Description
type	The type of log file. **system** creates error and system logs; **transaction** records audit logs.
enable	Sets whether the log is active. Only enabled logs actually record events.
level	Sets the log level in the text field. The level must be manually entered in the field; there is no selection menu. The log level setting is a numeric value, as listed in Section 15.2.1.2, “Log Levels (Message Categories)”.
fileName	The full path, including the file name, to the log file. The subsystem user should have read/write permission to the file.

Parameter	Description
bufferSize	The buffer size in kilobytes (KB) for the log. Once the buffer reaches this size, the contents of the buffer are flushed out and copied to the log file. The default size is 512 KB. For more information on buffered logging, see Section 15.2.1.3, “Buffered and Unbuffered Logging”.
flushInterval	The amount of time, in seconds, before the contents of the buffer are flushed out and added to the log file. The default interval is 5 seconds.
maxFileSize	The size, kilobytes (KB), a log file can become before it is rotated. Once it reaches this size, the file is copied to a rotated file, and the log file is started new. For more information on log file rotation, see Section 15.2.1.4, “Log File Rotation”. The default size is 2000 KB.
rolloverInterval	The frequency which the server rotates the active log file. The available choices are hourly, daily, weekly, monthly, and yearly. The default selection is monthly. For more information, see Section 15.2.1.4, “Log File Rotation”.
register [a]	If this variable is set to **false** (the default value), the self-test messages are only logged to the log file specified by **selftests.container.logger.fileName**. If this variable is set to **true**, then the self-test messages are written to both the log file specified by **selftests.container.logger.fileName** as well as to the log file specified by **log.** *instance* **.Transactions.** *fileName*.
logSigning [b]	Enables signed logging. When this parameter is enabled, provide a value for the **signedAuditCertNickname** parameter. This option means the log can only be viewed by an auditor. The value is either **true** or **false**.
signedAuditCertNickname[b]	The nickname of the certificate used to sign audit logs. The private key for this certificate must be accessible to the subsystem in order for it to sign the log.
events[b]	Specifies which events are logged to the audit log. Table 15.5, “General Audit Log Events” lists the loggable events. Log events are separated by commas with no spaces.

[a] This is for self-test logs only.
[b] This is for audit logs only.

5. Save the file.

6. Start the subsystem instance.

```
systemctl start pki-tomcatd@instance_name.service
```

15.2.5. Managing Audit Logs

The audit log contains records for events that have been set up as recordable events. If the **logSigning** attribute is set to **true**, the audit log is signed with a log signing certificate belonging to the server. This certificate can be used by auditors to verify that the log has not been tampered with.

By default, regular audit logs are located in the **/var/log/pki/*instance_name*/*subsystem_name*/** directory with other types of logs, while signed audit logs are written to **/var/log/pki/*instance_name*/*subsystem_name*/signedAudit/**. The default location for logs can be changed by modifying the configuration.

The signed audit log creates a log recording system events, and the events are selected from a list of potential events. When enabled, signed audit logs record a verbose set of messages about the selected event activity.

Signed audit logs are configured by default when the instance is first created, but it is possible to configure signed audits logs after installation. (See Section 15.2.5.2, "Enabling Signed Audit Logging after Installation".) It is also possible to edit the configuration or change the signing certificates after configuration, as covered in Section 15.2.5.3, "Configuring a Signed Audit Log in the Console".

15.2.5.1. A List of Audit Events

Table 15.5. General Audit Log Events

Event	Log Messages
AUDIT_LOG_STARTUP	The start of the subsystem, and thus the start of the audit function.
AUDIT_LOG_SHUTDOWN	The shutdown of the subsystem, and thus the shutdown of the audit function.
LOGGING_SIGNED_AUDIT_SIGNING	Shows changes in whether the audit log is signed.
ROLE_ASSUME	A user assuming a role. A user assumes a role after passing through authentication and authorization systems. Only the default roles of administrator, auditor, and agent are tracked. Custom roles are not tracked.
CONFIG	Shows general configuration changes not specifically defined below.
CONFIG_ROLE	Shows that a change has been made to the configuration settings for roles, including changes made to users or groups.
CONFIG_AUDIT	Shows that a change has been made to the audit log configuration.
CONFIG_CERT_PROFILE	A change is made to the configuration settings for the certificate profile framework.
CONFIG_CRL_PROFILE	A change is made to the configuration settings for the CRL framework, such as to the extensions, frequency, and CRL format.
CONFIG_CERT_POLICY	Shows when a change has been made to a certificate's policy configuration.
CONFIG_OCSP_PROFILE	A change is made to the configuration settings for the OCSP.
CONFIG_AUTH	A change is made to the configuration settings for the authentication framework.
CONFIG_SERIAL_NUMBER	A change is made to the serial number range assigned for certificates and keys. This is recorded by CA and KRA subsystems.

Event	Log Messages
SECURITY_DOMAIN_UPDATE	The security domain is changed by adding or removing subsystem instances.
CONFIG_ACL	A change is made to the configuration settings for the ACL framework.
CONFIG_SIGNED_AUDIT	A change is made to the configuration settings for the signed audit feature.
CONFIG_ENCRYPTION	A change is made to the encryption settings, including certificate settings and SSL cipher preferences.
CONFIG_TRUSTED_PUBLIC_KEY	The Certificate Setup Wizard is used to import certificates into the certificate database or any activity in **Manage Certificates**.
CONFIG_KRA	The configuration associated with a KRA changes.
SELFTESTS_EXECUTION	The self-tests are executed.
AUDIT_LOG_DELETE [a]	The signed audit log expires or is deleted.
LOG_PATH_CHANGE [b]	The path or name for the signed audit, system, transaction or any customized log is changed.
LOG_EXPIRATION_CHANGE	Shows when the log expiration time has been changed.
PRIVATE_KEY_ARCHIVE_REQUEST	Shows when an encryption private key is requested during enrollment.
PRIVATE_KEY_ARCHIVE_REQUEST_PROCESSED	Shows when a private encryption key is archived in the KRA.
KEY_RECOVERY_REQUEST	Shows when a request is made to recover a private encryption key stored in the KRA.
KEY_RECOVERY_AGENT_LOGIN	Shows when KRA agents log in as recovery agents to approve key recovery requests.
KEY_GEN_ASYMMETRIC	Shows when asymmetric keys are generated.
NON_PROFILE_CERT_REQUEST	Shows when a certificate request is made outside the certificate profile framework.
PROFILE_CERT_REQUEST	Shows when a certificate request is made through the certificate profile framework.
CERT_REQUEST_PROCESSED	Shows when a certificate request is being processed.
CERT_STATUS_CHANGE_REQUEST	Shows when the request is made to change the status of a certificate.
CERT_STATUS_CHANGE_REQUEST_PROCESSED	Shows when a certificate status change is processed.
AUTHZ_SUCCESS	Shows when a user is successfully processed by the authorization servlets.
AUTHZ_FAIL	Shows when a user is not successfully processed by the authorization servlets.
INTER_BOUNDARY	Records stat transfer between different subsystems.
AUTH_FAIL	Shows when a user does not successfully authenticate.

Event	Log Messages
AUTH_SUCCESS	Shows when a user successfully authenticates.
CERT_PROFILE_APPROVAL	Shows when a certificate profile sent by an administrator is approved by an agent.
PROOF_OF_POSSESSION	Shows when proof of possession is checked during certificate enrollment.
CRL_RETRIEVAL	Shows when a CRL is retrieved by the OCSP.
CRL_VALIDATION	Shows when a CRL is retrieved and the validation process occurs.
CMC_SIGNED_REQUEST_SIG_VERIFY	Used when CMC (agent pre-signed) certificate requests or revocation requests are submitted and the signature is verified.
COMPUTE_SESSION_KEY_REQUEST	Shows when a request to compute a session key has been received by the TKS.
COMPUTE_SESSION_KEY_REQUEST_PROCESSED_SUCCESS	Shows when a request to compute a session key has been succesfully processed by the TKS.
COMPUTE_SESSION_KEY_REQUEST_PROCESSED_FAILURE	Shows when a request to compute a session key has been processed by the TKS and failed.
DIVERSIFY_KEY_REQUEST	Shows when a request has been made for a key changeover.
DIVERSIFY_KEY_REQUEST_PROCESSED_SUCCESS	Shows when a request for key changeover has been successfully processed by the TKS.
DIVERSIFY_KEY_REQUEST_PROCESSED_FAILURE	Shows when a request key changeover has been request failed to process correctly.
ENCRYPT_DATA_REQUEST	Shows when a request has been made to encrypt data.
ENCRYPT_DATA_REQUEST_PROCESSED_SUCCESS	Shows when a request for encrypted data has been successfully processed.
ENCRYPT_DATA_REQUEST_PROCESSED_FAILURE	Shows when a request for encrypted data failed to process.
COMPUTE_RANDOM_DATA_REQUEST	Shows when a request has been made to generate or derive a random data set.
COMPUTE_RANDOM_DATA_REQUEST_PROCESSED_SUCCESS	Shows when a request to generatea random data set has been successfully processed.
COMPUTE_RANDOM_DATA_REQUEST_PROCESSED_FAILURE	Shows when a request to generatea random data set failed to process.
PRIVATE_KEY_EXPORT_REQUEST_PROCESSED_SUCCESS	Shows when a private key export request has been successfully processed.
PRIVATE_KEY_EXPORT_REQUEST_PROCESSED_FAILURE	Shows when a private key export request has been processed and returned a failed status.
SERVER_SIDE_KEYGEN_REQUEST	Shows when a server-side key generation request has been processed.
SERVER_SIDE_KEYGEN_REQUEST_PROCESSED_SUCCESS	Shows when a server-side key generation request has been successfully processed.

Event	Log Messages
SERVER_SIDE_KEYGEN_REQUEST_PROCESSED_FAILURE	Shows when a server-side key generation request has been processed but returned a failed status.
KEY_RECOVERY_REQUEST_ASYNC	Shows when an asynchronous key recovery request has been made.
KEY_RECOVERY_REQUEST_PROCESSED	Shows when a key recovery request has been processed.
KEY_RECOVERY_REQUEST_PROCESSED_ASYNC	Shows when an asynchronous key recovery request has been processed.
CIMC_CERT_VERIFICATION	Shows when a router (Cisco Integrated Management Controller) certificate verification request has been processed.
OCSP_ADD_CA_REQUEST	Shows when a request has been made to add a new certificate authority to the OCSP Manager's configuration.
OCSP_ADD_CA_REQUEST_PROCESSED	Shows when a request to add a certificate authority to the OCSP Manager's configuration has been completed.
OCSP_REMOVE_CA_REQUEST	Shows when a request to remove a certificate authority from the OCSP Manager's configuration has been submitted.
OCSP_REMOVE_CA_REQUEST_PROCESSED_SUCCESS	Shows when a request to remove a certificate authority from the OCSP Manager's configuration has been successfully completed.
OCSP_REMOVE_CA_REQUEST_PROCESSED_FAILURE	Shows when a request to remove a certificate authority from the OCSP Manager's configuration has failed.

[a] The authorization system should not allow a signed audit log to be deleted.

[b] The authorization system should not allow the log path or name to be changed.

Table 15.6. TPS Audit Log

Events	Description
ENROLLMENT	Shows when a token is enrolled through the TPS.
APPLET_UPGRADE	Shows when the applet on the token is upgraded.
PIN_RESET	Shows when the password used to access the token is reset.
CONFIG_TOKEN	Shows that a change was made to a token's configuration settings.
CONFIG_PROFILE	Shows that a change was made to a profile's configuration settings.
KEY_CHANGEOVER	Shows whether key changeover worked successfully.
RENEWAL	Shows if a token is renewed successfully through the TPS.
FORMAT	Records when a token is formatted.

15.2.5.2. Enabling Signed Audit Logging after Installation

Signed audit logs can be enabled by default when an instance is first created by using the **pki_audit_group** deployment parameter with the **pkispawn** command. If, however, signed audit logs were not configured when an instance was created, they can be enabled afterwards by reassigning ownership of the audit log directory to the auditor system users group, such as **pkiaudit**.

1. Stop the instance:

```
systemctl stop pki-tomcatd@instance_name.service
```

2. Set the group ownership of the signed audit log directory to the PKI auditors operating system group, such as **pkiaudit**. This allows the users in the PKI auditors group to have the required read access to the **signedAudit** directory to verify the signatures on the log files. No user (except for the Certificate System user account, **pkiuser**) should have write access to the log files in this directory.

```
chgrp -R pkiaudit
/var/log/pki/instance_name/subsystem_name/signedAudit
```

3. Restart the instance:

```
systemctl start pki-tomcatd@instance_name.service
```

15.2.5.3. Configuring a Signed Audit Log in the Console

Signed audit logs are configured by default when the instance is first created, but it is possible to edit the configuration or change the signing certificates after configuration.

> **Note**
>
> Provide enough space in the file system for the signed audit logs, since they can be large.

A log is set to a signed audit log by setting the **logSigning** parameter to **enable** and providing the nickname of the certificate used to sign the log. A special log signing certificate is created when the subsystems are first configured.

Only a user with auditor privileges can access and view a signed audit log. Auditors can use the **AuditVerify** tool to verify that signed audit logs have not been tampered with.

The signed audit log is created and enabled when the subsystem is configured, but it needs additional configuration to begin creating and signing audit logs.

1. Open the Console.

> **Note**
>
> To create or configure the audit log by editing the **CS.cfg** file, see Section 15.2.4, “Configuring Logs in the CS.cfg File”.

2. In the navigation tree of the **Configuration** tab, select **Log**.
3. In the **Log Event Listener Management** tab, select the **SignedAudit** entry.
4. Click **Edit/View**.
5. There are three fields which must be reset in the **Log Event Listener Editor** window.
   - Fill in the **signedAuditCertNickname**. This is the nickname of the certificate used to sign audit logs. An audit signing certificate is created when the subsystem is configured; it has a nickname like **auditSigningCert cert-*instance_name subsystem_name***.

     > **Note**
     >
     > To get the audit signing certificate nickname, list the certificates in the subsystem's certificate database using **certutil**. For example:
     >
     > ```
     > certutil -L -d /var/lib/pki-tomcat/alias
     >
     > Certificate Authority - Example Domain    CT,c,
     > subsystemCert cert-pki-tomcat             u,u,u
     > Server-Cert cert-pki-tomcat               u,u,u
     > auditSigningCert cert-pki-tomcat CA       u,u,Pu
     > ```

   - Set the **logSigning** field to **true** to enable signed logging.
   - Set any **events** which are logged to the audit log. Table 15.5, “General Audit Log Events” lists the loggable events. Log events are separated by commas with no spaces.
6. Set any other settings for the log, such as the file name, the log level, the file size, or the rotation schedule.

   > **Note**
   >
   > By default, regular audit logs are located in the **/var/log/pki/*instance_name*/*subsystem_name*/** directory with other types of logs, while signed audit logs are written to **/var/log/pki/*instance_name*/*subsystem_name*/signedAudit/**. The default location for logs can be changed by modifying the configuration.

7. Save the log configuration.

After enabling signed audit logging, assign auditor users by creating the user and assigning that entry to the auditor group. Members of the auditor group are the only users who can view and verify the signed audit log. See Section 14.4.2.1, “Creating Users” for details about setting up auditors.

Auditors can verify logs by using the **AuditVerify** tool. See the *Certificate System Command-Line Tools Guide* for details about using this tool.

15.2.5.4. Handling Audit Logging Failures

There are events that could cause the audit logging function to fail, so events cannot be written to the log. For example, audit logging can fail when the file system containing the audit log file is full or when the file permissions for the log file are accidentally changed. If audit logging fails, the Certificate System instance shuts down in the following manner.

- Servlets are disabled and will not process new requests.
- All pending and new requests are killed.
- The subsystem is shut down.

When this happens, administrators and auditors should work together with the operating system administrator to resolve the disk space or file permission issues. When the IT problem is resolved, the auditor should make sure that the last audit log entries are signed. If not, they should be preserved by manual signing (Section 15.2.5.5, “Signing Log Files”), archived, and removed to prevent audit verification failures in the future. When this is completed, the administrators can restart the Certificate System.

15.2.5.5. Signing Log Files

The Certificate System can digitally sign log files before they are archived or distributed for audit purposes. This feature allows files to be checked for tampering.

This is an alternative to the signed audit logs feature. The signed audit log feature creates audit logs that are automatically signed; this tool manually signs archived logs. See Section 15.2.5.3, “Configuring a Signed Audit Log in the Console” for details about signed audit logs.

For signing log files, use a command-line utility called the Signing Tool (**signtool**). For details about this utility, see http://www.mozilla.org/projects/security/pki/nss/tools/.

The utility uses information in the certificate, key, and security module databases of the subsystem instance.

To sign the log directories, use the **signtool** command:

```
signtool -d secdb_dir -k cert_nickname -Z output input
```

- *secdb_dir* specifies the path to the directory that contains the certificate, key, and security module databases for the CA.
- *cert_nickname* specifies the nickname of the certificate to use for signing.
- *output* specifies the name of the JAR file (a signed zip file).
- *input* specifies the path to the directory that contains the log files.

15.2.6. Managing Log Modules

The types of logs that are allowed and their behaviors are configured through *log module* plug-ins. New logging modules can be created and used to make custom logs.

New log plug-in modules can be registered through the Console. Registering a new module involves specifying the name of the module and the full name of the Java™ class that implements the log interface.

Before registering a plug-in module, put the Java™ class for the module in the **classes** directory; the implementation must be on the class path.

To register a log plug-in module with a subsystem instance:

1. Create the custom job class. For this example, the custom log plug-in is called **MyLog.java**.

2. Compile the new class into the lib directory of the instance.

```
javac -d . /var/lib/pki/pki-tomcat/lib -classpath $CLASSPATH
MyLog.java
```

3. Create a directory in the CA's **WEB-INF** web directory to hold the custom classes, so that the CA can access them.

```
mkdir /var/lib/pki/pki-tomcat/webapps/ca/WEB-INF/classes
```

4. Set the owner to the Certificate System system user (**pkiuser**).

```
chown -R pkiuser:pkiuser /var/lib/pki/pki-tomcat/lib
```

5. Register the plug-in.

   a. Log into the Console.

   b. In the **Configuration** tab, select **Logs** from the navigation tree. Then select the **Log Event Listener Plug-in Registration** tab.

   c. Click **Register**.

      The **Register Log Event Listener Plug-in Implementation** window appears.

   d. Give the name for the plug-in module and the Java™ class name.

      The Java™ class name is the full path to the implementing Java™ class. If this class is part of a package, include the package name. For example, registering a class named **customLog** in a package named **com.customplugins**, the class name would be **com.customplugins.customLog**.

   e. Click **OK**.

Unwanted log plug-in modules can be deleted through the Console. Before deleting a module, delete all the listeners based on this module; see Section 15.2.1.4, “Log File Rotation”.

15.3. Smart Card Error Codes

Smart cards can report certain error codes to the TPS; these are recorded in the TPS's debug log file, depending on the cause for the message.

Table 15.7. Smart Card Error Codes

Return Code	Description
General Error Codes	
6400	No specific diagnosis
6700	Wrong length in Lc
6982	Security status not satisfied
6985	Conditions of use not satisfied
6a86	Incorrect P1 P2
6d00	Invalid instruction
6e00	Invalid class
Install Load Errors	
6581	Memory Failure
6a80	Incorrect parameters in data field
6a84	Not enough memory space
6a88	Referenced data not found
Delete Errors	
6200	Application has been logically deleted
6581	Memory failure
6985	Referenced data cannot be deleted
6a88	Referenced data not found
6a82	Application not found
6a80	Incorrect values in command data
Get Data Errors	
6a88	Referenced data not found
Get Status Errors	
6310	More data available
6a88	Referenced data not found
6a80	Incorrect values in command data
Load Errors	
6581	Memory failure
6a84	Not enough memory space
6a86	Incorrect P1/P2
6985	Conditions of use not satisfied

Chapter 16. Managing Subsystem Certificates

This chapter gives an overview of using certificates: what types and formats are available, how to request and create them through the HTML end-entity forms and through the Certificate System Console, and how to install certificates in the Certificate System and on different clients. Additionally, there is information on managing certificates through the Console and configuring the servers to use them.

16.1. Required Subsystem Certificates

Each subsystem has a defined set of certificates which must be issued to the subsystem instance for it to perform its operations. There are certain details of the certificate contents that are set during the Certificate Manager configuration, with different considerations for constraints, settings, and attributes depending on the types of certificates; planning the formats of certificates is covered in the *Certificate System Planning, Installation, and Deployment Guide*.

16.1.1. Certificate Manager Certificates

When a Certificate Manager is installed, the keys and requests for the CA signing certificate, SSL server certificate, and OCSP signing certificate are generated. The certificates are created before the configuration can be completed.

The CA certificate request is either submitted as a self-signing request to the CA, which then issues the certificate and finishes creating the self-signed root CA, or is submitted to a third-party public CA or another Certificate System CA. When the external CA returns the certificate, the certificate is installed, and installation of the subordinate CA is completed.

- Section 16.1.1.1, “CA Signing Key Pair and Certificate”
- Section 16.1.1.2, “OCSP Signing Key Pair and Certificate”
- Section 16.1.1.3, “Subsystem Certificate”
- Section 16.1.1.4, “SSL Server Key Pair and Certificate”
- Section 16.1.1.5, “Audit Log Signing Key Pair and Certificate”

16.1.1.1. CA Signing Key Pair and Certificate

Every Certificate Manager has a CA signing certificate with a public key corresponding to the private key the Certificate Manager uses to sign the certificates and CRLs it issues. This certificate is created and installed when the Certificate Manager is installed. The default nickname for the certificate is **caSigningCert cert-***instance_ID CA*, where *instance_ID* identifies the Certificate Manager instance. The default validity period for the certificate is five years.

The subject name of the CA signing certificate reflects the name of the CA that was set during installation. All certificates signed or issued by the Certificate Manager include this name to identify the issuer of the certificate.

The Certificate Manager's status as a root or subordinate CA is determined by whether its CA signing certificate is self-signed or is signed by another CA, which affects the subject name on the certificates.

- If the Certificate Manager is a root CA, its CA signing certificate is self-signed, meaning the subject name and issuer name of the certificate are the same.
- If the Certificate Manager is a subordinate CA, its CA signing certificate is signed by another CA, usually the one that is a level above in the CA hierarchy (which may or may not be a root CA). The root CA's signing certificate must be imported into individual clients and servers before the Certificate Manager can be used to issue certificates to them.

> **Note**
>
> The CA name *cannot* be changed or all previously-issued certificates are invalidated. Similarly, reissuing a CA signing certificate with a new key pair invalidates all certificates that were signed by the old key pair.

16.1.1.2. OCSP Signing Key Pair and Certificate

The subject name of the OCSP signing certificate is in the form **`cn=OCSP cert-`***instance_ID CA*, and it contains extensions, such as **`OCSPSigning`** and **`OCSPNoCheck`**, required for signing OCSP responses.

The default nickname for the OCSP signing certificate is **`ocspSigningCert cert-`***instance_ID*, where *instance_ID CA* identifies the Certificate Manager instance.

The OCSP private key, corresponding to the OCSP signing certificate's public key, is used by the Certificate Manager to sign the OCSP responses to the OCSP-compliant clients when queried about certificate revocation status.

16.1.1.3. Subsystem Certificate

Every member of the security domain is issued a server certificate to use for communications among other domain members, which is separate from the server SSL certificate. This certificate is signed by the security domain CA; for the security domain CA itself, its subsystem certificate is signed by itself.

The default nickname for the certificate is **`subsystemCert cert-`***instance_ID*.

16.1.1.4. SSL Server Key Pair and Certificate

Every Certificate Manager has at least one SSL server certificate that was first generated when the Certificate Manager was installed. The default nickname for the certificate is **`Server-Cert cert-`***instance_ID*, where *instance_ID* identifies the Certificate Manager instance.

By default, the Certificate Manager uses a single SSL server certificate for authentication. However, additional server certificates can be requested to use for different operations, such as configuring the Certificate Manager to use separate server certificates for authenticating to the end-entity services interface and agent services interface.

If the Certificate Manager is configured for SSL-enabled communication with a publishing directory, it uses its SSL server certificate for client authentication to the publishing directory by default. The Certificate Manager can also be configured to use a different certificate for SSL client authentication.

16.1.1.5. Audit Log Signing Key Pair and Certificate

The CA keeps a secure audit log of all events which occurred on the server. To guarantee that the audit log has not been tampered with, the log file is signed by a special log signing certificate.

The audit log signing certificate is issued when the server is first configured.

> **Note**
>
> While other certificates can use ECC keys, the audit signing certificate must *always* use an RSA key.

16.1.2. Online Certificate Status Manager Certificates

When the Online Certificate Status Manager is first configured, the keys for all required certificates are created, and the certificate requests for the OCSP signing, SSL server, audit log signing, and subsystem certificates are made. These certificate requests are submitted to a CA (either a Certificate System CA or a third-party CA) and must be installed in the Online Certificate Status Manager database to complete the configuration process.

- Section 16.1.2.2, “SSL Server Key Pair and Certificate”
- Section 16.1.2.3, “Subsystem Certificate”
- Section 16.1.2.4, “Audit Log Signing Key Pair and Certificate”
- Section 16.1.2.5, “Recognizing Online Certificate Status Manager Certificates”

16.1.2.1. OCSP Signing Key Pair and Certificate

Every Online Certificate Status Manager has a certificate, the OCSP signing certificate, which has a public key corresponding to the private key the Online Certificate Status Manager uses to sign OCSP responses. The Online Certificate Status Manager's signature provides persistent proof that the Online Certificate Status Manager has processed the request. This certificate is generated when the Online Certificate Status Manager is configured. The default nickname for the certificate is **`ocspSigningCert cert-`***instance_ID*, where *instance_ID OSCP* is the Online Certificate Status Manager instance name.

16.1.2.2. SSL Server Key Pair and Certificate

Every Online Certificate Status Manager has at least one SSL server certificate which was generated when the Online Certificate Status Manager was configured. The default nickname for the certificate is **`Server-Cert cert-`***instance_ID*, where *instance_ID* identifies the Online Certificate Status Manager instance name.

The Online Certificate Status Manager uses its server certificate for server-side authentication for the Online Certificate Status Manager agent services page.

The Online Certificate Status Manager uses a single server certificate for authentication purposes. Additional server certificates can be installed and used for different purposes.

16.1.2.3. Subsystem Certificate

Every member of the security domain is issued a server certificate to use for communications among other domain members, which is separate from the server SSL certificate. This certificate is signed by the security domain CA.

The default nickname for the certificate is **`subsystemCert cert-`***instance_ID*.

16.1.2.4. Audit Log Signing Key Pair and Certificate

The OCSP keeps a secure audit log of all events which occurred on the server. To guarantee that the audit log has not been tampered with, the log file is signed by a special log signing certificate.

The audit log signing certificate is issued when the server is first configured.

> **Note**
>
> While other certificates can use ECC keys, the audit signing certificate must *always* use an RSA key.

16.1.2.5. Recognizing Online Certificate Status Manager Certificates

Depending on the CA which signed the Online Certificate Status Manager's SSL server certificate, it may be necessary to get the certificate and issuing CA recognized by the Certificate Manager.

- If the Online Certificate Status Manager's server certificate is signed by the CA that is publishing CRLs, then nothing needs to be done.
- If the Online Certificate Status Manager's server certificate is signed by the same root CA that signed the subordinate Certificate Manager's certificates, then the root CA must be marked as a trusted CA in the subordinate Certificate Manager's certificate database.
- If the Online Certificate Status Manager's SSL server certificate is signed by a different root CA, then the root CA certificate must be imported into the subordinate Certificate Manager's certificate database and marked as a trusted CA.

If the Online Certificate Status Manager's server certificate is signed by a CA within the selected security domain, the certificate chain is imported and marked when the Online Certificate Status Manager is configured. No other configuration is required. However, if the server certificate is signed by an external CA, the certificate chain has to be imported for the configuration to be completed.

> **Note**
>
> Not every CA within the security domain is automatically trusted by the OCSP Manager when it is configured. Every CA in the certificate chain of the CA configured in the CA panel is, however, trusted automatically by the OCSP Manager. Other CAs within the security domain but not in the certificate chain must be added manually.

16.1.3. Key Recovery Authority Certificates

The KRA uses the following key pairs and certificates:

- Section 16.1.3.1, “Transport Key Pair and Certificate”
- Section 16.1.3.2, “Storage Key Pair”
- Section 16.1.3.3, “SSL Server Certificate”
- Section 16.1.3.4, “Subsystem Certificate”
- Section 16.1.3.5, “Audit Log Signing Key Pair and Certificate”

16.1.3.1. Transport Key Pair and Certificate

Every KRA has a transport certificate. The public key of the key pair that is used to generate the transport certificate is used by the client software to encrypt an end entity's private encryption key before it is sent to the KRA for archival; only those clients capable of generating dual-key pairs use the transport certificate.

16.1.3.2. Storage Key Pair

Every KRA has a storage key pair. The KRA uses the public component of this key pair to encrypt (or wrap) private encryption keys when archiving the keys. It uses the private component to decrypt (or unwrap) the archived key during recovery. For more information on how this key pair is used, see Chapter 3, *Setting up Key Archival and Recovery*.

Keys encrypted with the storage key can be retrieved only by authorized key recovery agents.

16.1.3.3. SSL Server Certificate

Every Certificate System KRA has at least one SSL server certificate. The first SSL server certificate is generated when the KRA is configured. The default nickname for the certificate is **`Server-Cert cert-`***instance_ID*, where *instance_id* identifies the KRA instance is installed.

The KRA's SSL server certificate was issued by the CA to which the certificate request was submitted, which can be a Certificate System CA or a third-party CA. To view the issuer name, open the certificate details in the **`System Keys and Certificates`** option in the KRA Console.

The KRA uses its SSL server certificate for server-side authentication to the KRA agent services interface. By default, the Key Recovery Authority uses a single SSL server certificate for authentication. However, additional SSL server certificates can be requested and installed for the KRA.

16.1.3.4. Subsystem Certificate

Every member of the security domain is issued a server certificate to use for communications among other domain members, which is separate from the server SSL certificate. This certificate is signed by the security domain CA.

The default nickname for the certificate is **`subsystemCert cert-`***instance_ID*.

16.1.3.5. Audit Log Signing Key Pair and Certificate

The KRA keeps a secure audit log of all events which occurred on the server. To guarantee that the audit log has not been tampered with, the log file is signed by a special log signing certificate.

The audit log signing certificate is issued when the server is first configured.

> **Note**
>
> While other certificates can use ECC keys, the audit signing certificate must *always* use an RSA key.

16.1.4. TKS Certificates

The TKS has three certificates. The SSL server and subsystem certificates are used for standard operations. An additional signing certificate is used to protect audit logs.

- Section 16.1.4.1, "SSL Server Certificate"
- Section 16.1.4.2, "Subsystem Certificate"
- Section 16.1.4.3, "Audit Log Signing Key Pair and Certificate"

16.1.4.1. SSL Server Certificate

Every Certificate System TKS has at least one SSL server certificate. The first SSL server certificate is generated when the TKS is configured. The default nickname for the certificate is **`Server-Cert cert-`***instance_ID*.

16.1.4.2. Subsystem Certificate

Every member of the security domain is issued a server certificate to use for communications among other domain members, which is separate from the server SSL certificate. This certificate is signed by the security domain CA.

The default nickname for the certificate is **`subsystemCert cert-`***instance_ID*.

16.1.4.3. Audit Log Signing Key Pair and Certificate

The TKS keeps a secure audit log of all events which occurred on the server. To guarantee that the audit log has not been tampered with, the log file is signed by a special log signing certificate.

The audit log signing certificate is issued when the server is first configured.

> **Note**
>
> While other certificates can use ECC keys, the audit signing certificate must *always* use an RSA key.

16.1.5. TPS Certificates

The TPS only uses three certificates: a server certificate, subsystem certificate, and audit log signing certificate.

- Section 16.1.5.1, “SSL Server Certificate”
- Section 16.1.5.2, “Subsystem Certificate”
- Section 16.1.5.3, “Audit Log Signing Key Pair and Certificate”

16.1.5.1. SSL Server Certificate

Every Certificate System TPS has at least one SSL server certificate. The first SSL server certificate is generated when the TPS is configured. The default nickname for the certificate is **`Server-Cert cert-`***instance_ID*.

16.1.5.2. Subsystem Certificate

Every member of the security domain is issued a server certificate to use for communications among other domain members, which is separate from the server SSL certificate. This certificate is signed by the security domain CA.

The default nickname for the certificate is **`subsystemCert cert-`***instance_ID*.

16.1.5.3. Audit Log Signing Key Pair and Certificate

The TPS keeps a secure audit log of all events which occurred on the server. To guarantee that the audit log has not been tampered with, the log file is signed by a special log signing certificate.

The audit log signing certificate is issued when the server is first configured.

16.1.6. About Subsystem Certificate Key Types

The key type and the key size are determined for the subsystem certificates when the instance is configured in the configuration wizard, as is the signing algorithm for signing certificates (such as OCSP signing, CA signing, and audit log signing). Root CA configuration has additional options for signing algorithms for the algorithms used by each type of key.

While the same key type, size, and algorithm can be used for each certificate, advanced configuration in the setup wizard can allow different types, sizes, and algorithms to be used for each specific key pair.

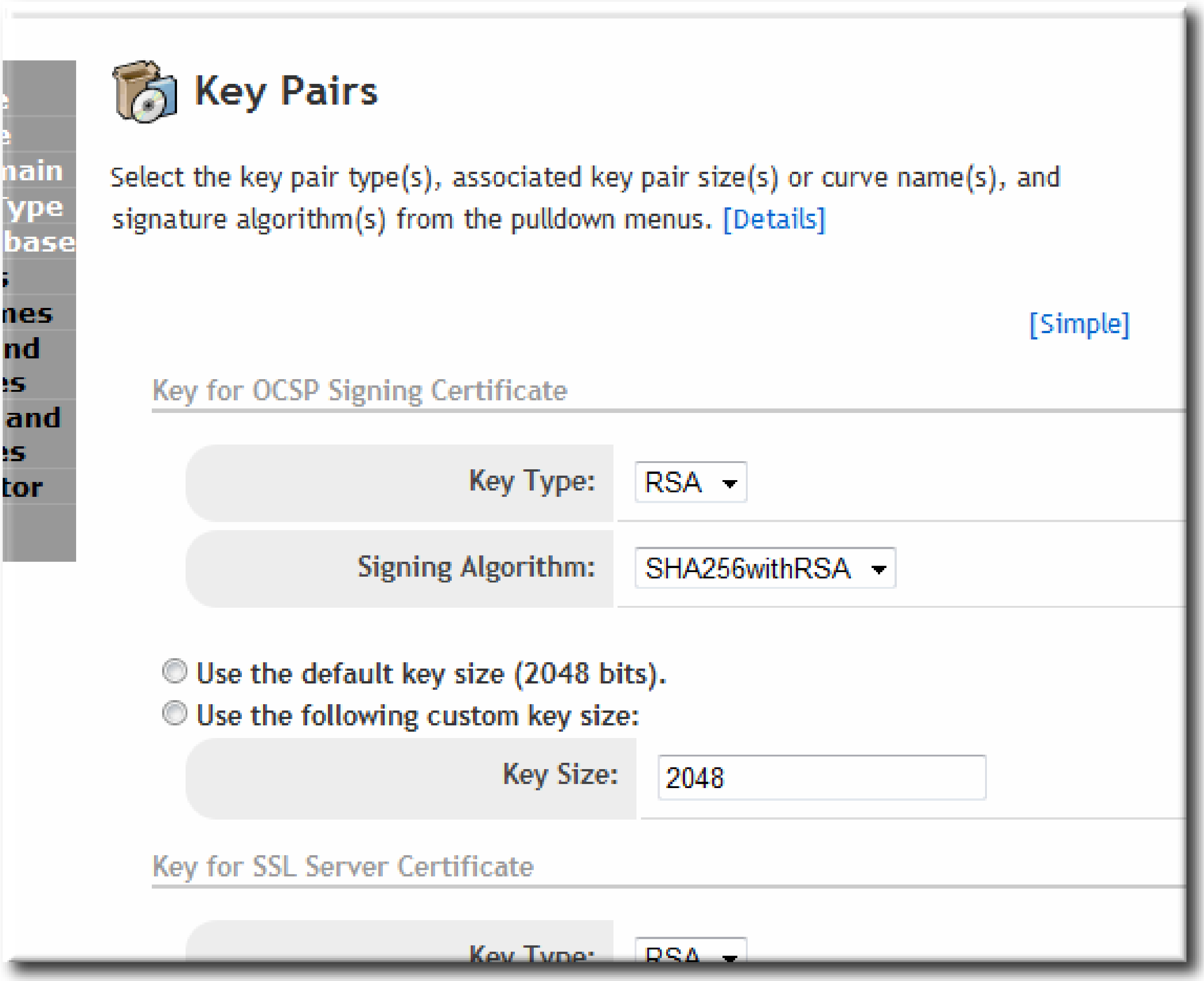


Figure 16.1. Advanced Key Pair Configuration

> **Note**
>
> The key type can be either RSA or ECC. RSA keys used hash algorithms. ECC keys use curves.

16.1.7. Using an HSM to Store Subsystem Certificates

By default, keys and certificates are stored in locally-managed databases, **`key3.db`** and **`cert8.db`**, respectively, in the **`/var/lib/pki/`*`instance_name`*`/alias/`** directory. However, Red Hat Certificate System also supports hardware security modules (HSM), external devices which can store keys and certificates in a centralized place on the network. Using an HSM can make some functions, like cloning, easier because the keys and certificates for the instance are readily accessible.

When an HSM is used to store certificates, then the HSM name is prepended to the certificate nickname, and the full name is used in the subsystem configuration, such as the **`server.xml`** file. For example:

```
serverCert="nethsm:Server-Cert cert-instance_ID
```

> **Note**
>
> A single HSM can be used to store certificates and keys for mulitple subsystem instances, which may be installed on multiple hosts. When an HSM is used, any certificate nickname for a subsystem must be unique for every subsystem instance managed on the HSM.

Certificate System supports two types of HSM, nCipher netHSM and Chrysalis LunaSA.

16.2. Requesting Certificates through the Console

The Certificate Setup Wizard for the CA, OCSP, KRA, and TKS automates the certificate enrollment process for subsystem certificates. The Console can create, submit, and install certificate requests and certificates for any of the certificates used by that subsystem. These certificates can be a server certificate or subsystem-specific certificate, such as a CA signing certificate or KRA transport certificate.

16.2.1. Requesting Signing Certificates

> **Note**
>
> It is important that the user generate and submit the client request from the computer that will be used later to access the subsystem because part of the request process generates a private key on the local machine. If location independence is required, use a hardware token, such as a smart card, to store the key pair and the certificate.

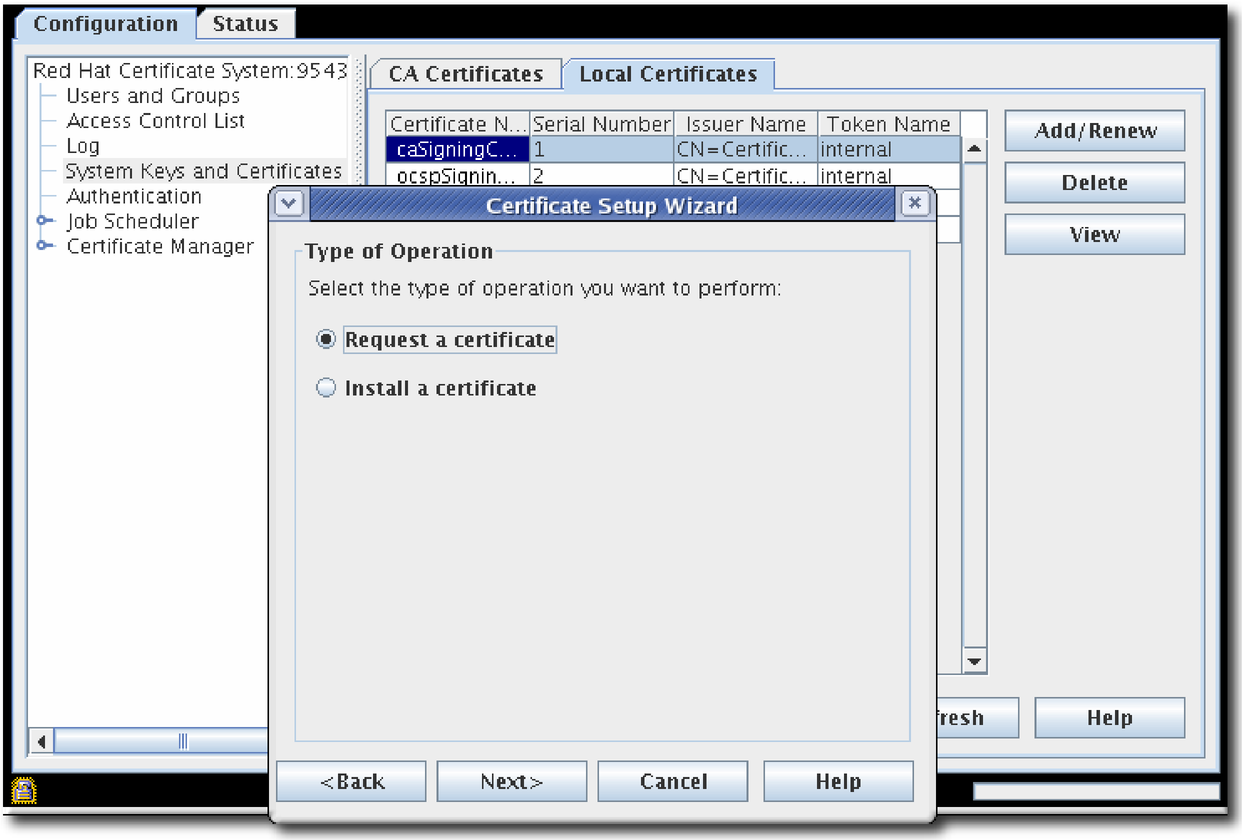
1. Open the subsystem console. For example:

   ```
   pkiconsole https://server.example.com:8443/ca
   ```

2. In the **`Configuration`** tab, select **`System Keys and Certificates`** in the navigation tree.

3. In the right panel, select the **`Local Certificates`** tab.

4. Click **`Add/Renew`**.



5. Select the **Request a certificate** radio button.

6. Choose the signing certificate type to request.

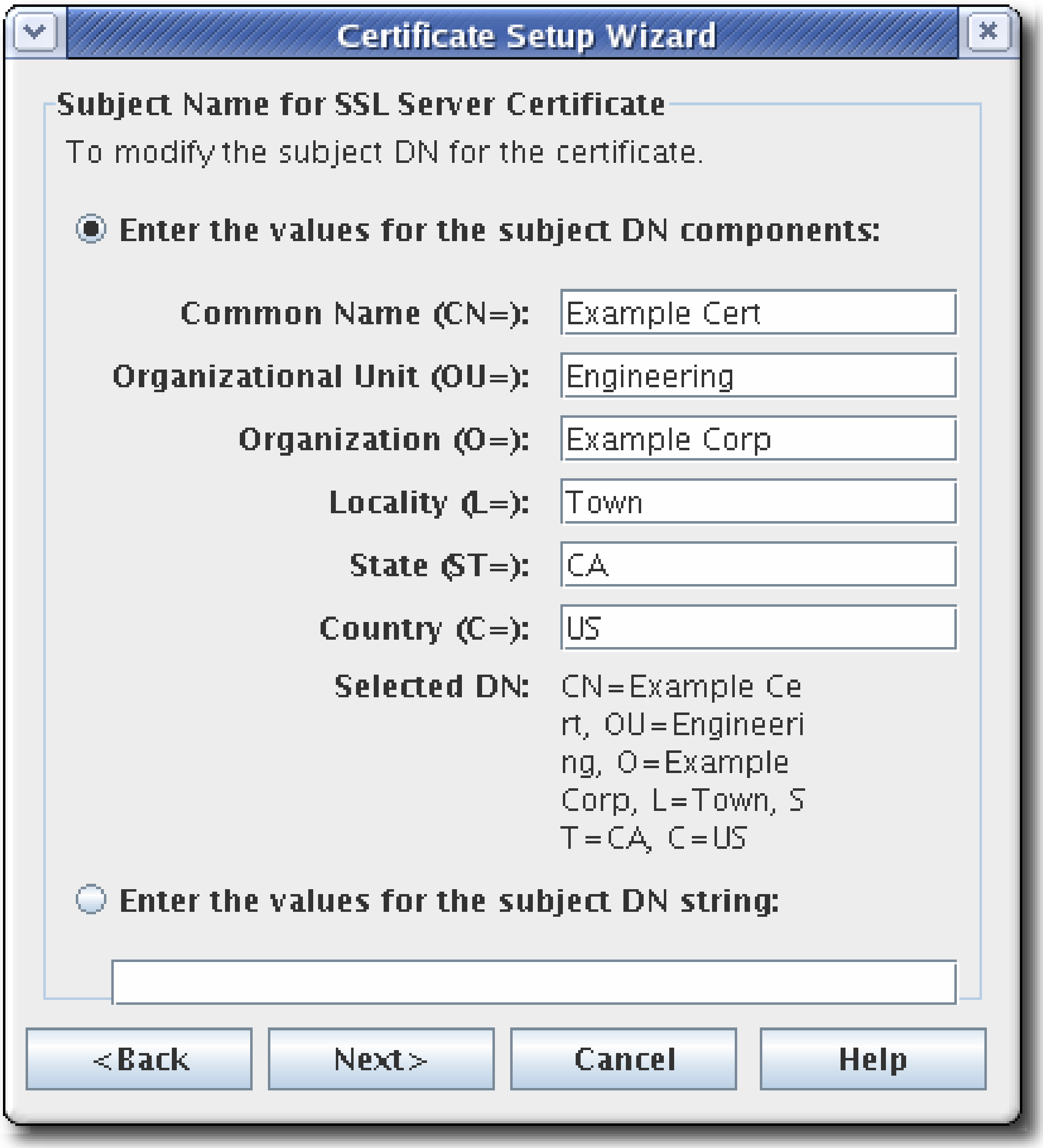
7. Select which type of CA will sign the request, either a root CA or a subordinate CA.

8. Set the key-pair information and set the location to generate the keys (the token), which can be either the internal security database directory or one of the listed external tokens.

   To create a new certificate, you must create a new key pair. Using an existing key pair will simply renew an existing certificate.

9. Select the message digest algorithm.

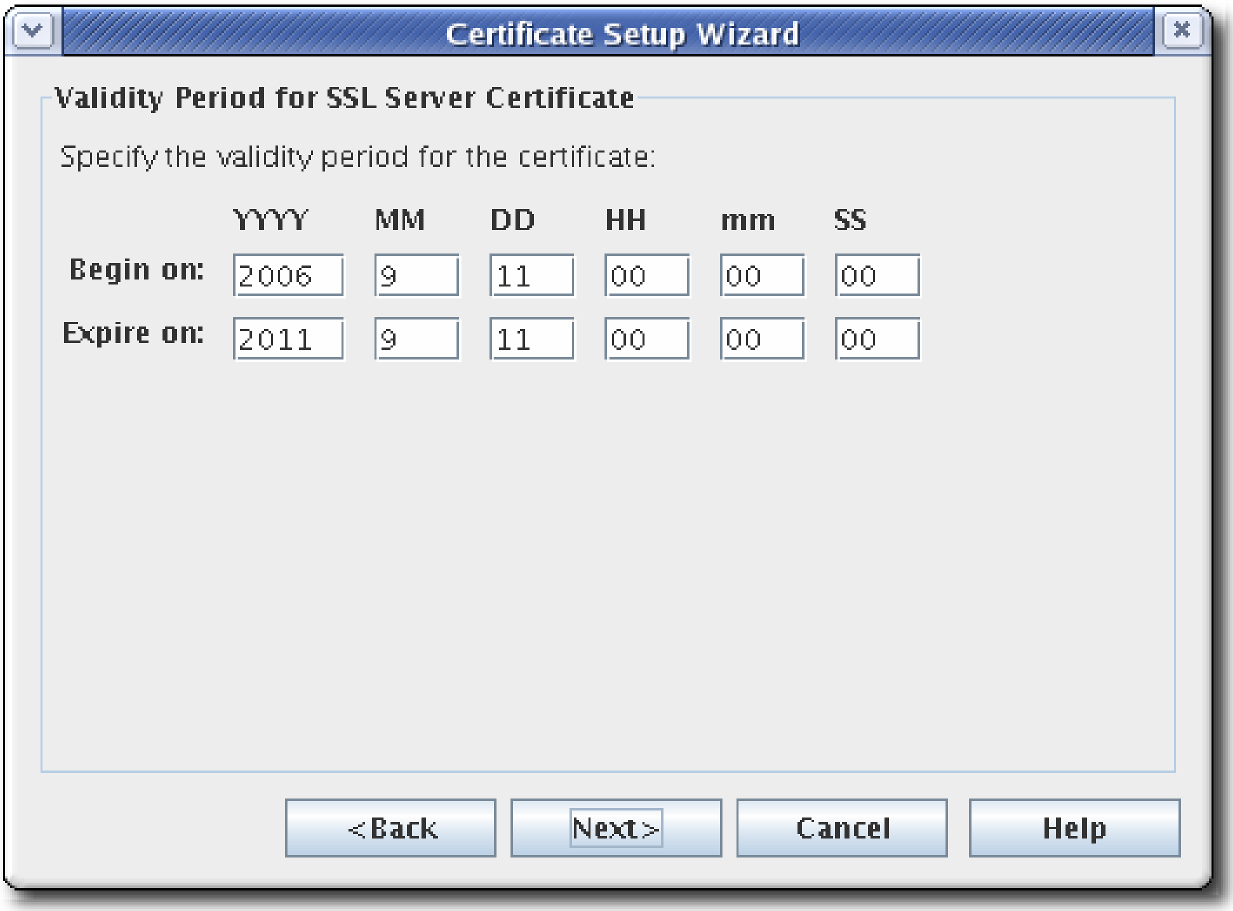
10. Give the subject name. Either enter values for individual DN attributes to build the subject DN or enter the full string.



The certificate request forms support all UTF-8 characters for the common name, organizational unit, and requester name fields.

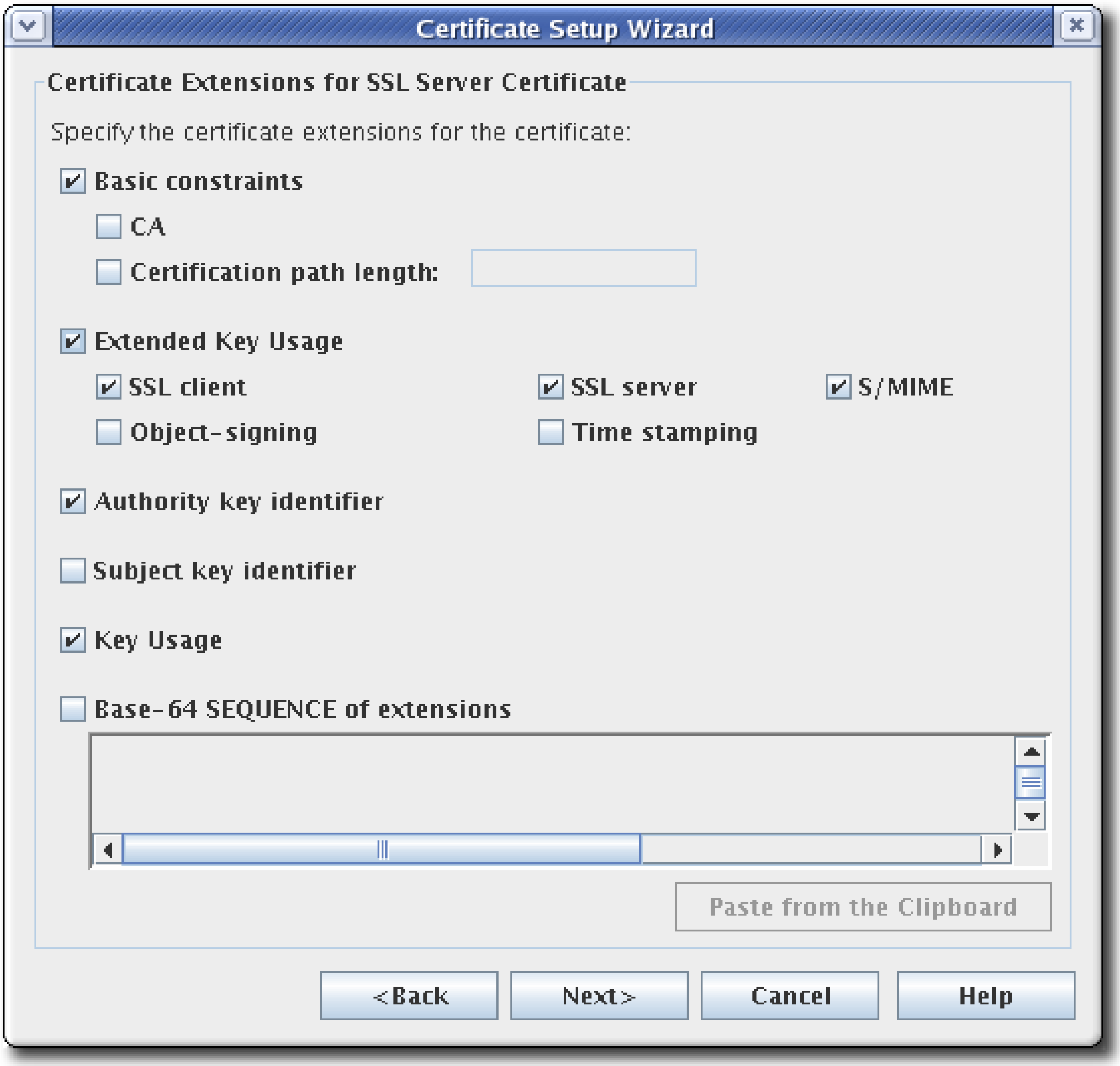
This support does not include supporting internationalized domain names.

11. Specify the start and end dates of the validity period for the certificate and the time at which the validity period will start and end on those dates.



The default validity period is five years.

12. Set the standard extensions for the certificate. The required extensions are chosen by default. To change the default choices, read the guidelines explained in Appendix B, *Defaults, Constraints, and Extensions for Certificates and CRLs*.



Note

Certificate extensions are required to set up a CA hierarchy. Subordinate CAs must have certificates that include the extension identifying them as either a subordinate SSL CA (which allows them to issue certificates for SSL) or a subordinate email CA (which allows them to issue certificates for secure email). Disabling certificate extensions means that CA hierarchies cannot be set up.

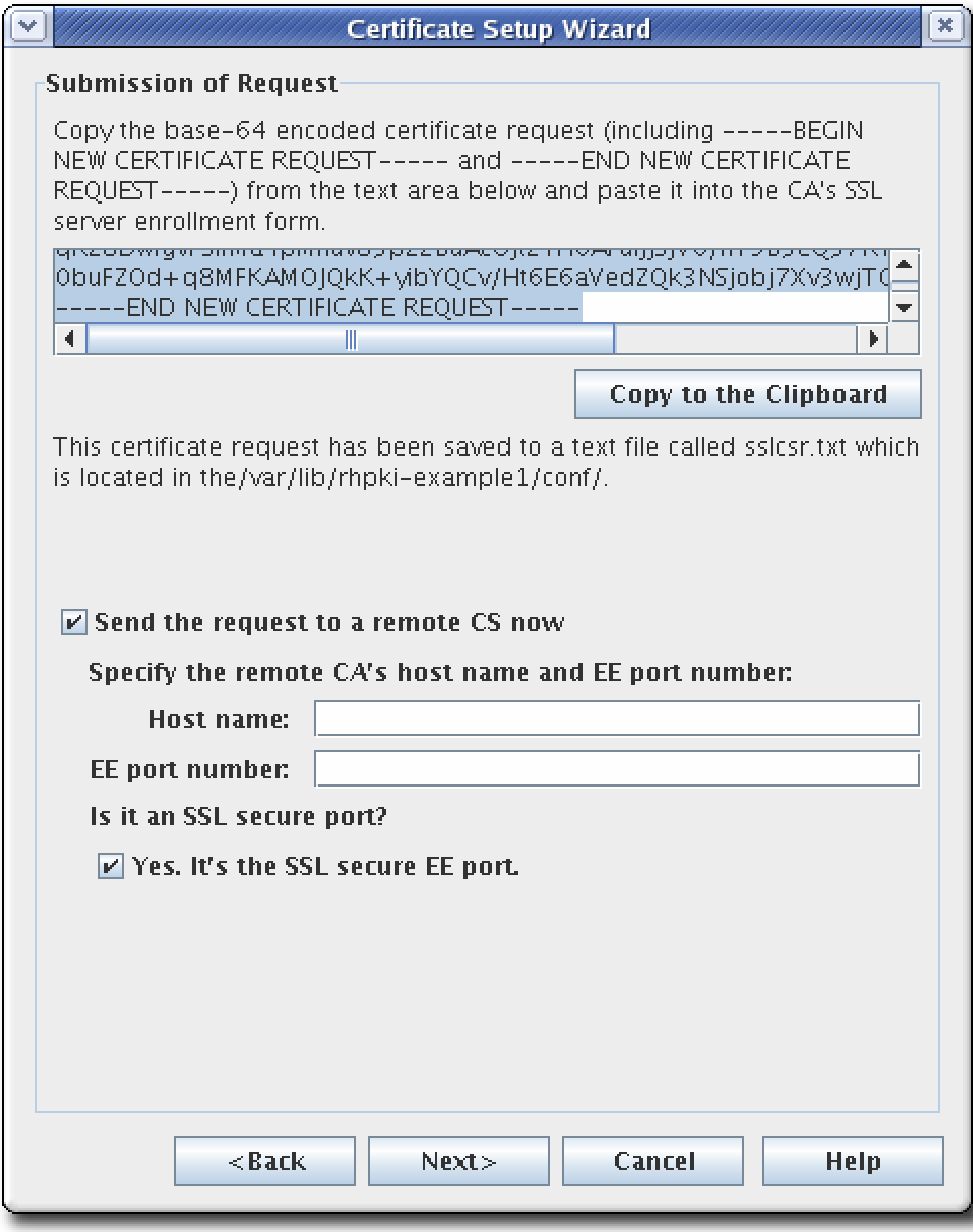
- Basic Constraints. The associated fields are CA setting and a numeric setting for the certification path length.
- Extended Key Usage.
- Authority Key Identifier.
- Subject Key Identifier.

- Key Usage. The digital signature (bit 0), non-repudiation (bit 1), key certificate sign (bit 5), and CRL sign (bit 6) bits are set by default. The extension is marked critical as recommended by the PKIX standard and RFC 2459. See RFC 2459 for a description of the Key Usage extension.

- Base-64 SEQUENCE of extensions. This is for custom extensions. Paste the extension in MIME 64 DER-encoded format into the text field.

To add multiple extensions, use the **ExtJoiner** program. For information on using the tools, see the *Certificate System Command-Line Tools Guide*.

13. The wizard generates the key pairs and displays the certificate signing request.



The request is in base-64 encoded PKCS #10 format and is bounded by the marker lines **-----BEGIN NEW CERTIFICATE REQUEST-----** and **-----END NEW CERTIFICATE REQUEST-----**. For example:


```
-----BEGIN NEW CERTIFICATE REQUEST-----
MIICJzCCAZCgAwIBAgIBAzANBgkqhkiG9w0BAQQFADBC6SAwHgYDVQQKExdOZXRzY2
FwZSBDb21tdW5pY2
F0aW9uczngjhnMVQ2VydGlmaWNhdGUgQXV0aG9yaXR5MB4XDTk4MDgyNzE5MDAwMFo
XDTk5MDIyMzE5MDA
wMnbjdgngYoxIDAeBgNVBAoTF05ldHNjYXBlIENvbW11bmljYXRpb25zMQ8wDQYDVQ
QLEwZQZW9wbGUxFz
AVBgoJkiaJkIsZAEBEwdzdXByaXlhMRcwFQYDVQQDEw5TdXByaXlhIFNoZXR0eTEjM
CEGCSqGSIb3Dbndg
JARYUc3Vwcml5Yhvfggsvwryw4y7214vAOBgNVHQ8BAf8EBAMCBLAwFAYJYIZIAYb4
QgEBAQHBAQDAgCAM
A0GCSqGSIb3DQEBBAUAA4GBAFi9FzyJlLmS+kzsue0kTXawbwamGdYql2w4hIBgdR+
jWeLmD4CP4x
-----END NEW CERTIFICATE REQUEST-----
```


The wizard also copies the certificate request to a text file it creates in the configuration directory, which is located in **/var/lib/pki/*instance_name*/conf/**. The name of the text file depends on the type of certificate requested. The possible text files are listed in Table 16.1, “Files Created for Certificate Signing Requests”.

Table 16.1. Files Created for Certificate Signing Requests

Filename	Certificate Signing Request
cacsr.txt	CA signing certificate
ocspcsr.txt	Certificate Manager OCSP signing certificate
ocspcsr.txt	OCSP signing certificate

Do not modify the certificate request before sending it to the CA. The request can either be submitted automatically through the wizard or copied to the clipboard and manually submitted to the CA through its end-entities page.

> **Note**
>
> The wizard's auto-submission feature can submit requests to a remote Certificate Manager only. It cannot be used for submitting the request to a third-party CA. To submit it to a third-party CA, use the certificate request file.

14. Retrieve the certificate.

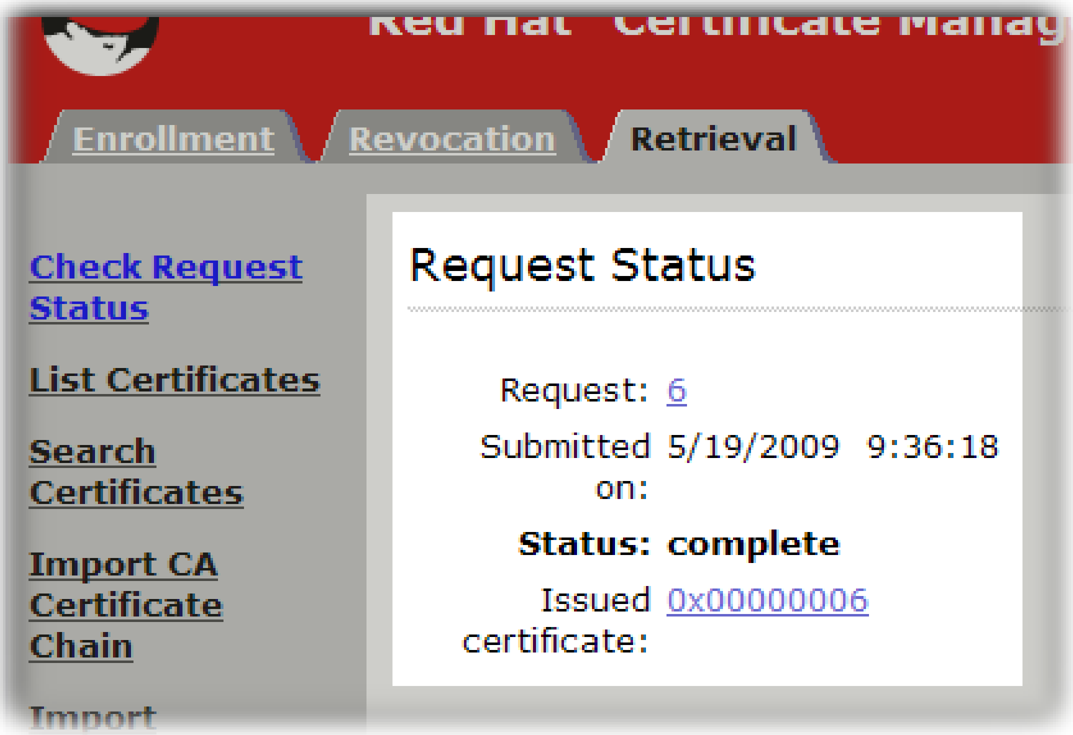
    a. Open the Certificate Manager end-entities page.

    ```
    https://server.example.com:8443/ca/ee/ca
    ```

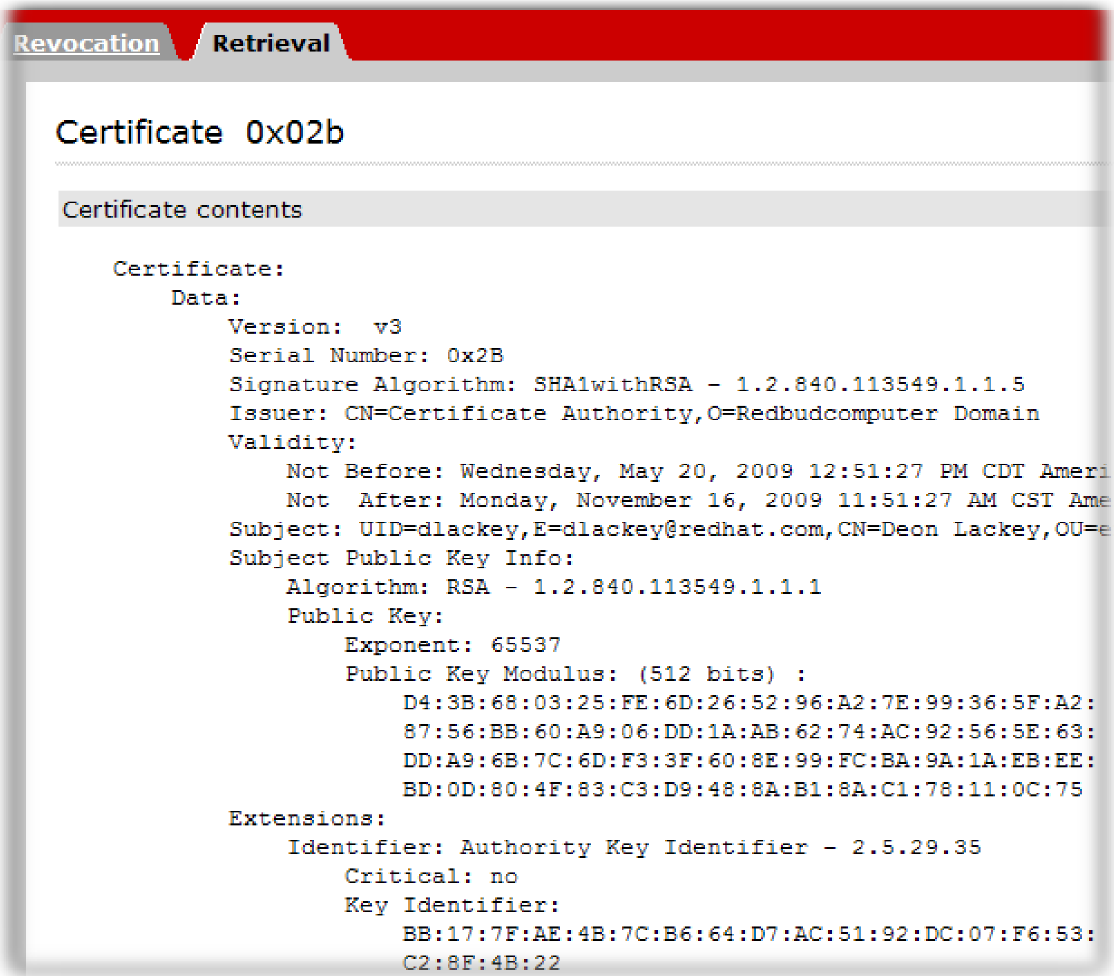
    b. Click the **Retrieval** tab.

    c. Fill in the request ID number that was created when the certificate request was submitted, and click **Submit**.

d. The next page shows the status of the certificate request. If the status is **complete**, then there is a link to the certificate. Click the **Issued certificate** link.



e. The new certificate information is shown in pretty-print format, in base-64 encoded format, and in PKCS #7 format.



f. Copy the base-64 encoded certificate, including the **-----BEGIN CERTIFICATE-----** and **-----END CERTIFICATE-----** marker lines, to a text file. Save the text file, and use it to store a copy of the certificate in a subsystem's internal database. See Section 14.4.2.1, “Creating Users”.

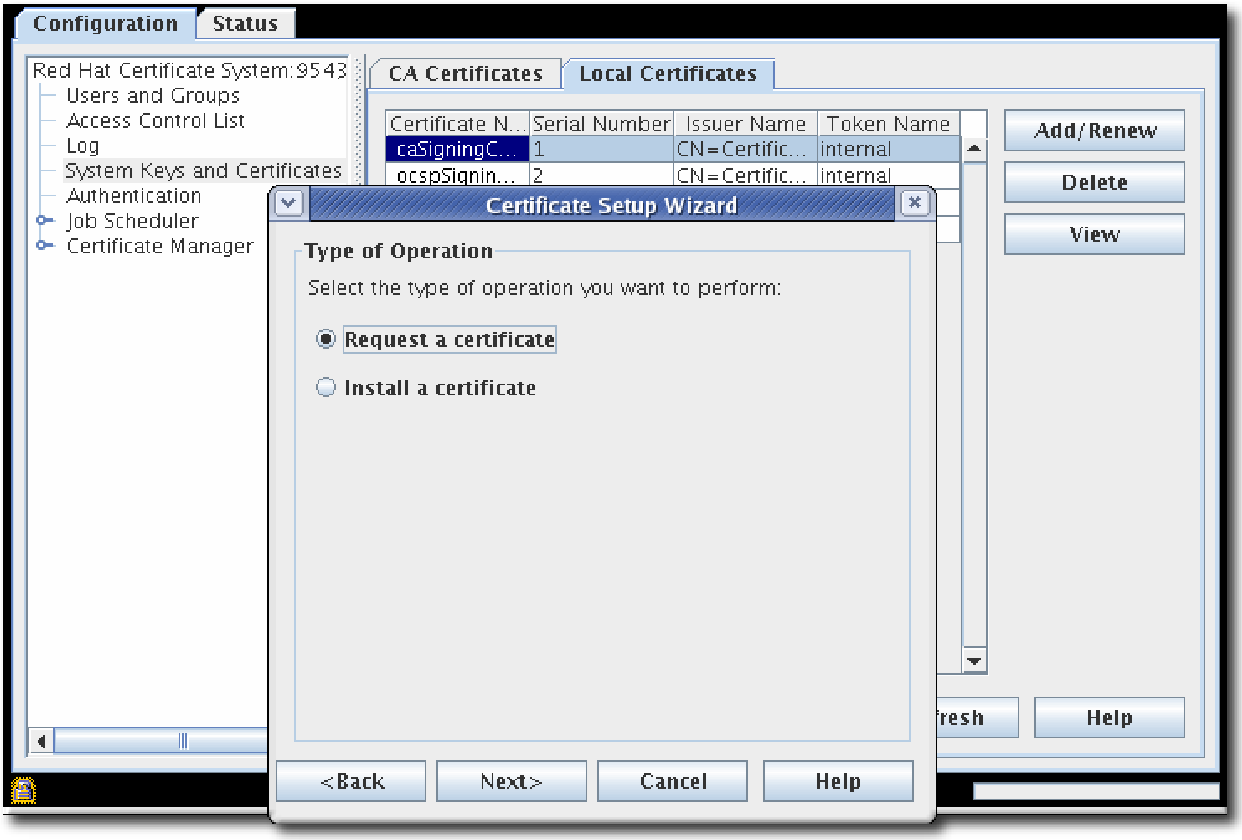
16.2.2. Requesting Other Certificates

> **Note**
>
> It is important that the user generate and submit the client request from the computer that will be used later to access the subsystem because part of the request process generates a private key on the local machine. If location independence is required, use a hardware token, such as a smart card, to store the key pair and the certificate.

1. Open the subsystem console. For example:

```
pkiconsole https://server.example.com:8443/ca
```

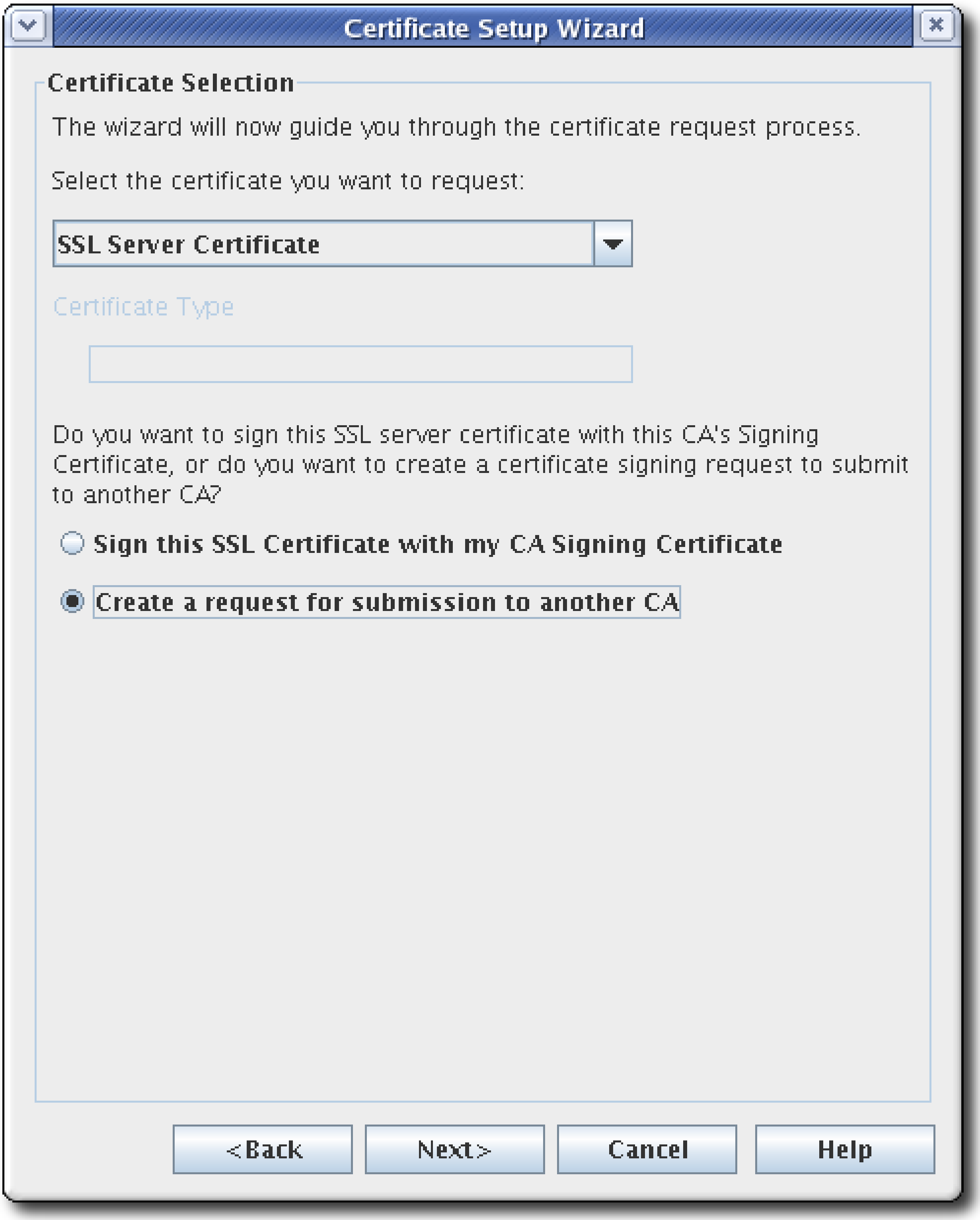
2. In the **Configuration** tab, select **System Keys and Certificates** in the navigation tree.
3. In the right panel, select the **Local Certificates** tab.
4. Click **Add/Renew**.



5. Select the **Request a certificate** radio button.

6. Choose the certificate type to request. The types of certificates that can be requested varies depending on the subsystem.

> **Note**
>
> If selecting to create an "other" certificate, the **Certificate Type** field becomes active. Fill in the type of certificate to create, either **caCrlSigning** for the CRL signing certificate, **caSignedLogCert** for an audit log signing certificate, or **client** for an SSL client certificate.

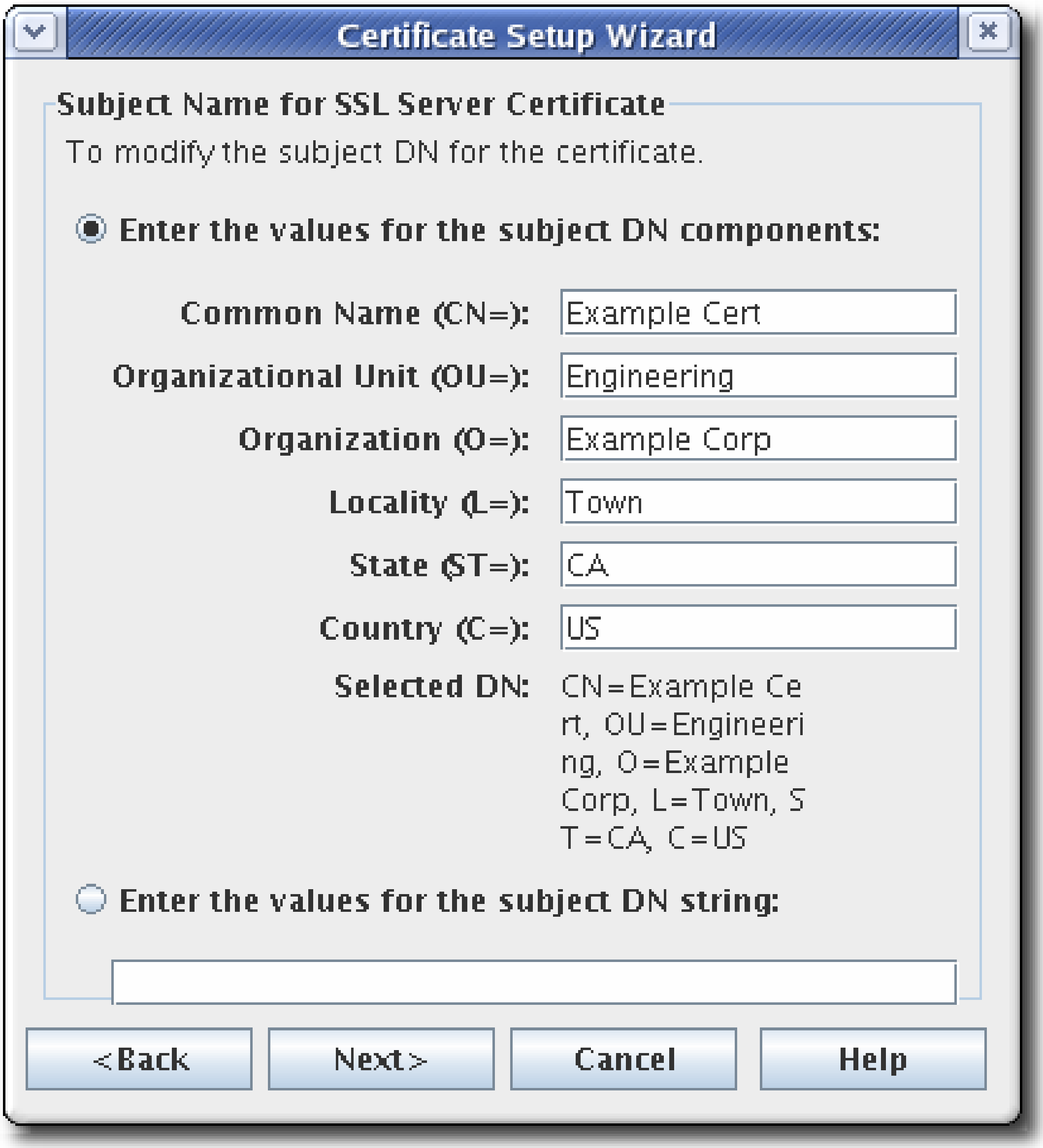


7. Select which type of CA will sign the request. The options are to use the local CA signing certificate or to create a request to submit to another CA.

8. Set the key-pair information and set the location to generate the keys (the token), which can be either the internal security database directory or one of the listed external tokens.

   To create a new certificate, you must create a new key pair. Using an existing key pair will simply renew an existing certificate.

9. Give the subject name. Either enter values for individual DN attributes to build the subject DN or enter the full string.



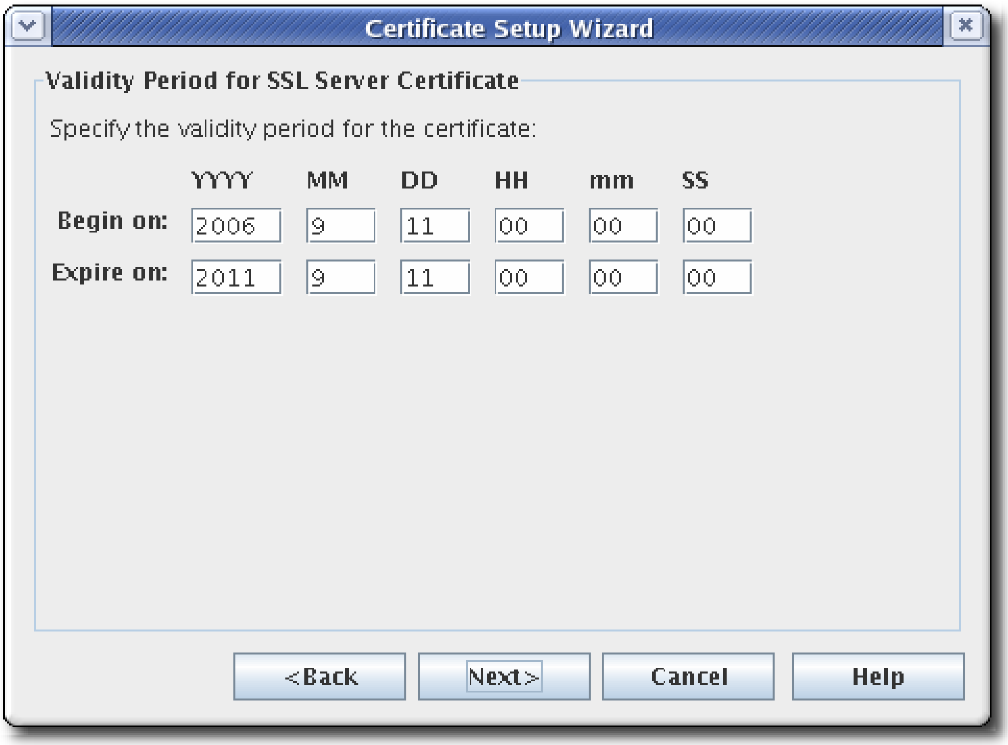
Note

For an SSL server certificate, the common name must be the fully-qualified host name of the Certificate System in the format *machine_name.domain.domain*.

The CA certificate request forms support all UTF-8 characters for the common name, organizational unit, and requester name fields.

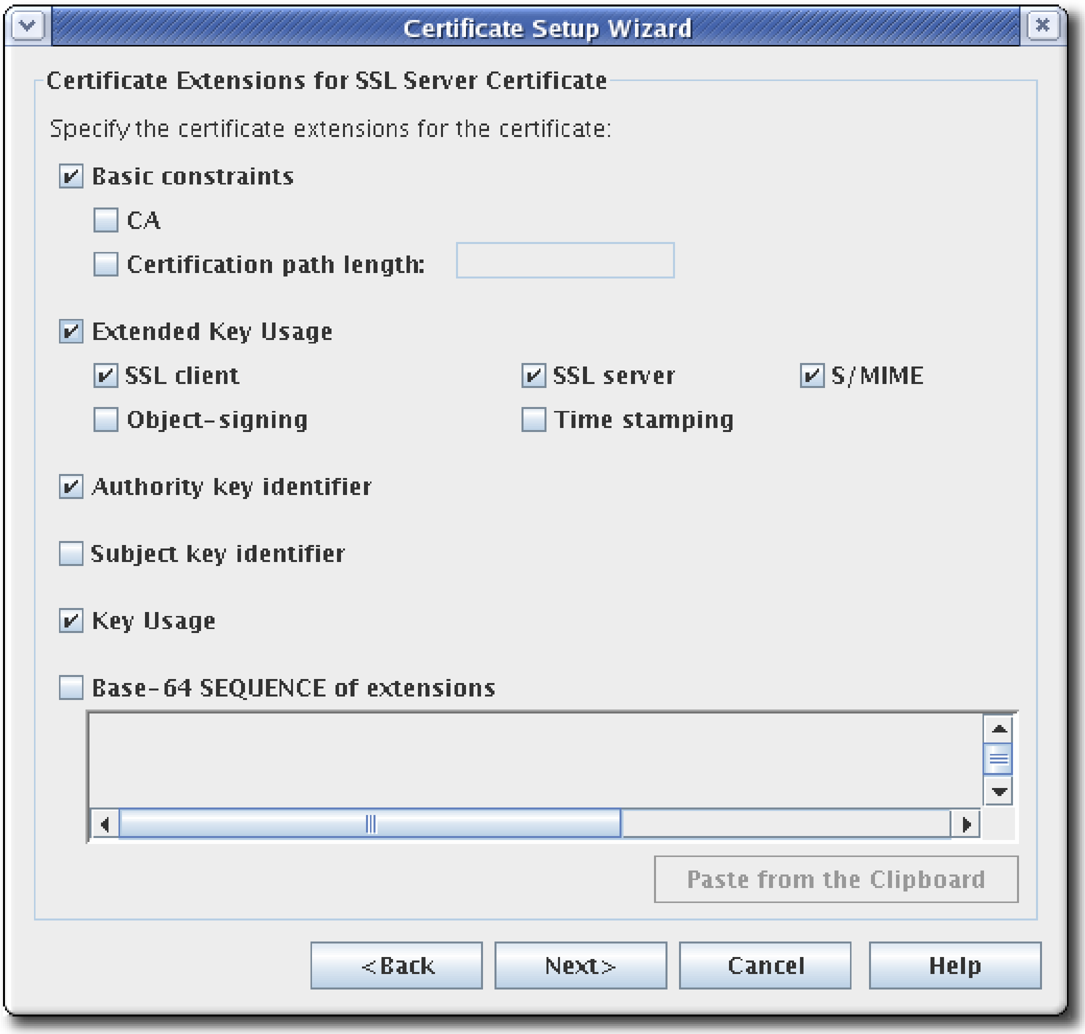
This support does not include supporting internationalized domain names.

10. Specify the start and end dates of the validity period for the certificate and the time at which the validity period will start and end on those dates.



The default validity period is five years.

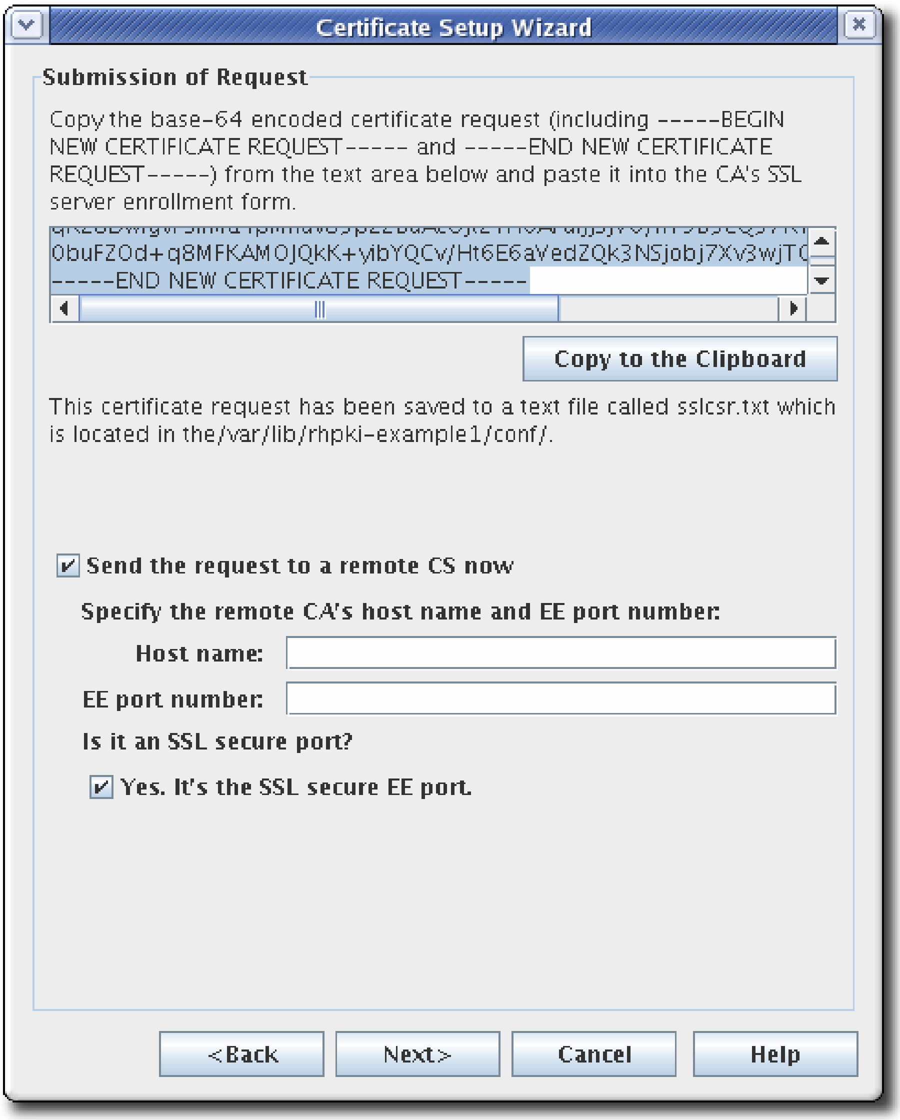
11. Set the standard extensions for the certificate. The required extensions are chosen by default. To change the default choices, read the guidelines explained in Appendix B, *Defaults, Constraints, and Extensions for Certificates and CRLs*.



- Extended Key Usage.
- Authority Key Identifier.
- Subject Key Identifier.
- Key Usage. The digital signature (bit 0), non-repudiation (bit 1), key certificate sign (bit 5), and CRL sign (bit 6) bits are set by default. The extension is marked critical as recommended by the PKIX standard and RFC 2459. See RFC 2459 for a description of the Key Usage extension.
- Base-64 SEQUENCE of extensions. This is for custom extensions. Paste the extension in MIME 64 DER-encoded format into the text field.

To add multiple extensions, use the **ExtJoiner** program. For information on using the tools, see the *Certificate System Command-Line Tools Guide*.

12. The wizard generates the key pairs and displays the certificate signing request.



The request is in base-64 encoded PKCS #10 format and is bounded by the marker lines **-----BEGIN NEW CERTIFICATE REQUEST-----** and **-----END NEW CERTIFICATE REQUEST-----**. For example:


```
-----BEGIN NEW CERTIFICATE REQUEST-----
MIICJzCCAZCgAwIBAgIBAzANBgkqhkiG9w0BAQQFADBC6SAwHgYDVQQKExdOZXRzY2
FwZSBDb21tdW5pY2
F0aW9uczngjhnMVQ2VydGlmaWNhdGUgQXV0aG9yaXR5MB4XDTk4MDgyNzE5MDAwMFo
XDTk5MDIyMzE5MDA
wMnbjdgngYoxIDAeBgNVBAoTF05ldHNjYXBlIENvbW11bmljYXRpb25zMQ8wDQYDVQ
QLEwZQZW9wbGUxFz
AVBgoJkiaJkIsZAEBEwdzdXByaXlhMRcwFQYDVQQDEw5TdXByaXlhIFNoZXR0eTEjM
CEGCSqGSIb3Dbndg
JARYUc3Vwcml5Yhvfggsvwryw4y7214vAOBgNVHQ8BAf8EBAMCBLAwFAYJYIZIAYb4
QgEBAQHBAQDAgCAM
A0GCSqGSIb3DQEBBAUAA4GBAFi9FzyJlLmS+kzsue0kTXawbwamGdYql2w4hIBgdR+
jWeLmD4CP4x
-----END NEW CERTIFICATE REQUEST-----
```


The wizard also copies the certificate request to a text file it creates in the configuration directory, which is located in **/var/lib/pki/*instance_name*/conf/**. The name of the text file depends on the type of certificate requested. The possible text files are listed in Table 16.2, “Files Created for Certificate Signing

Requests".

Table 16.2. Files Created for Certificate Signing Requests

Filename	Certificate Signing Request
kracsr.txt	KRA transport certificate
sslcsr.txt	SSL server certificate
othercsr.txt	Other certificates, such as Certificate Manager CRL signing certificate or SSL client certificate

Do not modify the certificate request before sending it to the CA. The request can either be submitted automatically through the wizard or copied to the clipboard and manually submitted to the CA through its end-entities page.

Note

The wizard's auto-submission feature can submit requests to a remote Certificate Manager only. It cannot be used for submitting the request to a third-party CA. To submit the request to a third-party CA, use one of the certificate request files.

13. Retrieve the certificate.

    a. Open the Certificate Manager end-entities page.

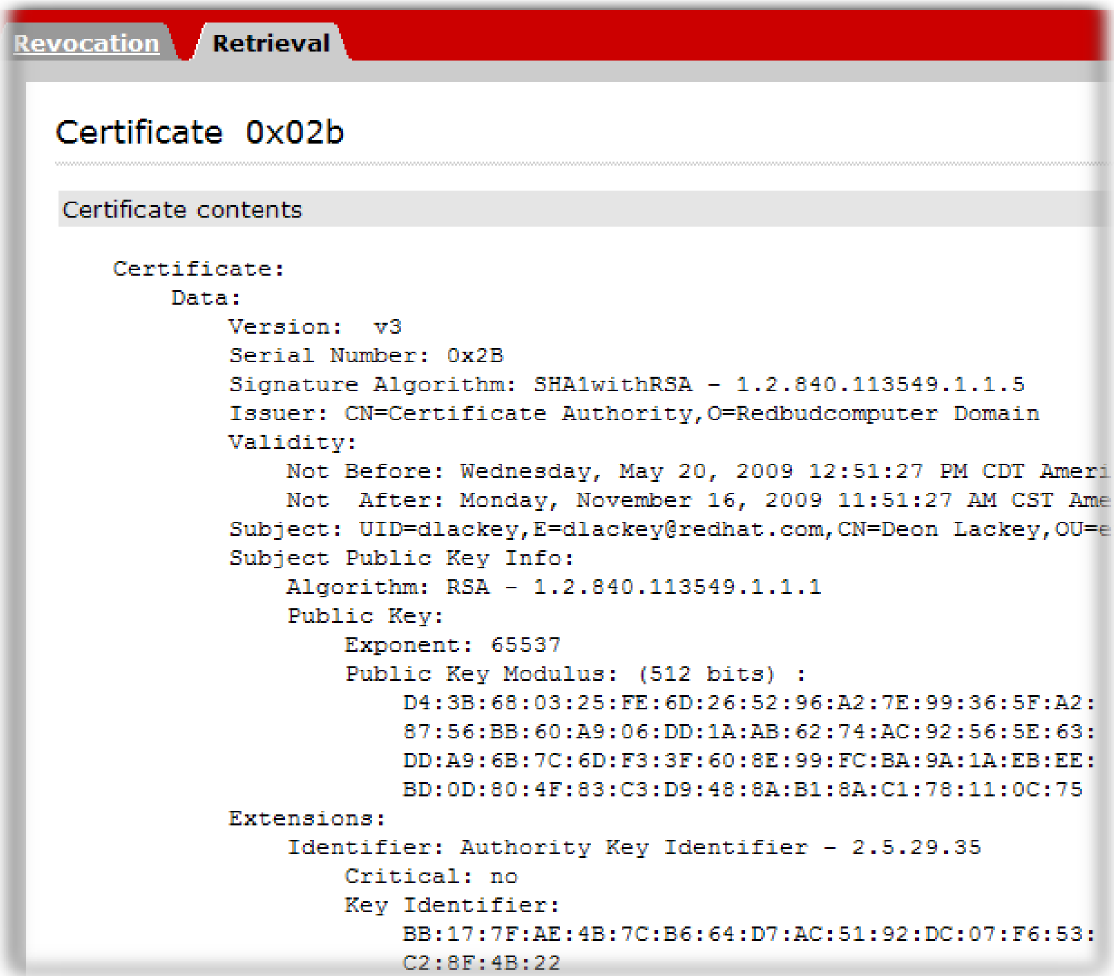
    ```
    https://server.example.com:8443/ca/ee/ca
    ```

    b. Click the **Retrieval** tab.

    c. Fill in the request ID number that was created when the certificate request was submitted, and click **Submit**.

    d. The next page shows the status of the certificate request. If the status is **complete**, then there is a link to the certificate. Click the **Issued certificate** link.

e. The new certificate information is shown in pretty-print format, in base-64 encoded format, and in PKCS #7 format.



f. Copy the base-64 encoded certificate, including the **-----BEGIN CERTIFICATE-----** and **-----END CERTIFICATE-----** marker lines, to a text file. Save the text file, and use it to store a copy of the certificate in a subsystem's internal database. See Section 14.4.2.1, “Creating Users”.

16.3. Renewing Subsystem Certificates

There are two methods of renewing a certificate. *Regenerating* the certificate takes its original key and its original profile and request, and recreates an identical key with a new validity period and expiration date. *Re-keying* a certificate resubmits the initial certificate request to the original profile, but generates a new key pair. Administrator certificates can be renewed by being re-keyed.

16.3.1. Re-keying Certificates in the End-Entities Forms

Subsystem certificates can be renewed directly in the end user enrollment forms, using the serial number of the original certificate.

1. Renew the certificates in the CA's end-entities forms, as described in Section 4.7, “Renewing Certificates”. This requires the serial number of the subsystem certificate being renewed.

2. Import the certificate into the subsystem's database, as described in Section 16.6.1, "Installing Certificates in the Certificate System Database". The certificate can be imported using **certutil** or the console. For example:

```
certutil -A -n "ServerCert cert-example" -t u,u,u -d
/var/lib/pki/instance_name/alias -a -i /tmp/example.cert
```

16.3.2. Renewing Certificates in the Console

The Java subsystems can renew any of their subsystem certificates through their administrative console. The process is exactly the same as requesting new subsystem certificates (Section 16.2, "Requesting Certificates through the Console"), with one crucial difference: renewal uses an *existing key pair* rather than generating a new one.

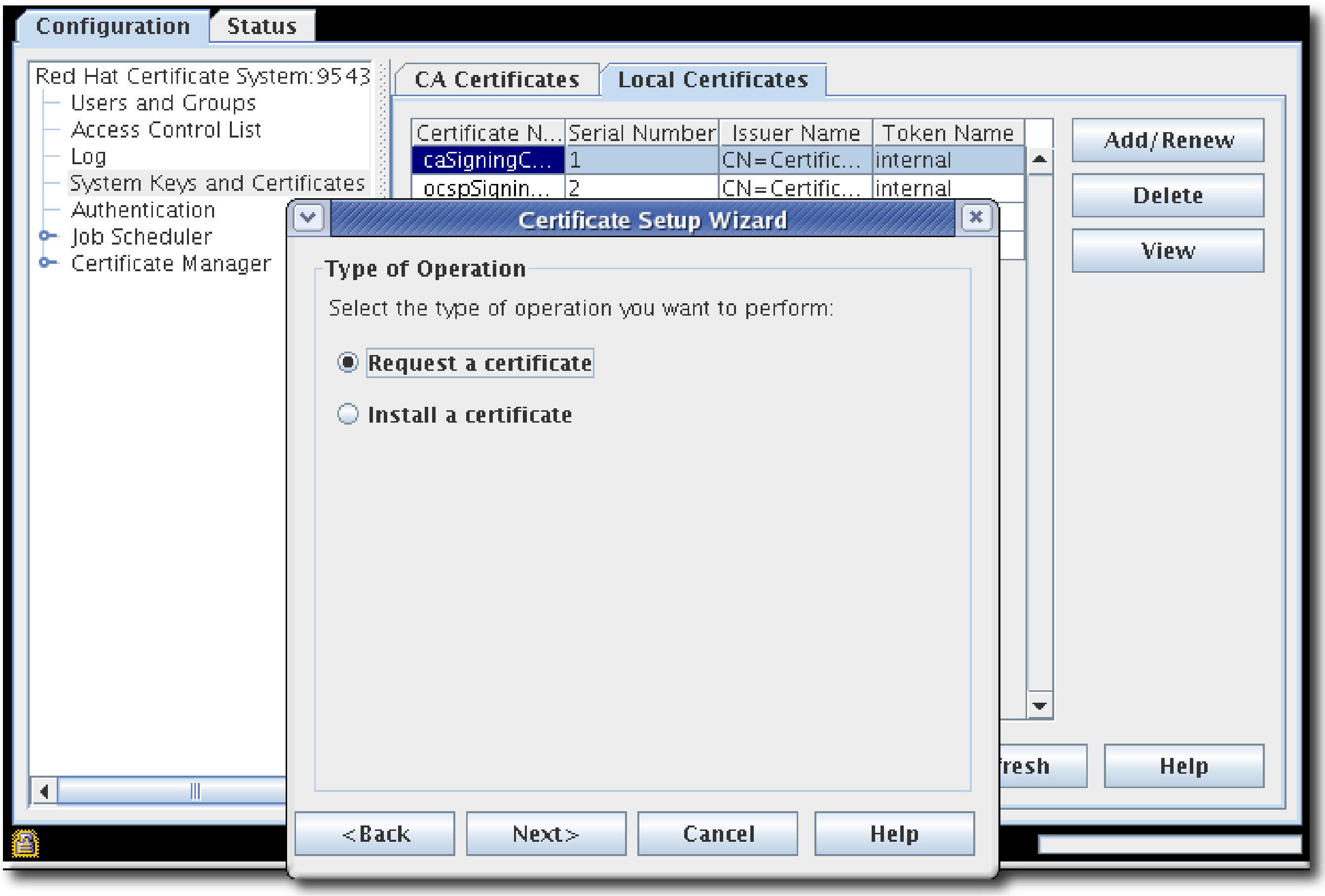


Figure 16.2. Renewing Subsystem Certificate

After renewing a certificate, then delete the original certificate from the database (Section 16.6.3, "Deleting Certificates from the Database").

16.3.3. Renewing Certificates Using certutil

certutil can be used to generate a certificate request using an existing key pair in the certificate database. The new certificate request can then be submitted through the regular profile pages for the CA to issue a renewed certificate.

Note

Encryption and signing certificates are created in a single step. However, the renewal process only renews one certificate at a time.

To renew both certificates in a certificate pair, each one has to be renewed individually.

1. Get the password for the token database.

   ```
   cat /var/lib/pki/instance_name/conf/password.conf

   internal=263163888660
   ```

2. Open the certificate database directory of the instance whose certificate is being renewed.

   ```
   cd /var/lib/pki/instance_name/alias
   ```

3. List the key and nickname for the certificate being renewed. In order to renew a certificate, the key pairs used to generate and the subject name given to the new certificate must be the same as the one in the old certificate.

   ```
   # certutil -K -d .

   certutil: Checking token "NSS Certificate DB" in slot "NSS User
   Private Key and Certificate Services"
   Enter Password or Pin for "NSS Certificate DB":
   < 0> rsa      69481646e38a6154dc105960aa24ccf61309d37d
   caSigningCert cert-pki-tomcat CA
   ```

4. Copy the **alias** directory as a backup, then delete the original certificate from the certificate database. For example:

   ```
   certutil -D -n "ServerCert cert-example"  -d .
   ```

5. Run the **certutil** command with the options set to the values in the existing certificate.

   ```
   certutil -d . -R -k "NSS Certificate DB:cert-pki-tomcat CA" -s
   "cn=CA Authority,o=Example Domain" -a -o example.req2.txt
   ```

   The difference between generating a new certificate and key pair and renewing the certificate is the value of the **-k** option. To generate an entirely new request and key pair, then **-k** sets the key type and is used with **-g**, which sets the bit length. For a renewal request, the **-k** option uses the certificate nickname to access the existing key pair stored in the security database.

   The options used to generate the renewal request are listed in Table 4.2, “Options for Requesting Certificates with certutil”, and more information about **certutil** is available at http://www.mozilla.org/projects/security/pki/nss/tools/certutil.html.

6. Submit the certificate request and then retrieve it and install it, as described in Section 4.3.2, “Requesting Certificates Using certutil”.

16.4. Changing the Names of Subsystem Certificates

One alternative to renewing certificates is replacing them with new certificates, meaning that a new certificate is generated with new keys. Generally, a new certificate can be added to the database and the old one deleted, a simple one-to-one swap. This is possible because the individual subsystem servers identify certificates based on their nickname; as long as the certificate nickname remains the same, the server can find the required certificate even if other factors — like the subject name, serial number, or key — are different.

However, in some situations, the new certificate may have a new certificate nickname, as well. In that case, the certificate nickname needs to be updated in all of the required settings in the subsystem's **CS.cfg** configuration file.

Important

Always restart a subsystem after editing the **CS.cfg** file.

These tables list all of the configuration parameters for each of the subsystem's certificates:

- Table 16.3, “CA Certificate Nickname Parameters”
- Table 16.4, “KRA Certificate Nickname Parameters”
- Table 16.5, “OCSP Certificate Nickname Parameters”
- Table 16.6, “TKS Certificate Nickname Parameters”
- Table 16.7, “TPS Nickname Parameters in CS.cfg”

Table 16.3. CA Certificate Nickname Parameters

CA Signing Certificate	ca.cert.signing.nickname ca.signing.cacertnickname ca.signing.certnickname ca.signing.nickname cloning.signing.nickname
OCSP Signing Certificate	ca.ocsp_signing.cacertnickname ca.ocsp_signing.certnickname ca.cert.ocsp_signing.nickname ca.ocsp_signing.nickname cloning.ocsp_signing.nickname

Subsystem Certificate	ca.cert.subsystem.nickname ca.subsystem.nickname cloning.subsystem.nickname pkiremove.cert.subsystem.nickname
Server Certificate	ca.sslserver.nickname ca.cert.sslserver.nickname
Audit Signing Certificate	ca.audit_signing.nickname ca.cert.audit_signing.nickname cloning.audit_signing.nickname

Table 16.4. KRA Certificate Nickname Parameters

Transport Certificate	cloning.transport.nickname kra.cert.transport.nickname kra.transport.nickname tks.kra_transport_cert_nickname Note that this parameter is in the TKS configuration file. This needs changed in the TKS configuration if the *KRA* transport certificate nickname changes, even if the TKS certificates all stay the same.
Storage Certificate	cloning.storage.nickname kra.storage.nickname kra.cert.storage.nickname
Server Certificate	kra.cert.sslserver.nickname kra.sslserver.nickname
Subsystem Certificate	cloning.subsystem.nickname kra.cert.subsystem.nickname kra.subsystem.nickname pkiremove.cert.subsystem.nickname
Audit Log Signing Certificate	cloning.audit_signing.nickname kra.cert.audit_signing.nickname kra.audit_signing.nickname

Table 16.5. OCSP Certificate Nickname Parameters

OCSP Signing Certificate	» cloning.signing.nickname » ocsp.signing.certnickname » ocsp.signing.cacertnickname » ocsp.signing.nickname
Server Certificate	» ocsp.cert.sslserver.nickname » ocsp.sslserver.nickname
Subsystem Certificate	» cloning.subsystem.nickname » ocsp.subsystem.nickname » ocsp.cert.subsystem.nickname » pkiremove.cert.subsystem
Audit Log Signing Certificate	» cloning.audit_signing.nickname » ocsp.audit_signing.nickname » ocsp.cert.audit_signing.nickname

Table 16.6. TKS Certificate Nickname Parameters

KRA Transport Certificate [a]	» tks.kra_transport_cert_nickname
Server Certificate	» tks.cert.sslserver.nickname » tks.sslserver.nickname
Subsystem Certificate	» cloning.subsystem.nickname » tks.cert.subsystem.nickname » tks.subsystem.nickname » pkiremove.cert.subsystem.nickname
Audit Log Signing Certificate	» cloning.audit_signing.nickname » tks.audit_signing.nickname » tks.cert.audit_signing.nickname

[a] This needs changed in the TKS configuration if the *KRA* transport certificate nickname changes, even if the TKS certificates all stay the same.

Table 16.7. TPS Nickname Parameters in CS.cfg

Server Certificate	» tps.cert.sslserver.nickname
Subsystem Certificate	» tps.cert.subsystem.nickname » selftests.plugin.TPSValidity.nickname » selftests.plugin.TPSPresence.nickname » pkiremove.cert.subsystem.nickname
Audit Log Signing Certificate	» tps.cert.audit_signing.nickname

16.5. Using Cross-Pair Certificates

In the late 1990s, as the US government began enhancing its public key infrastructure, it became apparent that branches of government with their own, separate PKI deployments still needed to be able to recognize and trust each others certificates *as if* the certificates were issued from their own CA. (The method of getting certificates trusted outside a network for external clients to use is a serious, not easily resolved issue for any PKI administrator.)

The US government devised a standard for issuing *cross-pair certificates* called the Federal Bridge Certificate Authority. These certificates are also called *bridge certificates*, for obvious reasons. Bridge or cross-pair certificates are CA signing certificate that are framed as dual certificate pairs, similar to encryption and signing certificate pairs for users, only each certificate in the pair is issued by a different CA. Both partner CAs store the other CA signing certificate in its database, so all of the certificates issued within the other PKI are trusted and recognized.

Bridging certificates honors certificates issued by a CA that is not chained to the root CA in its own PKI. By establishing a trust between the Certificate System CA and another CA through a cross-pair CA certificate, the cross-pair certificate can be downloaded and used to trust the certificates issued by the other CA, just as downloading and installing a single CA certificate trusts all certificates issued by the CA.

The Certificate System can issue, import, and publish cross-pair CA certificates. A special profile must be created for issuing cross-pair certificates, and then the certificates can be requested and installed for the CA using the Certificate Wizard for the CA subsystem.

To create cross-pair certificate profiles, see Section 2.2.5, “Configuring Cross-Pair Profiles”. For information on publishing cross-pair certificates, Section 7.9, “Publishing Cross-Pair Certificates”.

16.5.1. Installing Cross-Pair Certificates

Both cross-pair certificates can be imported into the Certificate System databases using the **certutil** tool or by selecting the **Cross-Pair Certificates** option from the Certificate Setup Wizard, as described in Section 16.6.1, “Installing Certificates in the Certificate System Database”.

When both certificates have been imported into the database, a **crossCertificatePair** entry is formed and stored in the database. The original individual cross-pair CA certificates are deleted once the **crossCertificatePair** entry is created.

16.5.2. Searching for Cross-Pair Certificates

Both CAs in bridge certificates can store or publish the cross-pair certificates as a **crossCertificatePair** entry in an LDAP database. The Certificate Manager's internal database can be searched for the **crossCertificatePair** entry with **ldapsearch**.

```
/usr/lib[64]/mozldap/ldapsearch -D "cn=directory manager" -w secret -p
389 -h server.example.com -b "o=server.example.com-pki-ca" -s sub "
(crossCertificatePair=*)"
```

16.6. Managing the Certificate Database

Each Certificate System instance has a certificate database, which is maintained in its internal token. This database contains certificates belonging to the subsystem installed in the Certificate System instance and various CA certificates the subsystems use for validating the certificates they receive.

Even if an external token is used to generate and store key pairs, Certificate System always maintains its list of trusted and untrusted CA certificates in its internal token.

This section explains how to view the contents of the certificate database, delete unwanted certificates, and change the trust settings of CA certificates installed in the database using the Certificate System window. For information on adding certificates to the database, see Section 16.6.1, “Installing Certificates in the Certificate System Database”.

> **Note**
>
> The Certificate System command-line utility **certutil** can be used to manage the certificate database by editing trust settings and adding and deleting certificates. For details about this tool, see http://www.mozilla.org/projects/security/pki/nss/tools/.

Administrators should periodically check the contents of the certificate database to make sure that it does not include any unwanted CA certificates. For example, if the database includes CA certificates that should not ever be trusted within the PKI setup, delete them.

16.6.1. Installing Certificates in the Certificate System Database

If new server certificates are issued for a subsystem, they must be installed in that subsystem database. Additionally, user and agent certificates must be installed in the subsystem databases. If the certificates are issued by an external CA, then usually the corresponding CA certificate or certificate chain needs to be installed.

Certificates can be installed in the subsystem certificate database through the Console's Certificate Setup Wizard or using the **certutil** utility.

- Section 16.6.1.1, “Installing Certificates through the Console”
- Section 16.6.1.2, “Installing Certificates Using certutil”
- Section 16.6.1.3, “About CA Certificate Chains”

16.6.1.1. Installing Certificates through the Console

The Certificate Setup Wizard can install or import the following certificates into either an internal or external token used by the Certificate System instance:

- Any of the certificates used by a Certificate System subsystem
- Any trusted CA certificates from external CAs or other Certificate System CAs
- Certificate chains

A certificate chain includes a collection of certificates: the subject certificate, the trusted root CA certificate, and any intermediate CA certificates needed to link the subject certificate to the trusted root. However, the certificate chain the wizard imports must include only CA certificates; none of the certificates can be a user certificate.

In a certificate chain, each certificate in the chain is encoded as a separate DER-encoded object. When the wizard imports a certificate chain, it imports these objects one after the other, all the way up the chain to the last certificate, which may or may not be the root CA certificate. If any of the certificates in the chain are already installed in the local certificate database, the wizard replaces the existing certificates with the ones in the chain. If the chain includes intermediate CA certificates, the wizard adds them to the certificate database as *untrusted* CA certificates.

The subsystem console uses the same wizard to install certificates and certificate chains. To install certificates in the local security database, do the following:

1. Open the console.

   ```
   pkiconsole https://server.example.com:secure_port/subsystem_type
   ```

2. In the **Configuration** tab, select **System Keys and Certificates** from the left navigation tree.

3. There are two tabs where certificates can be installed, depending on the subsystem type and the type of certificate.

   - The **CA Certificates** tab is for installing CA certificates and certificate chains. For Certificate Managers, this tab is used for third-party CA certificates or other Certificate System CA certificates; all of the local CA certificates are installed in the **Local Certificates** tab. For all other subsystems, all CA certificates and chains are installed through this tab.

   - The **Local Certificates** tab is where all server certificates, subsystem certificates, and local certificates such as OCSP signing or KRA transport are installed.

   Select the appropriate tab.

4. To install a certificate in the **Local Certificates** tab, click **Add/Renew**. To install a certificate in the **CA Certificates** tab, click **Add**. Both will open the Certificate Setup Wizard.

   a. When the wizard opens, select the **Install a certificate** radio button, and click **Next**.

   b. Select the type of certificate to install. The options for the drop-down menu are the same options available for creating a certificate, depending on the type of subsystem, with the additional option to install a cross-pair certificate.

   c. Paste in the certificate body, including the **-----BEGIN CERTIFICATE-----** and **-----END CERTIFICATE-----**, into the text area, or specify the absolute file location; this must be a local file.

      The certificate will look like the following:

      ```
      -----BEGIN CERTIFICATE-----
      MIICKzCCAZSgAwIBAgIBAzANgkqkiG9w0BAQQFADA3MQswCQYDVQQGEw
      JVUzERMA8GA1UEChMITmV0c2NhcGUxFTATBgNVBAsTDFN1cHJpeWEncy
      BDQTAeFw05NzEwMTgwMTM2MjVaFw05OTEwMTgwMTM2MjVaMEgxCzAJBg
      NVBAYTAlVTMREwDwYDVQQKEwhOZXRzY2FwZTENMAsGA1UECxMEUHawcz
      EXMBUGA1UEAxMOU3Vwcml5YSBTaGV0dHkwgZ8wDQYJKoZIhdfNAQEBBQ
      ADgY0AMIGJAoGBAMr6eZiPGfjX3uRJgEjmKiqG7SdATYzBcABu1AVyd7
      ```

```
chRFOGD3wNktbf6hRo6EAmM5R1Askzf8AW7LiQZBcrXpc0k4du+2j6xJ
u2MPm8WKuMOTuvzpo+SGXelmHVChEqooCwfdiZywyZNmgaMa2MS6pUkf
QVAgMBAAGjNjA0MBEGCWCGSAGG+EIBAQQEAwIAgD
-----END CERTIFICATE-----
```

5. The wizard displays the certificate details. Review the fingerprint to make sure this is the correct certificate, or use the **Back** button to go back and submit a different one. Give a nickname for the certificate.

   The wizard installs the certificate.

6. Any CA that signed the certificate must be trusted by the subsystem. Make sure that this CA's certificate exists in the subsystem's certificate database (internal or external) and that it is trusted.

   If the CA certificate is not listed, add the certificate to the certificate database as a trusted CA. If the CA's certificate is listed but untrusted, change the trust setting to trusted, as shown in Section 16.7, "Changing the Trust Settings of a CA Certificate".

   When installing a certificate issued by a CA that is not stored in the Certificate System certificate database, add that CA's certificate chain to the database. To add the CA chain to the database, copy the CA chain to a text file, start the wizard again, and install the CA chain.

16.6.1.2. Installing Certificates Using certutil

To install subsystem certificates in the Certificate System instance's security databases using **certutil**, do the following:

1. Open the subsystem's security database directory.

   ```
   cd /var/lib/pki/instance_name/alias
   ```

2. Run the **certutil** command with the **-A** to add the certificate and **-i** pointing to the file containing the certificate issued by the CA.

   ```
   certutil -A -n cert-name -t trustargs
      -d . -a -i certificate_file
   ```

   > **Note**
   >
   > If the Certificate System instance's certificates and keys are stored on an HSM, then specify the token name using the **-h** option.

   For example:

   ```
   certutil -A -n "ServerCert cert-instance_name" -t u,u,u -d . -a -i
   /tmp/example.cert
   ```

For information about using the **certutil** command, see http://www.mozilla.org/projects/security/pki/nss/tools/certutil.html.

16.6.1.3. About CA Certificate Chains

Any client or server software that supports certificates maintains a collection of trusted CA certificates in its certificate database. These CA certificates determine which other certificates the software can validate. In the simplest case, the software can validate only certificates issued by one of the CAs for which it has a certificate. It is also possible for a trusted CA certificate to be part of a chain of CA certificates, each issued by the CA above it in a certificate hierarchy.

The first certificate in the chain is processed in a context-specific manner, which varies according to how it is being imported. For Mozilla Firefox, this handling depends upon the MIME content type used on the object being downloaded. For Red Hat servers, it depends upon the options selected in the server administration interface.

Subsequent certificates are all treated the same. If the certificates contain the SSL-CA bit in the Netscape Certificate Type certificate extension and do not already exist in the local certificate database, they are added as untrusted CAs. They can be used for certificate chain validation as long as there is a trusted CA somewhere in the chain.

16.6.2. Viewing Database Content

The certificates stored in the subsystem certificates database, **cert8.db**, can be viewed through the subsystem administrative console. Alternatively, the certificates can be listed using the **certutil** utility. **certutil** must be used to view the TPS certificates because the TPS subsystem does not use an administrative console.

- Section 16.6.2.1, “Viewing Database Content through the Console”
- Section 16.6.2.2, “Viewing Database Content Using certutil”

> **Note**
>
> The certificates listed in the **cert8.db** database are the subsystem certificates used for subsystem operations. User certificates are stored with the user entries in the LDAP internal database.

16.6.2.1. Viewing Database Content through the Console

To view the contents of the database through the administrative console, do the following:

1. Open the subsystem console.

   ```
   pkiconsole https://server.example.com:secure_port/subsystem_type
   ```

2. In the **Configuration** tab, select **System Keys and Certificates** from the left navigation tree.

3. There are two tabs, **CA Certificates** and **Local Certificates**, which list different kinds of certificates.

   - **CA Certificates** lists CA certificates for which the corresponding private key material is not available, such as certificates issued by third-party CAs such as Entrust or Verisign or external Certificate System Certificate Managers.

   - **Local Certificates** lists certificates kept by the Certificate System subsystem instance, such as the KRA transport certificate or OCSP signing certificate.

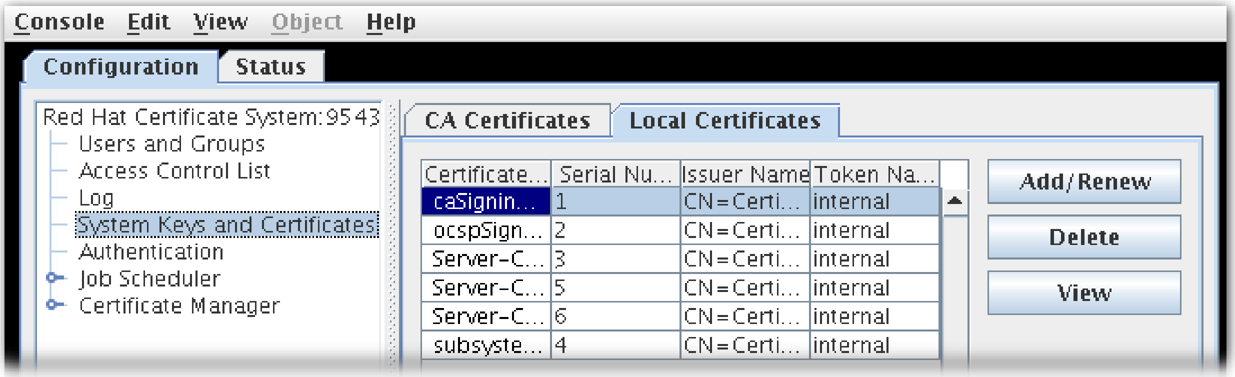


Figure 16.3. Certificate Database Tab

4. The **`Certificate Database Management`** table lists the all of the certificates installed on the subsystem. The following information is supplied for each certificate:
   - **`Certificate Name`**
   - **`Serial Number`**
   - **`Issuer Names`**, the common name (**`cn`**) of the issuer of this certificate.
   - **`Token Name`**, the name of the cryptographic token holding the certificate; for certificate stored in the database, this is **`internal`**.

To view more detailed information about the certificate, select the certificate, and click **View**. This opens a window which shows the serial number, validity period, subject name, issuer name, and certificate fingerprint of the certificate.

16.6.2.2. Viewing Database Content Using certutil

To view the certificates in the subsystem database using **`certutil`**, open the instance's certificate database directory, and run the **`certutil`** with the **`-L`** option. For example:

```
cd /var/lib/pki/instance_name/alias

certutil -L -d .

Certificate Authority - Example Domain    CT,c,
subsystemCert cert-instance name          u,u,u
Server-Cert cert-instance_name            u,u,u
```

To view the keys stored in the subsystem databases using **`certutil`**, run the **`certutil`** with the **`-K`** option. For example:

```
cd /var/lib/pki/instance_name/alias

certutil -K -d .

Enter Password or Pin for "NSS Certificate DB":
<0> subsystemCert cert-instance_name
<1>
<2> Server-Cert cert-instance_name
```

For information about using the **certutil** command, see http://www.mozilla.org/projects/security/pki/nss/tools/certutil.html.

16.6.3. Deleting Certificates from the Database

Removing unwanted certificates reduces the size of the certificate database.

> **Note**
>
> When deleting CA certificates from the certificate database, be careful not to delete the *intermediate CA certificates*, which help a subsystem chain up to the trusted CA certificate. If in doubt, leave the certificates in the database as *untrusted* CA certificates; see Section 16.7, "Changing the Trust Settings of a CA Certificate".

- Section 16.6.3.1, "Deleting Certificates through the Console"
- Section 16.6.3.2, "Deleting Certificates Using certutil"

16.6.3.1. Deleting Certificates through the Console

To delete a certificate through the Console, do the following:

1. Open the subsystem console.

   ```
   pkiconsole https://server.example.com:secure_port/subsystem_type
   ```

2. In the **Configuration** tab, select **System Keys and Certificates** from the left navigation tree.

3. Select the certificate to delete, and click **Delete**.

4. When prompted, confirm the delete.

16.6.3.2. Deleting Certificates Using certutil

To delete a certificate from the database using **certutil**:

1. Open the instance's certificate databases directory.

   ```
   /var/lib/pki/instance_name/alias
   ```

2. List the certificates in the database by running the **certutil** with the **-L** option. For example:

   ```
   certutil -L -d .

   Certificate Authority - Example Domain    CT,c,
   subsystemCert cert-instance_name          u,u,u
   Server-Cert cert-instance_name            u,u,u
   ```

3. Delete the certificate by running the **certutil** with the **-D** option.

```
certutil -D -d . -n certificate_nickname
```

For example:

```
certutil -D -d . -n "ServerCert cert-instance_name"
```

4. List the certificates again to confirm that the certificate was removed.

```
certutil -L -d .

Certificate Authority - Example Domain    CT,c,
subsystemCert cert-instance_name          u,u,u
```

For information about using the **certutil** command, see http://www.mozilla.org/projects/security/pki/nss/tools/certutil.html.

16.7. Changing the Trust Settings of a CA Certificate

Certificate System subsystems use the CA certificates in their certificate databases to validate certificates received during an SSL-enabled communication.

It can be necessary to change the trust settings on a CA stored in the certificate database, temporarily or permanently. For example, if there is a problem with access or compromised certificates, marking the CA certificate as untrusted prevents entities with certificates signed by that CA from authenticating to the Certificate System. When the problem is resolved, the CA can be marked as trusted again.

To untrust a CA permanently, consider removing its certificate from the trust database. For instructions, see Section 16.6.3, “Deleting Certificates from the Database”.

16.7.1. Changing Trust Settings through the Console

To change the trust setting of a CA certificate, do the following:

1. Open the subsystem console.

```
pkiconsole https://server.example.com:secure_port/subsystem_type
```

2. In the **Configuration** tab, **System Keys and Certificates** from the left navigation tree.

3. Select the **CA certificates** tab.

4. Select the CA certificate to modify, and click **Edit**.

5. A prompt opens which reads **The Certificate chain is (un)trusted, are you sure you want to (un)trust it?**

   Clicking **yes** changes the trust setting of the certificate chain; pressing **no** preserves the original trust relationship.

16.7.2. Changing Trust Settings Using certutil

To change the trust setting of a certificate using **certutil**, do the following:

1. Open the instance's certificate databases directory.

```
cd /var/lib/pki/instance_name/alias
```

2. List the certificates in the database by running the **certutil** with the **-L** option. For example:

```
certutil -L -d .

Certificate Authority - Example Domain    CT,c,
subsystemCert cert-instance_name          u,u,u
Server-Cert cert-instance_name            u,u,u
```

3. Change the trust settings for the certificate by running the **certutil** with the **-M** option.

```
certutil -M -n cert_nickname -t trust -d .
```

For example:

```
certutil -M -n "Certificate Authority - Example Domain" -t
TCu,TCu,TCu -d .
```

4. List the certificates again to confirm that the certificate trust was changed.

```
certutil -L -d .

Certificate Authority - Example Domain    CTu,CTu,CTu
subsystemCert cert-instance_name          u,u,u
Server-Cert cert-instance_name            u,u,u
```

For information about using the **certutil** command, see http://www.mozilla.org/projects/security/pki/nss/tools/certutil.html.

16.8. Managing Tokens Used by the Subsystems

Certificate System managers two groups of tokens: tokens used by the subsystems to perform PKI tasks and tokens issued through the subsystem. These management tasks refer specifically to tokens that are used by the subsystems.

For information on managing smart card tokens, see Chapter 5, *Using and Configuring the Token Management System: TPS, TKS, and Enterprise Security Client*.

16.8.1. Detecting Tokens

To see if a token can be detected by Certificate System to be installed or configured, use the **TokenInfo** utility.

```
TokenInfo /var/lib/pki/instance_name/alias
Database Path: /var/lib/pki/instance_name/alias
Found external module 'NSS Internal PKCS #11 Module'
```

This utility will return all tokens which can be detected by the Certificate System, not only tokens which are installed in the Certificate System.

16.8.2. Viewing Tokens

To view a list of the tokens currently installed for a Certificate System instance, use the **modutil** utility.

1. Open the instance **alias** directory. For example:

   ```
   cd /var/lib/pki/instance_name/alias
   ```

2. Show the information about the installed PKCS #11 modules installed as well as information on the corresponding tokens using the **modutil** tool.

   ```
   modutil -dbdir . -nocertdb -list
   ```

16.8.3. Changing a Token's Password

The token, internal or external, that stores the key pairs and certificates for the subsystems is protected (encrypted) by a password. To decrypt the key pairs or to gain access to them, enter the token password. This password is set when the token is first accessed, usually during Certificate System installation.

It is good security practice to change the password that protects the server's keys and certificates periodically. Changing the password minimizes the risk of someone finding out the password. To change a token's password, use the **certutil** command-line utility.

For information about **certutil**, see http://www.mozilla.org/projects/security/pki/nss/tools/.

The single sign-on password cache stores token passwords in the **password.conf** file. This file must be manually updated every time the token password is changed. For more information on managing passwords through the **password.conf** file, see Section 12.3, “Managing System Passwords”.

Part IV. References

Appendix A. Certificate Profile Input and Output Reference

Profile inputs and outputs define the expected input parameters in the certificate request and the output format of the enrollment result. Like many other components in Red Hat Certificate System, profile inputs and outputs are implemented as JAVA plug-ins to offer customization and flexibility. This appendix provides reference for the default input and output plug-ins.

- Section A.1, “Input Reference”
- Section A.2, “Output Reference”

A.1. Input Reference

An input puts certain fields on the enrollment page associated with a particular certificate profile. The inputs set for a certificate profile are used to generate the enrollment page dynamically with the appropriate fields; these input fields collect necessary information for the profile to generate the final certificate.

A.1.1. Certificate Request Input

The Certificate Request input is used for enrollments in which a certificate request is pasted into the enrollment form. It allows the request format to be set from a drop-down list and provides an input field to paste the request.

This input puts the following fields in the enrollment form:

- **Certificate Request Type**. This drop-down menu lets the user specify the certificate request type. The choices are PKCS #10 or CRMF. Certificate Management Messages over Cryptographic Message Syntax (CMC) enrollment is supported with both PKCS #10 and CRMF.
- **Certificate Request**. This is the text area in which to paste the request.

Example A.1.

```
caAdminCert.cfg:input.i1.class_id=certReqInputImpl
```

A.1.2. CMC Certificate Request Input

The CMC Certificate Request input is used for enrollments using a Certificate Message over CMS (CMC) certificate request is submitted in the request form. The request type must be either PKCS #10 or CRMF, and the only field is the **Certificate Request** text area in which to paste the request.

Example A.2.

```
caCMCUserCert.cfg:input.i1.class_id=cmcCertReqInputImpl
```

A.1.3. Dual Key Generation Input

The Dual Key Generation input is for enrollments in which dual key pairs will be generated, and thus two certificates issued, one for signing and one for encryption.

This input puts the following fields into the enrollment form:

- **`Key Generation Request Type`**. This field is a read-only field displaying **`crmf`** as the request type.
- **`Key Generation Request`**. This field sets the selection for the key size in the key generation request for both encryption and signing certificates.

Example A.3.

```
caDualCert.cfg:input.i1.class_id=dualKeyGenInputImpl
```

A.1.4. File-Signing Input

The File-Signing input sets the fields to sign a file to show it has not been tampered with.

This input creates the following fields:

- **`Key Generation Request Type`**. This field is a read-only field displaying **`crmf`** as the request type.
- **`Key Generation Request`**. This input adds a drop-down menu to select the key size to use in the key generation request.
- **`URL Of File Being Signed`**. This gives the location of the file which is to be signed.
- **`Text Being Signed`**. This gives the filename.

Example A.4.

```
caAgentFileSigning.cfg:input.i2.class_id=fileSigningInputImpl
```

A.1.5. Image Input

The Image input sets the field to sign an image file. The only field which this input creates is **`Image URL`**, which gives the location of the image which is to be signed.

A.1.6. Key Generation Input

The Key Generation input is used for enrollments in which a single key pair will be generated, generally user-based certificate enrollments.

This input puts the following fields into the enrollment form:

- **`Key Generation Request Type`**. This field is a read-only field displaying **`crmf`** as the request type.

- **Key Generation Request**. This input adds a drop-down menu to select the key size to use in the key generation request.

Example A.5.

```
caDualCert.cfg:input.i1.class_id=keyGenInputImpl
```

A.1.7. nsHKeyCertRequest (Token Key) Input

The Token Key input is used to enroll keys for hardware tokens for agents to use later for certificate-based authentication.

This input puts the following fields into the enrollment form:

- **Token Key CUID**. This field gives the CUID (contextually unique user ID) for the token device.
- **Token Key User Public Key**. This field must contain the token user's public key.

Example A.6.

```
caTempTokenDeviceKeyEnrollment.cfg:input.i1.class_id=nsHKeyCertReqInpu
tImpl
```

A.1.8. nsNKeyCertRequest (Token User Key) Input

The Token User Key input is used to enroll keys for the user of a hardware token, for agents to use the token later for certificate-based authentication. This input puts the following fields into the enrollment form:

- **Token Key User UID**. This field gives the UID for the LDAP entry of the user of the token device.
- **Token Key User Public Key**. This field must contain the token user's public key.

Example A.7.

```
caTempTokenUserEncryptionKeyEnrollment.cfg:input.i1.class_id=nsNKeyCer
tReqInputImpl
```

A.1.9. Serial Number Renewal Input

The Serial Number Renewal Input is used to set the serial number of an existing certificate so that the CA can pull the original certificate entry and use the information to regenerate the certificate. The input inserts a **Serial Number** field into the enrollment form.

This is the only input that needs to be used with a renewal form; all the other information is supplied by the certificate entry.

Example A.8.

```
caTokenUserEncryptionKeyRenewal.cfg:input.i1.class_id=serialNumRenewIn
putImpl
```

A.1.10. Subject DN Input

The Subject DN input allows the user to input the specific DN to set as the certificate subject name, and the input inserts a single **Subject Name** field into the enrollment form.

Example A.9.

```
caAdminCert.cfg:input.i3.class_id=subjectDNInputImpl
```

A.1.11. Subject Name Input

The Subject Name input is used for enrollment when DN parameters need to be collected from the user. The parameters are used to formulate the subject name in the certificate. This input puts the following fields into the enrollment form:

- **UID** (the LDAP directory user ID)
- **Email**
- **Common Name** (the name of the user)
- **Organizational Unit** (the organizational unit (***ou***) to which the user belongs)
- **Organization** (the organization name)
- **Country** (the country where the user is located)

Example A.10.

```
caDualCert.cfg:input.i2.class_id=subjectNameInputImpl
```

A.1.12. Submitter Information Input

The Submitter Information input collects the certificate requester's information such as name, email, and phone.

This input puts the following fields into the enrollment form:

- Requester Name
- Requester Email
- Requester Phone

Example A.11.

```
caAdminCert.cfg:input.i2.class_id=submitterInfoInputImpl
```

A.1.13. Generic Input

The Generic Input allows admins to specify any number of input fields to be used with extension plug-ins that handle patterns. For example, the **ccm** and **GUID** parameters are used in the patterned Subject Alternative Name Extension Default plug-in:

Example A.12.

```
input.i3.class_id=genericInputImpl
input.i3.params.gi_display_name0=ccm
input.i3.params.gi_param_enable0=true
input.i3.params.gi_param_name0=ccm
input.i3.params.gi_display_name1=GUID
input.i3.params.gi_param_enable1=true
input.i3.params.gi_param_name1=GUID
input.i3.params.gi_num=2
…
policyset.set1.p6.default.class_id=subjectAltNameExtDefaultImpl
policyset.set1.p6.default.name=Subject Alternative Name Extension
Default
policyset.set1.p6.default.params.subjAltExtGNEnable_0=true
policyset.set1.p6.default.params.subjAltExtGNEnable_1=true
policyset.set1.p6.default.params.subjAltExtPattern_0=$request.ccm$
policyset.set1.p6.default.params.subjAltExtType_0=DNSName
policyset.set1.p6.default.params.subjAltExtPattern_1=
(Any)1.3.6.1.4.1.311.25.1,0410$request.GUID$
policyset.set1.p6.default.params.subjAltExtType_1=OtherName
policyset.set1.p6.default.params.subjAltNameExtCritical=false
policyset.set1.p6.default.params.subjAltNameNumGNs=2
```

A.1.14. Subject Alternative Name Extension Input

The Subject Alternative Name Extension Input is used along with the Subject Alternative Name Extension Default plug-in. It allows admins to enable the numbered parameters in URI with the pattern **req_san_pattern_#** into the input and therefore the **SubjectAltNameExt** extension. For example, URI containing:

```
...&req_san_pattern_0=host0.Example.com&req_san_pattern_1=host1.Example.
com
```

injects **host0.Example.com** and **host1.Example.com** into the **SubjectAltNameExt** extension from the profile below.

Example A.13.

```
input.i3.class_id=
```

```
input.i3.name=subjectAltNameExtInputImplsubjectAltNameExtInputImpl
…
policyset.serverCertSet.9.constraint.class_id=noConstraintImpl
policyset.serverCertSet.9.constraint.name=No Constraint
policyset.serverCertSet.9.default.class_id=subjectAltNameExtDefaultImp
l
policyset.serverCertSet.9.default.name=Subject Alternative Name
Extension Default
policyset.serverCertSet.9.default.params.subjAltExtGNEnable_0=true
policyset.serverCertSet.9.default.params.subjAltExtPattern_0=$request.
req_san_pattern_0$
policyset.serverCertSet.9.default.params.subjAltExtType_0=DNSName
policyset.serverCertSet.9.default.params.subjAltExtGNEnable_1=true
policyset.serverCertSet.9.default.params.subjAltExtPattern_1=$request.
req_san_pattern_1$
policyset.serverCertSet.9.default.params.subjAltExtType_1=DNSName
policyset.serverCertSet.9.default.params.subjAltExtGNEnable_2=false
policyset.serverCertSet.9.default.params.subjAltExtPattern_2=$request.
req_san_pattern_2$
policyset.serverCertSet.9.default.params.subjAltExtType_2=DNSName
policyset.serverCertSet.9.default.params.subjAltNameExtCritical=false
policyset.serverCertSet.9.default.params.subjAltNameNumGNs=2
```

A.2. Output Reference

An output is the response to the end user of a successful enrollment.

A.2.1. Certificate Output

This output displays the certificate in pretty-print format. This output cannot be configured or changed. It does not display anything other than the certificate in pretty-print format.

This output needs to be specified for any automated enrollment. Once a user successfully authenticates using the automated enrollment method, the certificate is automatically generated, and this output page is returned to the user. In an agent-approved enrollment, the user can get the certificate, once it is issued, by providing the request ID in the end-entities page.

Example A.14.

```
caAdminCert.cfg:output.o1.class_id=certOutputImpl
```

A.2.2. PKCS #7 Output

This output returns the certificate and the certificate chain in PKCS #7 format. PKCS #7 format is the Cryptographic Message Syntax Standard, which is used for signing. This output cannot be configured or changed.

Example A.15.

```
caAgentFileSigning.cfg:output.o1.class_id=pkcs7OutputImpl
```

A.2.3. nsNSKeyOutput

This class implements the output plug-in that returns the DER encoded certificates for token keys.

A.2.4. CMMF Output

This output returns the certificate in Certificate Management Messages Formats (CMMF). CMMF govern communication between different parts of a PKI and is used for requesting certificates and requesting certificate revocation.

Appendix B. Defaults, Constraints, and Extensions for Certificates and CRLs

This appendix explains both the standard certificate extensions defined by X.509 v3 and the extensions defined by Netscape that were used in versions of products released before X.509 v3 was finalized. It provides recommendations for extensions to use with specific kinds of certificates, including PKIX Part 1 recommendations.

Important

This appendix is a reference for defaults, constraints, and certificate and CRL extensions that are used or are configurable in Red Hat Certificate System. For a complete reference and explanation of certificate and CRL extensions, see RFC 3280.

This appendix contains the following sections:

B.1. Defaults Reference

Defaults are used to define the contents of a certificate. This section lists and defines the predefined defaults.

B.1.1. Authority Info Access Extension Default

This default attaches the Authority Info Access extension. This extension specifies how an application validating a certificate can access information, such as online validation services and CA policy data, about the CA that has issued the certificate. This extension should not be used to point directly to the CRL location maintained by a CA; the CRL Distribution Points extension, Section B.1.7, “CRL Distribution Points Extension Default”, provides references to CRL locations.

For general information about this extension, see Section B.3.1, “authorityInfoAccess”.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

This default can define up to five locations, with parameters for each location. The parameters are marked with an *n* in the table to show with which location the parameter is associated.

Table B.1. Authority Info Access Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
Method_*n*	Specifies the access method for retrieving additional information about the CA that has issued the certificate in which the extension appears. This is one of the following values: - ocsp (1.3.6.1.5.5.7.48.1). - calssuers (1.3.6.1.5.5.7.48.2) - renewal (2.16.840.1.113730.16.1)
LocationType_*n*	Specifies the general name type for the location that contains additional information about the CA that has issued the certificate. This is one of the following types: - DirectoryName - DNSName - EDIPartyName - IPAddress - OID - RFC822Name - URIName

Parameter	Description
Location_*n*	Specifies the address or location to get additional information about the CA that has issued the certificate. » For **directoryName**, the value must be a string form of X.500 name, similar to the subject name in a certificate. For example, *cn=SubCA, ou=Research Dept, o=Example Corporation, c=US*. » For **dNSName**, the value must be a valid fully-qualified domain name. For example, *testCA.example.com*. » For **EDIPartyName**, the value must be an IA5String. For example, *Example Corporation*. » For **iPAddress**, the value must be a valid IP address. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*. » For **OID**, the value must be a unique, valid OID specified in dot-separated numeric component notation. For example, *1.2.3.4.55.6.5.99*. » For **RFC822Name**, the value must be a valid Internet mail address. » For **URIName**, the value must be a non-relative universal resource identifier (URI) following the URL syntax and encoding rules. The name must include both a scheme, such as **http**, and a fully-qualified domain name or IP address of the host. For example, *http://ocspResponder.example.com:8000*. Certificate System allows both IPv4 and IPv6 IP addresses.
Enable_*n*	Specifies whether this location is enabled. Select **true** to mark this as set; select **false** to disable it.

B.1.2. Authority Key Identifier Extension Default

This default attaches the Authority Key Identifier extension to the certificate. The extension identifies the public key that corresponds to the private key used by a CA to sign certificates. This default has no parameters. If used, this extension is included in the certificate with the public key information.

This default takes the following constraint:

- No Constraints; see Section B.2.8, “No Constraint”.

For general information about this extension, see Section B.3.2, “authorityKeyIdentifier”.

B.1.3. Authentication Token Subject Name Default

This profile default populates subject names based on the attribute values in the authentication token (AuthToken) object.

This default plug-in works with the directory-based authentication manager. The Directory-Based User Dual-Use Certificate Enrollment certificate profile has two input parameters, UID and password. The directory-based authentication manager checks if the given UID and password are correct.

In addition, the directory-based authentication manager formulates the subject name of the issuing certificate. It forms the subject name by using the user's DN value from *AuthToken*.

This default is responsible for reading the subject name from the *AuthToken* and placing it in the certificate request so that the final certificate contains the subject name.

The following constraints can be defined with this default:

- No Constraints; see Section B.2.8, “No Constraint”.

B.1.4. Basic Constraints Extension Default

This default attaches the Basic Constraint extension to the certificate. The extension identifies whether the Certificate Manager is a CA. The extension is also used during the certificate chain verification process to identify CA certificates and to apply certificate chain-path length constraints.

For general information about this extension, see Section B.3.3, “basicConstraints”.

The following constraints can be defined with this default:

- Basic Constraints Extension Constraint; see Section B.2.1, “Basic Constraints Extension Constraint”.
- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.2. Basic Constraints Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.

Parameter	Description
IsCA	Specifies whether the certificate subject is a CA. With **true**, the server checks the **PathLen** parameter and sets the specified path length in the certificate. With **false**, the server treats the certificate subject as a non-CA and ignores the value specified for the **PathLen** parameter.
PathLen	Specifies the path length, the maximum number of CA certificates that may be chained below (subordinate to) the subordinate CA certificate being issued. The path length affects the number of CA certificates to be used during certificate validation. The chain starts with the end-entity certificate being validated and moves up. The **maxPathLen** parameter has no effect if the extension is set in end-entity certificates. The permissible values are **0** or *n*. The value should be less than the path length specified in the Basic Constraints extension of the CA signing certificate. **0** specifies that no subordinate CA certificates are allowed below the subordinate CA certificate; only an end-entity certificate may follow in the path. *n* must be an integer greater than zero. It specifies the maximum number of subordinate CA certificates allowed below the subordinate CA certificate. If the field is blank, the path length defaults to a value that is determined by the path length set in the Basic Constraints extension in the issuer's certificate. If the issuer's path length is unlimited, the path length in the subordinate CA certificate will also be unlimited. If the issuer's path length is an integer greater than zero, the path length in the subordinate CA certificate will be set to a value that is one less than the issuer's path length; for example, if the issuer's path length is 4, the path length in the subordinate CA certificate will be set to 3.

B.1.5. CA Validity Default

This default adds an option to a CA certificate enrollment or renewal profile to bypass the CA's signing certificate's expiration constraint. This means that the issued CA certificate can have an expiration date that is later than the issuing CA signing certificate expiration date.

The following constraints can be defined with this default:

- Validity Constraint; see Section B.2.14, “Validity Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.3. CA Validity Default Parameters

Parameter	Description
bypassCAnotafterrange	Sets the default value for whether a requesting CA can request a certificate whose validity period extends past the issuing CA's validity period.
range	Specifies the absolute validity period for this certificate, in the number of days.
startTime	Sets when the validity period begins, based on the current time.

B.1.6. Certificate Policies Extension Default

This default attaches the Certificate Policy Mappings extension into the certificate template. This extension defines one or more policies, indicating the policy under which the certificate has been issued and the purposes for which the certificate may be used. This default defines up to five policies, but this can be value can be changed.

For general information about this extension, see Section B.3.4, “certificatePoliciesExt”

Table B.4. Certificate Policies Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
numCertPolicies	Specifies the number of policies that can be defined. The default is **5**.
enable	Select **true** to enable the policy; select **false** to disable the policy.
policyId	Specifies the OID identifier for the policy.
cpsURI.enable	The extension can include a URI to the issuer's Certificate Practice Statement. Select **true** to enable URI; select **false** to disable URI.
CPSURI.value	This value is a pointer to a Certification Practice Statement (CPS) published by the CA. The pointer is in the form of a URI.

Parameter	Description
usernotice.enable	The extension can include a URI to the issuer's Certificate Practice Statement or can embed issuer information, such as a user notice in text form. Select **true** to enable user notices; select **false** to disable the user notices.
usernotice.noticeReference.noticeNumbers	This optional user notice parameter is a sequence of numbers that points to messages stored elsewhere.
usernotice.noticeReference.organization	This optional user notice parameter specifies the name of the company.
usernotice.explicitText.value	This optional user notice parameter contains the message within the certificate.

B.1.7. CRL Distribution Points Extension Default

This default attaches the CRL Distribution Points extension to the certificate. This extension identifies locations from which an application that is validating the certificate can obtain the CRL information to verify the revocation status of the certificate.

For general information about this extension, see Section B.3.5, “CRLDistributionPoints”.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

This default defines up to five locations, with parameters for each location. The parameters are marked with an *n* in the table to show with which location the parameter is associated.

Table B.5. CRL Distribution Points Extension Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
Type_*n*	Specifies the type of CRL distribution point. The permissible values are **DirectoryName**, **URIName**, or **RelativeToIssuer**. The type must correspond to the value in the **Name** field.

Parameter	Description
Name_*n*	Specifies the name of the CRL distribution point, the name can be in any of the following formats: • An X.500 directory name in the RFC 2253 syntax. The name looks similar to the subject name in a certificate, like *cn=CA Central, ou=Research Dept, o=Example Corporation, c=US*. • A URIName, such as *http://testCA.example.com:80*. • An RDN which specifies a location relative to the CRL issuer. In this case, the value of the **Type** attribute must be **RelativeToIssuer**.
Reasons_*n*	Specifies revocation reasons covered by the CRL maintained at the distribution point. Provide a comma-separated list of the following constants: • unused • keyCompromise • cACompromise • affiliationChanged • superseded • cessationOfOperation • certificateHold
IssuerType_*n*	Specifies the naming type of the issuer that has signed the CRL maintained at the distribution point. The issuer name can be in any of the following formats: • RFC822Name • DirectoryName • DNSName • EDIPartyName • URIName • IPAddress • OIDName • OtherName
IssuerName_*n*	Specifies the name format of the CRL issuer that signed the CRL. The permissible values are as follows: • For **RFC822Name**, the value must be a valid Internet mail address. For example, *testCA@example.com*. • For **DirectoryName**, the value must be a string form of X.500 name, similar to the subject name in a certificate. For

Parameter	Description
	example, *cn=SubCA, ou=Research Dept, o=Example Corporation, c=US*. » For **DNSName**, the value must be a valid fully-qualified domain name. For example, *testCA.example.com*. » For **EDIPartyName**, the value must be an IA5String. For example, *Example Corporation*. » For **URIName**, the value must be a non-relative URI following the URL syntax and encoding rules. The name must include both a scheme, such as **http**, and a fully qualified domain name or IP address of the host. For example, *http://testCA.example.com*. Certificate System supports both IPv4 and IPv6 addresses. » For **IPAddress**, the value must be a valid IP address. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*. » For **OIDName**, the value must be a unique, valid OID specified in dot-separated numeric component notation. For example, *1.2.3.4.55.6.5.99*. » **OtherName** is used for names with any other format; this supports **PrintableString**, **IA5String**, **UTF8String**, **BMPString**, **Any**, and **KerberosName**. **KerberosName** has the format *Realm|NameType|NameStrings*, such as **realm1|0|userID1,userID2**. **OtherName** must have the format *(type)oid,string*. For example, **(IA5String)1.2.3.4,MyExample**. The value for this parameter must correspond to the value in the **issuerName** field.

B.1.8. Extended Key Usage Extension Default

This default attaches the Extended Key Usage extension to the certificate.

For general information about this extension, see Section B.3.6, “extKeyUsage”.

The extension identifies the purposes, in addition to the basic purposes indicated in the Key Usage extension, for which the certified public key may be used. For example, if the key usage extension identifies a signing key, the Extended Key Usage extension can narrow the usage of the key for only signing OCSP responses or only Java™ applets.

Table B.6. PKIX Usage Definitions for the Extended Key Usage Extension

Usage	OID
Server authentication	1.3.6.1.5.5.7.3.1
Client authentication	1.3.6.1.5.5.7.3.2
Code signing	1.3.6.1.5.5.7.3.3
Email	1.3.6.1.5.5.7.3.4
IPsec end system	1.3.6.1.5.5.7.3.5
IPsec tunnel	1.3.6.1.5.5.7.3.6
IPsec user	1.3.6.1.5.5.7.3.7
Timestamping	1.3.6.1.5.5.7.3.8

Windows 2000 can encrypt files on the hard disk, a feature known as encrypted file system (EFS), using certificates that contain the Extended Key Usage extension with the following two OIDs:

1.3.6.1.4.1.311.10.3.4 (EFS certificate)

1.3.6.1.4.1.311.10.3.4.1 (EFS recovery certificate)

The EFS recovery certificate is used by a recovery agent when a user loses the private key and the data encrypted with that key needs to be used. Certificate System supports these two OIDs and allows certificates to be issued containing the Extended Key Usage extension with these OIDs.

Normal user certificates should be created with only the EFS OID, not the recovery OID.

The following constraints can be defined with this default:

- Extended Key Usage Constraint; see Section B.2.3, “Extended Key Usage Extension Constraint”.
- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.7. Extended Key Usage Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.

Parameter	Description
OIDs	Specifies the OID that identifies a key-usage purpose. The permissible values are a unique, valid OID specified in the dot-separated numeric component notation. For example, *2.16.840.1.113730.1.99*. Depending on the key-usage purposes, the OIDs can be designated by PKIX (listed in Table B.6, "PKIX Usage Definitions for the Extended Key Usage Extension") or custom OIDs. Custom OIDs must be in the registered subtree of IDs reserved for the company's use. Although it is possible to use custom OIDs for evaluating and testing the Certificate System, in a production environment, comply with the ISO rules for defining OIDs and for registering subtrees of IDs.

B.1.9. Freshest CRL Extension Default

This default attaches the Freshest CRL extension to the certificate.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, "Extension Constraint".
- No Constraints; see Section B.2.8, "No Constraint".

This default defines five locations with parameters for each location. The parameters are marked with an *n* in the table to show with which location the parameter is associated.

Table B.8. Freshest CRL Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
PointEnable_*n*	Select **true** to enable this point; select **false** to disable this point.
PointType_*n*	Specifies the type of issuing point, either **DirectoryName** or **URIName**.
PointName_*n*	• If **pointType** is set to **directoryName**, the value must be an X.500 name, similar to the subject name in a certificate. For example, *cn=CACentral,ou=Research Dept,o=Example Corporation,c=US*. • If **pointType** is set to **URIName**, the name must be a URI, an absolute pathname that specifies the host. For example, *http://testCA.example.com/get/crls/here/*.
PointIssuerName_*n*	

Parameter	Description
	Specifies the name of the issuer that has signed the CRL. The name can be in any of the following formats: - For **RFC822Name**, the value must be a valid Internet mail address. For example, *testCA@example.com*. - For **DirectoryName**, the value must be a string form of X.500 name, similar to the subject name in a certificate. For example, *cn=SubCA, ou=Research Dept, o=Example Corporation, c=US*. - For **DNSName**, the value must be a valid fully-qualified domain name. For example, *testCA.example.com*. - For **EDIPartyName**, the value must be an IA5String. For example, *Example Corporation*. - For **URIName**, the value must be a non-relative URI following the URL syntax and encoding rules. The name must include both a scheme, such as **http**, and a fully qualified domain name or IP address of the host. For example, *http://testCA.example.com*. Certificate System supports both IPv4 and IPv6 addresses. - For **IPAddress**, the value must be a valid IP address. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*. - For **OIDName**, the value must be a unique, valid OID specified in dot-separated numeric component notation. For example, *1.2.3.4.55.6.5.99*. - **OtherName** is used for names with any other format; this supports **PrintableString**, **IA5String**, **UTF8String**, **BMPString**, **Any**, and **KerberosName**. **KerberosName** has the format *Realm|NameType|NameStrings*, such as **realm1|0|userID1,userID2**. **OtherName** must have the format *(type)oid,string*. For example, **(IA5String)1.2.3.4,MyExample**.

Parameter	Description
	The name value must comply with the format specified in **PointType_**.
PointType_*n*	Specifies the general name type of the CRL issuer that signed the CRL. The permissible values are as follows: » RFC822Name » DirectoryName » DNSName » EDIPartyName » URIName » IPAddress » OIDName » OtherName The value for this parameter must correspond to the value in the **PointIssuerName** field.

B.1.10. Generic Extension Default

This extension allows for the creation of a generic extension with user determined data. The default ensures the generic extension is populated correctly.

Table B.9. Generic Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
genericExtOID	Specifies the extensions OID identifier.
genericExtData	The binary data contained within the extension.

B.1.11. Inhibit Any-Policy Extension Default

The inhibit any-policy extension can be used for certificates issued to CAs. The inhibit any-policy indicates that the special anyPolicy OID, with the value { 2 5 29 32 0 }, is not considered an explicit match for other certificate policies.

Table B.10. Inhibit Any-Policy Extension Default Configuration Parameters

Parameter	Description
Critical	*This policy must be marked as critical.* Select **true** to mark this extension critical; select **false** to mark the extension noncritical.

Parameter	Description
SkipCerts	This parameter indicate the number of additional certificates that may appear in the path before any-policy is no longer allowed. A value of **1** indicates that any-policy may be processed in certificates issued by the subject of this certificate, but not in additional certificates in the path.

B.1.12. Issuer Alternative Name Extension Default

This default attaches the Issuer Alternative Name extension to the certificate. The Issuer Alternative Name extension is used to associate Internet-style identities with the certificate issuer.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

This default defines five locations with parameters for each location. The parameters are marked with an *n* in the table to show with which location the parameter is associated.

Table B.11. Issuer Alternative Name Extension Default Configuration Parameters

Parameter	Description
Critical	Select **`true`** to mark this extension critical; select **`false`** to mark the extension noncritical.
issuerAltExtType	This sets the type of name extension to be used, which can be one of the following: • RFC822Name • DirectoryName • DNSName • EDIPartyName • URIName • IPAddress • OIDName

Parameter	Description
issuerAltExtPattern	Specifies the request attribute value to include in the extension. The attribute value must conform to any of the supported general name types. The permissible value is a request attribute included in the certificate request. If the server finds the attribute in the request, it sets the attribute value in the extension and adds the extension to certificates. If multiple attributes are specified and none of the attributes are present in the request, the server does not add the Issuer Alternative Name extension to certificates. If no suitable attributes can be used from the request to form the issuerAlternativeName, then literal string can be used without any token expression. For example, *Certificate Authority*.

B.1.13. Key Usage Extension Default

This default attaches the Key Usage extension to the certificate. The extension specifies the purposes for which the key contained in a certificate should be used, such as data signing, key encryption, or data encryption, which restricts the usage of a key pair to predetermined purposes.

For general information about this extension, see Section B.3.8, “keyUsage”.

The following constraints can be defined with this default:

- Key Usage Constraint; see Section B.2.6, “Key Usage Extension Constraint”.
- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.12. Key Usage Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
digitalSignature	Specifies whether to allow signing SSL client certificates and S/MIME signing certificates. Select **true** to set.

Parameter	Description
nonRepudiation	Specifies whether to use for S/MIME signing certificates. Select **true** to set. **Warning** Using this bit is controversial. Carefully consider the legal consequences of its use before setting it for any certificate.
keyEncipherment	Specifies whether the public key in the subject is used to encipher private or secret keys. This is set for SSL server certificates and S/MIME encryption certificates. Select **true** to set.
dataEncipherment	Specifies whether to set the extension when the subject's public key is used to encipher user data as opposed to key material. Select **true** to set.
keyAgreement	Specifies whether to set the extension whenever the subject's public key is used for key agreement. Select **true** to set.
keyCertsign	Specifies whether the public key is used to verify the signature of other certificates. This setting is used for CA certificates. Select **true** to set the option.
cRLSign	Specifies whether to set the extension for CA signing certificates that sign CRLs. Select **true** to set.
encipherOnly	Specifies whether to set the extension if the public key is only for encrypting data while performing key agreement. If this bit is set, **keyAgreement** should also be set. Select **true** to set.
decipherOnly	Specifies whether to set the extension if the public key is only for decrypting data while performing key agreement. If this bit is set, **keyAgreement** should also be set. Select **true** to set.

B.1.14. Name Constraints Extension Default

This default attaches a Name Constraints extension to the certificate. The extension is used in CA certificates to indicate a name space within which the subject names or subject alternative names in subsequent certificates in a certificate chain should be located.

For general information about this extension, see Section B.3.9, “nameConstraints”.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

This default defines up to five locations for both the permitted subtree and the excluded subtree and sets parameters for each location. The parameters are marked with an *n* in the table to show with which location the parameter is associated.

Table B.13. Name Constraints Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
PermittedSubtrees*n*.min	Specifies the minimum number of permitted subtrees. • **-1** specifies that the field should not be set in the extension. • **0** specifies that the minimum number of subtrees is zero. • *n* must be an integer that is greater than zero. It sets the minimum required number of subtrees.
PermittedSubtreesmax_*n*	Specifies the maximum number of permitted subtrees. • **-1** specifies that the field should not be set in the extension. • **0** specifies that the maximum number of subtrees is zero. • *n* must be an integer that is greater than zero. It sets the maximum number of subtrees allowed.
PermittedSubtreeNameChoice_*n*	Specifies the general name type for the permitted subtree to include in the extension. The permissible values are as follows: • RFC822Name • DirectoryName • DNSName • EDIPartyName • URIName • IPAddress • OIDName • OtherName
PermittedSubtreeNameValue_*n*	Specifies the general name value for the permitted subtree to include in the extension.

Parameter	Description
	For **RFC822Name**, the value must be a valid Internet mail address. For example, *testCA@example.com*. For **DirectoryName**, the value must be a string form of X.500 name, similar to the subject name in a certificate. For example, *cn=SubCA, ou=Research Dept, o=Example Corporation, c=US*. For **DNSName**, the value must be a valid fully-qualified domain name. For example, *testCA.example.com*. For **EDIPartyName**, the value must be an IA5String. For example, *Example Corporation*. For **URIName**, the value must be a non-relative URI following the URL syntax and encoding rules. The name must include both a scheme, such as **http**, and a fully qualified domain name or IP address of the host. For example, *http://testCA.example.com*. Certificate System supports both IPv4 and IPv6 addresses. For **IPAddress**, the value must be a valid IP address. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address with netmask is separated by a comma. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*. For **OIDName**, the value must be a unique, valid OID specified in dot-separated numeric component notation. For example, *1.2.3.4.55.6.5.99*. **OtherName** is used for names with any other format; this supports **PrintableString**, **IA5String**, **UTF8String**, **BMPString**, **Any**, and **KerberosName**. **KerberosName** has the format *Realm|NameType|NameStrings*, such as **realm1|0|userID1,userID2**. **OtherName** must have the format *(type)oid,string*. For example, **(IA5String)1.2.3.4,MyExample**.
PermittedSubtreeEnable_*n*	Select **true** to enable this permitted subtree entry.

Parameter	Description
ExcludedSubtreesn.min	Specifies the minimum number of excluded subtrees. » **-1** specifies that the field should not be set in the extension. » **0** specifies that the minimum number of subtrees is zero. » *n* must be an integer that is greater than zero. This sets the minimum number of required subtrees.
ExcludedSubtreeMax_*n*	Specifies the maximum number of excluded subtrees. » **-1** specifies that the field should not be set in the extension. » **0** specifies that the maximum number of subtrees is zero. » *n* must be an integer that is greater than zero. This sets the maximum number of allowed subtrees.
ExcludedSubtreeNameChoice_*n*	Specifies the general name type for the excluded subtree to include in the extension. The permissible values are as follows: » RFC822Name » DirectoryName » DNSName » EDIPartyName » URIName » IPAddress » OIDName » OtherName
ExcludedSubtreeNameValue_*n*	Specifies the general name value for the permitted subtree to include in the extension. » For **RFC822Name**, the value must be a valid Internet mail address. For example, *testCA@example.com*. » For **DirectoryName**, the value must be an X.500 name, similar to the subject name in a certificate. For example, *cn=SubCA, ou=Research Dept, o=Example Corporation, c=US*. » For **DNSName**, the value must be a valid fully-qualified domain name. For example, *testCA.example.com*.

Parameter	Description
	• For **EDIPartyName**, the value must be an IA5String. For example, *Example Corporation*. • For **URIName**, the value must be a non-relative URI following the URL syntax and encoding rules. The name must include both a scheme, such as **http**, and a fully qualified domain name or IP address of the host. For example, *http://testCA.example.com*. Certificate System supports both IPv4 and IPv6 addresses. • For **IPAddress**, the value must be a valid IP address. An IPv4 address must be in *n.n.n.n* format, with netmask in *n.n.n.n,m.m.m.m* format. For example, *128.21.39.40*, *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*. • For **OIDName**, the value must be a unique, valid OID specified in dot-separated numeric component notation. For example, *1.2.3.4.55.6.5.99*. • For **OtherName**, the values are names with any other format. This supports **PrintableString**, **IA5String**, **UTF8String**, **BMPString**, **Any**, and **KerberosName**. **KerberosName** has the format *Realm|NameType|NameStrings*, such as **realm1|0|userID1,userID2**. **OtherName** must have the format *(type)oid,string*. For example, **(IA5String)1.2.3.4,MyExample**.
ExcludedSubtreeEnable_*n*	Select **true** to enable this excluded subtree entry.

B.1.15. Netscape Certificate Type Extension Default

Warning

This extension is obsolete. Use the Key Usage or Extended Key Usage certificate extensions instead.

This default attaches a Netscape Certificate Type extension to the certificate. The extension identifies the certificate type, such as CA certificate, server SSL certificate, client SSL certificate, or S/MIME certificate. This restricts the usage of a certificate to predetermined purposes.

B.1.16. Netscape Comment Extension Default

Warning

This extension is obsolete.

This default attaches a Netscape Comment extension to the certificate. The extension can be used to include textual comments in certificates. Applications that are capable of interpreting the comment display it when the certificate is used or viewed.

For general information about this extension, see Section B.4.3.2, “netscape-comment”.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.14. Netscape Comment Extension Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
CommentContent	Specifies the content of the comment to appear in the certificate.

B.1.17. No Default Extension

This default can be used to set constraints when no defaults are being used. This default has no settings and sets no defaults but does allow all of the constraints available to be set.

B.1.18. OCSP No Check Extension Default

This default attaches an OCSP No Check extension to the certificate. The extension, which should be used in OCSP responder certificates only, indicates how OCSP-compliant applications can verify the revocation status of the certificate an authorized OCSP responder uses to sign OCSP responses.

For general information about this extension, see Section B.3.10, “OCSPNocheck”.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.15. OCSP No Check Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.

B.1.19. Policy Constraints Extension Default

This default attaches a Policy Constraints extension to the certificate. The extension, which can be used in CA certificates only, constrains path validation in two ways: either to prohibit policy mapping or to require that each certificate in a path contain an acceptable policy identifier. The default can specify both **ReqExplicitPolicy** and **InhibitPolicyMapping**. PKIX standard requires that, if present in the certificate, the extension must never consist of a null sequence. At least one of the two specified fields must be present.

For general information about this extension, see Section B.3.11, “policyConstraints”.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.16. Policy Constraints Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
reqExplicitPolicy	Specifies the total number of certificates permitted in the path before an explicit policy is required. This is the number of CA certificates that can be chained below the subordinate CA certificate before an acceptable policy is required. • **-1** specifies that the field should not be set in the extension. • **0** specifies that no subordinate CA certificates are permitted in the path before an explicit policy is required. • *n* must be an integer that is greater than zero. It specifies the maximum number of subordinate CA certificates allowed in the path before an explicit policy is required. This number affects the number of CA certificates to be used during certificate validation. The chain starts with the end-entity certificate being validated and moving up the chain. The parameter has no effect if the extension is set in end-entity certificates.

Parameter	Description
inhibitPolicyMapping	Specifies the total number of certificates permitted in the path before policy mapping is no longer permitted. • **-1** specifies that the field should not be set in the extension. • **0** specifies that no subordinate CA certificates are permitted in the path before policy mapping is no longer permitted. • *n* must be an integer that is greater than zero. It specifies at the maximum number of subordinate CA certificates allowed in the path before policy mapping is no longer permitted. For example, a value of 1 indicates that policy mapping may be processed in certificates issued by the subject of this certificate, but not in additional certificates in the path.

B.1.20. Policy Mappers Extension Default

This default attaches a Policy Mappings extension to the certificate. The extension lists pairs of OIDs, each pair identifying two policy statements of two CAs. The pairing indicates that the corresponding policies of one CA are equivalent to policies of another CA. The extension may be useful in the context of cross-certification. If supported, the extension is included in CA certificates only. The default maps policy statements of one CA to that of another by pairing the OIDs assigned to their policy statements

Each pair is defined by two parameters, **issuerDomainPolicy** and **subjectDomainPolicy**. The pairing indicates that the issuing CA considers the **issuerDomainPolicy** equivalent to the **subjectDomainPolicy** of the subject CA. The issuing CA's users may accept an **issuerDomainPolicy** for certain applications. The policy mapping tells these users which policies associated with the subject CA are equivalent to the policy they accept.

For general information about this extension, see Section B.3.12, “policyMappings”.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.17. Policy Mappings Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
IssuerDomainPolicy_*n*	Specifies the OID assigned to the policy statement of the issuing CA to map with the policy statement of another CA. For example, *1.2.3.4.5*.

Parameter	Description
SubjectDomainPolicy_*n*	Specifies the OID assigned to the policy statement of the subject CA that corresponds to the policy statement of the issuing CA. For example, *6.7.8.9.10*.

B.1.21. Private Key Usage Period Extension Default

The Private Key Usage Period extension allows the certificate issuer to specify a different validity period for the private key than for the certificate itself. This extension is intended for use with digital signature keys.

Table B.18. Private key Usage Period Configuration Parameters

Parameter	Description
Critical	This extension should always be non-critical.
puStartTime	This parameters sets the start time. The default value is **`0`**, which starts the validity period from the time the extension is activated.
puDurationDays	This parameters sets the duration of the usage period. The default value is **`365`**, which sets the validity period to 365 days from the time the extension is activated.

B.1.22. Signing Algorithm Default

This default attaches a signing algorithm in the certificate request. This default presents an agent with the possible algorithms that can be used for signing the certificate.

The following constraints can be defined with this default:

- Signing Algorithm Constraint; see Section B.2.10, “Signing Algorithm Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.19. Signing Algorithm Default Configuration Parameters

Parameter	Description
signingAlg	Specify the default signing algorithm to be used to create this certificate. An agent can override this value by specifying one of the values contained in the **`signingAlgsAllowed`** parameter.

Parameter	Description
signingAlgsAllowed	Specify the signing algorithms that can be used for signing this certificate. The algorithms can be any or all of the following: » MD2withRSA » MD5withRSA » SHA1withRSA » SHA256withRSA » SHA512withRSA » SHA1withEC (if ECC is enabled)

B.1.23. Subject Alternative Name Extension Default

This default attaches a Subject Alternative Name extension to the certificate. The extension binds additional identities, such as an email address, a DNS name, an IP address (both IPv4 and IPv6), or a URI, to the subject of the certificate. The standard requires that if the certificate subject field contains an empty sequence, then the Subject Alternative name extension must contain the subject's alternative name and that the extension be marked critical.

For any of the directory-based authentication methods, the Certificate System can retrieve values for any string and byte attributes and set them in the certificate request. These attributes are set by entering them in the **`ldapStringAttributes`** and **`ldapByteAttributes`** fields defined in the automated enrollment modules.

If authenticated attributes — meaning attributes stored in an LDAP database — need to be part of this extension, use values from the **`$request.`*`X`*`$`** token.

There is an additional attribute to insert a universally unique identifier (UUID) into the subject alt name. This option generates a random number for version 4 UUID; the pattern is defined by referencing the server which will generate the number in an additional **`subjAltExtSource`** parameter.

A basic Subject Alternative Name Extension default is configured in the example.

Example B.1. Default Subject Alternative Name Extension Configuration

```
policyset.serverCertSet.9.constraint.name=No Constraint
policyset.serverCertSet.9.default.class_id=subjectAltNameExtDefaultImp
l
policyset.serverCertSet.9.default.name=Subject Alternative Name
Extension Default
policyset.serverCertSet.9.default.params.subjAltExtGNEnable_0=true
policyset.serverCertSet.9.default.params.subjAltExtPattern_0=$request.
requester_email$
policyset.serverCertSet.9.default.params.subjAltExtType_0=RFC822Name
policyset.serverCertSet.9.default.params.subjAltExtGNEnable_1=true
policyset.serverCertSet.9.default.params.subjAltExtPattern_1=$request.
SAN1$
policyset.serverCertSet.9.default.params.subjAltExtType_1=DNSName
policyset.serverCertSet.9.default.params.subjAltExtGNEnable_2=true
policyset.serverCertSet.9.default.params.subjAltExtPattern_2=http://ww
```

```
w.server.example.com
policyset.serverCertSet.9.default.params.subjAltExtType_2=URIName
policyset.serverCertSet.9.default.params.subjAltExtType_3=OtherName
policyset.serverCertSet.9.default.params.subjAltExtPattern_3=
(IA5String)1.2.3.4,$server.source$
policyset.serverCertSet.9.default.params.subjAltExtSource_3=UUID4
policyset.serverCertSet.9.default.params.subjAltExtGNEnable_3=true
policyset.serverCertSet.9.default.params.subjAltExtType_4=RFC822Name
policyset.serverCertSet.9.default.params.subjAltExtGNEnable_4=false
policyset.serverCertSet.9.default.params.subjAltExtPattern_4=
policyset.serverCertSet.9.default.params.subjAltNameExtCritical=false
policyset.serverCertSet.9.default.params.subjAltNameNumGNs=4
```

The Subject Alternative Name extension default checks the certificate request for the profile attributes. If the request contains an attribute, the profile reads its value and sets it in the extension. It is also possible for the Subject Alternative Name extension default to insert attribute values from an LDAP directory, if LDAP-based authentication is configured. The extension added to the certificates contain all the configured attributes.

The variables that can be used with the Subject Alternative Name extension default are listed in Table B.20, "Variables to Insert Values in the Subject Alternative Name".

Table B.20. Variables to Insert Values in the Subject Alternative Name

Policy Set Token	Description
$request.auth_token.cn$	The LDAP common name (***cn***) attribute of the user who requested the certificate.
$request.auth_token.mail$	The value of the LDAP email (***mail***) attribute of the user who requested the certificate.
$request.auth_token.tokenCertSubject$	The certificate subject name.
$request.auth_token.uid$	The LDAP user ID (***uid***) attribute of the user who requested the certificate.
$request.auth_token.user$	
$request.auth_token.userDN$	The user DN of the user who requested the certificate.
$request.auth_token.userid$	The value of the user ID attribute for the user who requested the certificate.
$request.uid$	The value of the user ID attribute for the user who requested the certificate.

Policy Set Token	Description
$request.profileRemoteAddr$	The IP address of the user making the request. This can be an IPv4 or an IPv6 address, depending on the client. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*.
$request.profileRemoteHost$	The hostname or IP address of the user's machine. The hostname can be the fully-qualified domain name and the protocol, such as **http://server.example.com**. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*.
$request.requestor_email$	The email address of the person who submitted the request.
$request.requestowner$	The person who submitted the request.
$request.subject$	The subject name DN of the entity to which the certificate is issued. For example, *uid=jsmith, e=jsmith@example.com*.
$request.tokencuid$	The card unique ID (CUID) of the smart card token used for requesting the enrollment.
$request.upn$	The Microsoft UPN. This has the format *(UTF8String)1.3.6.1.4.1.311.20.2.3,$request.upn$*.
$server.source$	Instructs the server to generate a version 4 UUID (random number) component in the subject name. This always has the format *(IA5String)1.2.3.4,$server.source$*.

Multiple attributes can be set for a single extension. The **subjAltNameNumGNs** parameter controls how many of the listed attributes are required to be added to the certificate. This parameter must be added to custom profiles and may need modified in default profiles to include as many attributes as required. In Example B.1, “Default Subject Alternative Name Extension Configuration”, the **subjAltNameNumGNs** is set to **3** to insert the **RFC822Name**, **DNSName**, and **URIName** names (generic names **_0**, **_1**, and **_2**).

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.21. Subject Alternative Name Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
Pattern	Specifies the request attribute value to include in the extension. The attribute value must conform to any of the supported general name types. If the server finds the attribute in the request, it sets the attribute value in the extension and adds the extension to certificates. If multiple attributes are specified and none of the attributes are present in the request, the server does not add the Subject Alternative Name extension to certificates. The permissible value is a request attribute included in the certificate request. For example, *$request.requester_email$*.
Type	Specifies the general name type for the request attribute. - Select **RFC822Name** if the request-attribute value is an email address in the **local-part@domain** format. For example, *jdoe@example.com* - Select **DirectoryName** if the request-attribute value is an X.500 directory name, similar to the subject name in a certificate. For example, *cn=Jane Doe, ou=Sales Dept, o=Example Corporation, c=US*. - Select **DNSName** if the request-attribute value is a DNS name. For example, *corpDirectory.example.com*. - Select **EDIPartyName** if the request-attribute value is an EDI party name. For example, *Example Corporation*. - Select **URIName** if the request-attribute value is a non-relative URI that includes both a scheme, such as **http**, and a fully qualified domain name or IP address of the host. For example, *http://hr.example.com*. Certificate System supports both IPv4 and IPv6 addresses. - Select **IPAddress** if the request-

Parameter	Description
	attribute value is a valid IP address specified in dot-separated numeric component notation. For example, *128.21.39.40*. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*. • Select **OIDName** if the request-attribute value is a unique, valid OID specified in the dot-separated numeric component notation. For example, *1.2.3.4.55.6.5.99*. • Select **OtherName** for names with any other format. This supports **PrintableString**, **IA5String**, **UTF8String**, **BMPString**, **Any**, and **KerberosName**. **KerberosName** has the format *Realm|NameType|NameStrings*, such as **realm1|0|userID1,userID2**. **OtherName** must have the format *(type)oid,string*. For example, **(IA5String)1.2.3.4,MyExample**.
Source	Specifies an identification source or protocol to use to generate an ID. The only supported source is UUID4, which generates a random number to create the UUID.
Number of Components (NumGNs)	Specifies the number of name components that must be included in the subject alternative name.

B.1.24. Subject Directory Attributes Extension Default

This default attaches a Subject Directory Attributes extension to the certificate. The Subject Directory Attributes extension conveys any desired directory attribute values for the subject of the certificate.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.22. Subject Directory Attributes Extension Default Configuration Parameters

Parameter	Description
Critical	Select **true** to mark this extension critical; select **false** to mark the extension noncritical.
Name	The attribute name; this can be any LDAP directory attribute, such as ***cn*** or ***mail***.
Pattern	Specifies the request attribute value to include in the extension. The attribute value must conform to the allowed values of the attribute. If the server finds the attribute, it sets the attribute value in the extension and adds the extension to certificates. If multiple attributes are specified and none of the attributes are present in the request, the server does not add the Subject Directory Attributes extension to certificates. For example, *$request.requester_email$*.
Enable	Sets whether that attribute is able to be added to the certificate. Select **true** to enable the attribute.

B.1.25. Subject Info Access Extension Default

Implements an enrollment default policy that populates a Subject Information Access extension in the certificate template. This extension indicates how to access information and services for the subject of the certificate in which the extension appears.

Parameter	Description
Critical	This extension is supposed to be non-critical.
subjInfoAccessNumADs	The number of information access sections included with the certificate.
subjInfoAccessADMethod_n	OID of the access method.
subjInfoAccessADMethod_n	Type of access method. » URIName » Directory name » DNS Name » EID Party Name » IP Address » OID Name » RFC822Name
subjInfoAccessADLocation_n	Location based on the type subjInfoAccessADMethod_n i.e., a URL for URI Name.
subjInfoAccessADEnable_n	Select **true** to enable this extension; select **false** to disable this extension.

B.1.26. Subject Key Identifier Extension Default

This default attaches a Subject Key Identifier extension to the certificate. The extension identifies certificates that contain a particular public key, which identifies a certificate from among several that have the same subject name.

For general information about this extension, see Section B.3.16, “subjectKeyIdentifier”.

If enabled, the profile adds a Subject Key Identifier Extension to an enrollment request if the extension does not already exist. If the extension exists in the request, such as a CRMF request, the default replaces the extension. After an agent approves the manual enrollment request, the profile accepts any Subject Key Identifier Extension that is already there.

This default has no parameters. If used, this extension is included in the certificate with the public key information.

The following constraints can be defined with this default:

- Extension Constraint; see Section B.2.4, “Extension Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

B.1.27. Subject Name Default

This default attaches a server-side configurable subject name to the certificate request. A static subject name is used as the subject name in the certificate.

The following constraints can be defined with this default:

- Subject Name Constraint; see Section B.2.11, “Subject Name Constraint”.
- Unique Subject Name Constraint; see Section B.2.13, “Unique Subject Name Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.23. Subject Name Default Configuration Parameters

Parameter	Description
Name	Specify the subject name for this certificate.

If you need to get a certificate subject name that uses the DNPATTERN value from the UidPwdDirAuth plugin, then configure the profile to use the Subject Name Default plugin and substitute the ***Name*** parameter with the "Subject Name" from the *AuthToken* as shown below.

```
policyset.userCertSet.1.default.class_id=subjectNameDefaultImpl
policyset.userCertSet.1.default.name=Subject Name Default
policyset.userCertSet.1.default.params.name=$request.auth_token.tokenCer
tSubject$
```

B.1.28. User Key Default

This default attaches a user-supplied key into the certificate request. This is a required default. Keys are part of the enrollment request.

The following constraints can be defined with this default:

- Key Constraint; see Section B.2.5, “Key Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

B.1.29. User Signing Algorithm Default

This default implements an enrollment default profile that populates a user-supplied signing algorithm in the certificate request. If included in the certificate profile, this allows a user to choose a signing algorithm for the certificate, subject to the constraint set.

No inputs are provided to add signing algorithm choices to the enrollment form, but it is possible to submit a request that contains this information.

The following constraints can be defined with this default:

- Signing Algorithm Constraint; see Section B.2.10, “Signing Algorithm Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

B.1.30. User Subject Name Default

This default attaches a user-supplied subject name to the certificate request. If included in the certificate profile, it allows a user to supply a subject name for the certificate, subject to the constraints set. This extension preserves the subject name that is specified in the original certificate request when the certificate is issued.

The following constraints can be defined with this default:

- Subject Name Constraint; see Section B.2.11, “Subject Name Constraint”.
- Unique Subject Name Constraint; see Section B.2.13, “Unique Subject Name Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

B.1.31. User Validity Default

This default attaches a user-supplied validity to the certificate request. If included in the certificate profile, it allows a user to supply the validity period, subject to the constraints set. This default profile preserves that user-defined validity period in the original certificate request when the certificate is issued.

No inputs are provided to add user-supplied validity date to the enrollment form, but it is possible to submit a request that contains this information.

The following constraints can be defined with this default:

- Validity Constraint; see Section B.2.14, “Validity Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

B.1.32. User Supplied Extension Default

The User Supplied Extension Default class populates a certificate with any certificate extension defined by the user in the certificate request. This requires users to submit certificate requests which meet certain standards or give certain information because the profile can require specific extensions before enrolling a certificate.

> **Warning**
>
> Be exceptionally cautious about setting this extension default, since it allows users to specify an extension in the certificate request. If this default is used, then Red Hat strongly recommends using a constraint corresponding to the extension to minimize any possible abuse of the User Supplied Extension Default.

The user-defined extension is validated against whatever constraint is set, so it is possible to restrict the kind of extension (through the Extension Constraint) or to set rules for the key and other basic constraints, such as whether this is a CA certificate.

> **Note**
>
> If this extension is set on a profile with a corresponding OID (Extension Constraint), then any certificate request processed through that profile *must* carry the specified extension or the request is rejected.
>
> If a certificate profile was enabled with the User Supplied Extension Default *before* the errata RHSA 2008:0500, then this profile must be edited to support user supplied extensions in certificate requests. Apply the **userExtensionDefaultImpl** default, as shown in the example. The given OID is for the Basic Constraints Extension Constraint.
>
> ```
> policyset.set1.p6.default.class_id=userExtensionDefaultImpl
> policyset.set1.p6.default.name=User Supplied Extension Default
> policyset.set1.p6.default.params.userExtOID=2.5.29.19
> ```

The CA handles an enrollment with the User Supplied Extension Default in one of three ways:

- If the OID of the extension is specified in both the certificate request and the default, then the extension is validated by the constraints and applied to the certificate.
- If an OID of an extension is given in the request but is not specified in the User Supplied Extension Default in the profile, then the user-specified extension is ignored, and the certificate is successfully enrolled without that extension.
- If this extension is set on a profile with a corresponding OID (Extension Constraint), then any certificate request processed through that profile *must* carry the specified extension or the request is rejected.

A certificate *request* that contains the user-defined extensions must be submitted to the profile. The certificate enrollment forms, however, do not have any input fields for users to add user-supplied extensions. Submitting a certificate request without supplying the extension fails.

Example B.2, “User Supplied Extension Default for the Extended Key Usage Extension” adds the User Supplied Extension Default to a profile with the Extended Key Usage Constraint. The OID specified in the ***userExtOID*** parameter is for the Extended Key Usage Extension.

Example B.2. User Supplied Extension Default for the Extended Key Usage Extension

```
policyset.set1.2.constraint.class_id=extendedKeyUsageExtConstraintImpl

policyset.set1.2.constraint.name=Extended Key Usage Extension
policyset.set1.2.constraint.params.exKeyUsageCritical=false
policyset.set1.2.constraint.params.exKeyUsageOIDs=1.3.6.1.5.5.7.3.2,1.
3.6.1.5.5.7.3.4
policyset.set1.2.default.class_id=userExtensionDefaultImpl
policyset.set1.2.default.name=User Supplied Extension Default
policyset.set1.2.default.params.userExtOID=2.5.29.37
```

In Example B.2, “User Supplied Extension Default for the Extended Key Usage Extension”, although the User Supplied Extension Default allows a user to specify the Extended Key Usage Extension (2.5.29.37), the constraint limits the user request to only the SSL client authentication (1.3.6.1.5.5.7.3.2) and email protection (1.3.6.1.5.5.7.3.4) uses.

Editing profiles is described in Section 2.2.3, “Creating and Editing Certificate Profiles through the Command Line”.

B.1.33. Validity Default

This default attaches a server-side configurable validity period into the certificate request.

The following constraints can be defined with this default:

- Validity Constraint; see Section B.2.14, “Validity Constraint”.
- No Constraints; see Section B.2.8, “No Constraint”.

Table B.24. Validity Default Configuration Parameters

Parameter	Description
range	Specifies the validity period for this certificate.
startTime	Sets when the validity period begins, based on the current time.

B.2. Constraints Reference

Constraints are used to define the allowable contents of a certificate and the values associated with that content. This section lists the predefined constraints with complete definitions of each.

B.2.1. Basic Constraints Extension Constraint

The Basic Constraints extension constraint checks if the basic constraint in the certificate request satisfies the criteria set in this constraint.

Table B.25. Basic Constraints Extension Constraint Configuration Parameters

Parameter	Description
basicConstraintsCritical	Specifies whether the extension can be marked critical or noncritical. Select **true** to mark this extension critical; select **false** to prevent this extension from being marked critical. Selecting a hyphen **-**, implies no criticality preference.
basicConstraintsIsCA	Specifies whether the certificate subject is a CA. Select **true** to require a value of **true** for this parameter (is a CA); select **false** to disallow a value of **true** for this parameter; select a hyphen, **-**, to indicate no constraints are placed for this parameter.
basicConstraintsMinPathLen	Specifies the minimum allowable path length, the maximum number of CA certificates that may be chained below (subordinate to) the subordinate CA certificate being issued. The path length affects the number of CA certificates used during certificate validation. The chain starts with the end-entity certificate being validated and moves up. This parameter has no effect if the extension is set in end-entity certificates. The permissible values are **0** or **n**. The value must be less than the path length specified in the Basic Constraints extension of the CA signing certificate. **0** specifies that no subordinate CA certificates are allowed below the subordinate CA certificate being issued; only an end-entity certificate may follow in the path. *n* must be an integer greater than zero. This is the minimun number of subordinate CA certificates allowed below the subordinate CA certificate being used.

Parameter	Description
basicConstraintsMaxPathLen	Specifies the maximum allowable path length, the maximum number of CA certificates that may be chained below (subordinate to) the subordinate CA certificate being issued. The path length affects the number of CA certificates used during certificate validation. The chain starts with the end-entity certificate being validated and moves up. This parameter has no effect if the extension is set in end-entity certificates. The permissible values are **0** or *n*. The value must be greater than the path length specified in the Basic Constraints extension of the CA signing certificate. **0** specifies that no subordinate CA certificates are allowed below the subordinate CA certificate being issued; only an end-entity certificate may follow in the path. *n* must be an integer greater than zero. This is the maximum number of subordinate CA certificates allowed below the subordinate CA certificate being used. If the field is blank, the path length defaults to a value determined by the path length set on the Basic Constraints extension in the issuer's certificate. If the issuer's path length is unlimited, the path length in the subordinate CA certificate is also unlimited. If the issuer's path length is an integer greater than zero, the path length in the subordinate CA certificate is set to a value one less than the issuer's path length; for example, if the issuer's path length is 4, the path length in the subordinate CA certificate is set to 3.

B.2.2. CA Validity Constraint

The CA Validity constraint checks if the validity period in the certificate template is within the CA's validity period. If the validity period of the certificate is out outside the CA certificate's validity period, the constraint is rejected.

B.2.3. Extended Key Usage Extension Constraint

The Extended Key Usage extension constraint checks if the Extended Key Usage extension on the certificate satisfies the criteria set in this constraint.

Table B.26. Extended Key Usage Extension Constraint Configuration Parameters

Parameter	Description
exKeyUsageCritical	When set to **true**, the extension can be marked as critical. When set to **false**, the extension can be marked noncritical.
exKeyUsageOIDs	Specifies the allowable OIDs that identifies a key-usage purpose. Multiple OIDs can be added in a comma-separated list.

B.2.4. Extension Constraint

This constraint implements the general extension constraint. It checks if the extension is present.

Table B.27. Extension Constraint

Parameter	Description
extCritical	Specifies whether the extension can be marked critical or noncritical. Select **true** to mark the extension critical; select **false** to mark it noncritical. Select **-** to enforce no preference.
extOID	The OID of an extension that must be present in the cert to pass the constraint.

B.2.5. Key Constraint

This constraint checks the size of the key for RSA keys, and the name of the elliptic curve for EC keys. When used with RSA keys the ***KeyParameters*** parameter contains a comma-separated list of legal key sizes, and with EC Keys the ***KeyParameters*** parameter contains a comma-separated list of available ECC curves.

Table B.28. Key Constraint Configuration Parameters

Parameter	Description
keyType	Gives a key type; this is set to **-** by default and uses an RSA key system. The choices are rsa and ec. If the key type is specified and not identified by the system, the constraint will be rejected.

Parameter	Description
KeyParameters	Defines the specific key parameters. The parameters which are set for the key differe, depending on the value of the ***keyType*** parameter (meaning, depending on the key type). • With RSA keys, the ***KeyParameters*** parameter contains a comma-separated list of legal key sizes. • With ECC keys, the ***KeyParameters*** parameter contains a comma-separated list of available ECC curves.

B.2.6. Key Usage Extension Constraint

The Key Usage extension constraint checks if the key usage constraint in the certificate request satisfies the criteria set in this constraint.

Table B.29. Key Usage Extension Constraint Configuration Parameters

Parameter	Description
keyUsageCritical	Select **true** to mark this extension critical; select **false** to mark it noncritical. Select **-** for no preference.
keyUsageDigitalSignature	Specifies whether to sign SSL client certificates and S/MIME signing certificates. Select **true** to mark this as set; select **false** to keep this from being set; select a hyphen, **-**, to indicate no constraints are placed for this parameter.
kleyUsageNonRepudiation	Specifies whether to set S/MIME signing certificates. Select **true** to mark this as set; select **false** to keep this from being set; select a hyphen, **-**, to indicate no constraints are placed for this parameter. **Warning** Using this bit is controversial. Carefully consider the legal consequences of its use before setting it for any certificate.
keyEncipherment	Specifies whether to set the extension for SSL server certificates and S/MIME encryption certificates. Select **true** to mark this as set; select **false** to keep this from being set; select a hyphen, **-**, to indicate no constraints are placed for this parameter.

Parameter	Description
keyUsageDataEncipherment	Specifies whether to set the extension when the subject's public key is used to encrypt user data, instead of key material. Select **true** to mark this as set; select **false** to keep this from being set; select a hyphen, **-**, to indicate no constraints are placed for this parameter.
keyUsageKeyAgreement	Specifies whether to set the extension whenever the subject's public key is used for key agreement. Select **true** to mark this as set; select **false** to keep this from being set; select a hyphen, **-**, to indicate no constraints are placed for this parameter.
keyUsageCertsign	Specifies whether the extension applies for all CA signing certificates. Select **true** to mark this as set; select **false** to keep this from being set; select a hyphen, **-**, to indicate no constraints are placed for this parameter.
keyUsageCRLSign	Specifies whether to set the extension for CA signing certificates that are used to sign CRLs. Select **true** to mark this as set; select **false** to keep this from being set; select a hyphen, **-**, to indicate no constraints are placed for this parameter.
keyUsageEncipherOnly	Specifies whether to set the extension if the public key is to be used only for encrypting data. If this bit is set, **keyUsageKeyAgreement** should also be set. Select **true** to mark this as set; select **false** to keep this from being set; select a hyphen, **-**, to indicate no constraints are placed for this parameter.
keyUsageDecipherOnly	Specifies whether to set the extension if the public key is to be used only for deciphering data. If this bit is set, **keyUsageKeyAgreement** should also be set. Select **true** to mark this as set; select **false** to keep this from being set; select a hyphen, **-**, to indicate no constraints are placed for this parameter.

B.2.7. Netscape Certificate Type Extension Constraint

Warning

This constraint is obsolete. Instead of using the Netscape Certificate Type extension constraint, use the Key Usage extension or Extended Key Usage extension.

The Netscape Certificate Type extension constraint checks if the Netscape Certificate Type extension in the certificate request satisfies the criteria set in this constraint.

B.2.8. No Constraint

This constraint implements no constraint. When chosen along with a default, there are not constraints placed on that default.

B.2.9. Renewal Grace Period Constraint

The Renewal Grace Period Constraint sets rules on when a user can renew a certificate based on its expiration date. For example, users cannot renew a certificate until a certain time before it expires or if it goes past a certain time after its expiration date.

One important thing to remember when using this constraint is that this constraint is set on the *original enrollment profile*, not the renewal profile. The rules for the renewal grace period are part of the original certificate and are carried over and applied for any subsequent renewals.

This constraint is only available with the No Default extension.

Table B.30. Renewal Grace Period Constraint Configuration Parameters

Parameter	Description
renewal.graceAfter	Sets the period, in days, *after* the certificate expires that it can be submitted for renewal. If the certificate has been expired longer that that time, then the renewal request is rejected. If no value is given, there is no limit.
renewal.graceBefore	Sets the period, in days, *before* the certificate expires that it can be submitted for renewal. If the certificate is not that close to its expiration date, then the renewal request is rejected. If no value is given, there is no limit.

B.2.10. Signing Algorithm Constraint

The Signing Algorithm constraint checks if the signing algorithm in the certificate request satisfies the criteria set in this constraint.

Table B.31. Signing Algorithms Constraint Configuration Parameters

Parameter	Description

Parameter	Description
signingAlgsAllowed	Sets the signing algorithms that can be specified to sign the certificate. The algorithms can be any or all of the following: - MD2withRSA - MD5withRSA - SHA1withRSA - SHA256withRSA - SHA512withRSA - SHA1withEC (if ECC is enabled) - SHA256withEC - SHA384withEC - SHA512withEC - SHA1withDSA

B.2.11. Subject Name Constraint

The Subject Name constraint checks if the subject name in the certificate request satisfies the criteria.

Table B.32. Subject Name Constraint Configuration Parameters

Parameter	Description
Pattern	Specifies a regular expression or other string to build the subject DN.

Subject Names and Regular Expressions

The regular expression for the Subject Name Constraint is matched by the Java facility for matching regular expressions. The format for these regular expressions are listed in http://download-llnw.oracle.com/javase/6/docs/api/java/util/regex/Pattern.html#sum. This allows wildcards such as asterisks (*) to search for any number of the characters and periods (**.**) to search for any type character.

For example, if the pattern of the subject name constraint is set to **uid=.***, the certificate profile framework checks if the subject name in the certificate request matches the pattern. A subject name like **uid=user, o=Example, c=US** satisfies the pattern **uid=.***. The subject name **cn=user, o=example,c=US** does not satisfy the pattern. **uid=.*** means the subject name must begin with the ***uid*** attribute; the period-asterisk (**.***) wildcards allow any type and number of characters to follow ***uid***.

It is possible to require internal patterns, such as **.*ou=Engineering.***, which requires the **ou=Engineering** attribute with any kind of string before and after it. This matches **cn=jdoe,ou=internal,ou=west coast,ou=engineering,o="Example Corp",st=NC** as well as **uid=bjensen,ou=engineering,dc=example,dc=com**.

Lastly, it is also possible to allow requests that are either one string or another by setting a pipe sign (**|**) between the options. For example, to permit subject names that contain either **ou=engineering,ou=people** or **ou=engineering,o="Example Corp"**, the pattern is **.*ou=engineering,ou=people.* | .*ou=engineering,o="Example Corp".***.

> **Note**
>
> For constructing a pattern which uses a special character, such as a period (**.**), escape the character with a back slash (\). For example, to search for the string **o="Example Inc."**, set the pattern to **o="Example Inc\."**.

Subject Names and the UID or CN in the Certificate Request

The pattern that is used to build the subject DN can also be based on the CN or UID of the person requesting the certificate. The Subject Name Constraint sets the patter of the CN (or UID) to recognize in the DN of the certificate request, and then the Subject Name Default builds on that CN to create the subject DN of the certificate, using a predefined directory tree.

For example, to use the CN of the certificate request:

```
policyset.serverCertSet.1.constraint.class_id=subjectNameConstraintImpl
policyset.serverCertSet.1.constraint.name=Subject Name Constraint
policyset.serverCertSet.1.constraint.params.pattern=CN=[^,]+,.+
policyset.serverCertSet.1.constraint.params.accept=true
policyset.serverCertSet.1.default.class_id=subjectNameDefaultImpl
policyset.serverCertSet.1.default.name=Subject Name Default
policyset.serverCertSet.1.default.params.name=CN=$request.req_subject_na
me.cn$,DC=example, DC=com
```

B.2.12. Unique Key Constraint

This constraint checks that the public key is unique.

Table B.33. Unique Key Constraints Parameters

Parameter	Description
allowSameKeyRenewal	A request is considered a renewal and is accepted if this parameter is set to **true**, if a public key is not unique, *and* if the subject DN matches an existing certificate. However, if the public key is a duplicate and does not match an existing Subject DN, the request is rejected. When the parameter is set to **false**, a duplicate public key request will be rejected.

B.2.13. Unique Subject Name Constraint

The Unique Subject Name constraint restricts the server from issuing multiple certificates with the same subject names. When a certificate request is submitted, the server automatically checks the nickname against other issued certificate nicknames. This constraint can be applied to certificate enrollment and renewal through the end-entities' page.

Certificates cannot have the same subject name unless one certificate is expired or revoked (and not on hold). So, active certificates cannot share a subject name, with one exception: if certificates have different key usage bits, then they can share the same subject name, because they have different uses.

Table B.34. Unique Subject Name Constraint Configuration Parameters

Parameter	Description
enableKeyUsageExtensionChecking	Optional setting which allows certificates to have the same subject name as long as their key usage settings are different. This is either **true** or **false**. The default is **true**, which allows duplicate subject names.

B.2.14. Validity Constraint

The Validity constraint checks if the validity period in the certificate request satisfies the criteria.

The parameters provided must be sensible values. For instance, a ***notBefore*** parameter that provides a time which has already passed will not be accepted, and a ***notAfter*** parameter that provides a time earlier than the ***notBefore*** time will not be accepted.

Table B.35. Validity Constraint Configuration Parameters

Parameter	Description
range	The range of the validity period. This is an integer which sets the number of days. The difference (in days) between the ***notBefore*** time and the ***notAfter*** time must be less than the range value, or this constraint will be rejected.
notBeforeCheck	Verifies that the range is not within the grace period. When the ***NotBeforeCheck*** Boolean parameter is set to true, the system will check the ***notBefore*** time is not greater than the current time plus the ***notBeforeGracePeriod*** value. If the ***notBeforeTime*** is not between the current time and the ***notBeforeGracePeriod*** value, this constraint will be rejected.
notBeforeGracePeriod	The grace period (in seconds) after the ***notBefore*** time. If the ***notBeforeTime*** is not between the current time and the ***notBeforeGracePeriod*** value, this constraint will be rejected. This constraint is only checked if the ***notBeforeCheck*** parameter has been set to true.

Parameter	Description
notAfterCheck	Verfies whether the given time is not after the expiration period. When the ***notAfterCheck*** Boolean parameter is set to true, the system will check the ***notAfter*** time is not greater than the current time. If the current time exceeds the ***notAfter*** time, this constraint will be rejected.

B.3. Standard X.509 v3 Certificate Extension Reference

An X.509 v3 certificate contains an extension field that permits any number of additional fields to be added to the certificate. Certificate extensions provide a way of adding information such as alternative subject names and usage restrictions to certificates. Older Netscape servers, such as Red Hat Directory Server and Red Hat Certificate System, that were developed before PKIX part 1 standards were defined require Netscape-specific extensions.

The following is an example of the section of a certificate containing X.509 v3 extensions. The Certificate System can display certificates in readable pretty-print format, as shown here. As in this example, certificate extensions appear in sequence and only one instance of a particular extension may appear per certificate; for example, a certificate may contain only one subject key identifier extension. Certificates that support these extensions have the version **0x2** (which corresponds to version 3).

Example B.3. Sample Pretty-Print Certificate Extensions

```
Data:
  Version:  v3
  Serial Number: 0x1
  Signature Algorithm: SHA1withRSA - 1.2.840.113549.1.1.5
  Issuer: CN=Certificate
Manager,OU=netscape,O=ExampleCorp,L=MV,ST=CA,C=US
  Validity:
    Not Before: Friday, February 21, 2005 12:00:00 AM PST
America/Los_Angeles
    Not  After: Monday, February 21, 2007 12:00:00 AM PST
America/Los_Angeles
  Subject: CN=Certificate
Manager,OU=netscape,O=ExampleCorp,L=MV,ST=CA,C=US
  Subject Public Key Info:
    Algorithm: RSA - 1.2.840.113549.1.1.1
    Public Key:
      Exponent: 65537
      Public Key Modulus: (2048 bits) :
        E4:71:2A:CE:E4:24:DC:C4:AB:DF:A3:2E:80:42:0B:D9:
        CF:90:BE:88:4A:5C:C5:B3:73:BF:49:4D:77:31:8A:88:
        15:A7:56:5F:E4:93:68:83:00:BB:4F:C0:47:03:67:F1:
        30:79:43:08:1C:28:A8:97:70:40:CA:64:FA:9E:42:DF:
        35:3D:0E:75:C6:B9:F2:47:0B:D5:CE:24:DD:0A:F7:84:
        4E:FA:16:29:3B:91:D3:EE:24:E9:AF:F6:A1:49:E1:96:
        70:DE:6F:B2:BE:3A:07:1A:0B:FD:FE:2F:75:FD:F9:FC:
        63:69:36:B6:5B:09:C6:84:92:17:9C:3E:64:C3:C4:C9
  Extensions:
```

```
    Identifier: Netscape Certificate Type - 2.16.840.1.113730.1.1
      Critical: no
      Certificate Usage:
        SSL CA
        Secure Email CA
        ObjectSigning CA
    Identifier: Basic Constraints - 2.5.29.19
      Critical: yes
      Is CA: yes
      Path Length Constraint: UNLIMITED
    Identifier: Subject Key Identifier - 2.5.29.14
      Critical: no
      Key Identifier:
        3B:46:83:85:27:BC:F5:9D:8E:63:E3:BE:79:EF:AF:79:
        9C:37:85:84
    Identifier: Authority Key Identifier - 2.5.29.35
      Critical: no
      Key Identifier:
        3B:46:83:85:27:BC:F5:9D:8E:63:E3:BE:79:EF:AF:79:
        9C:37:85:84
    Identifier: Key Usage: - 2.5.29.15
      Critical: yes
      Key Usage:
        Digital Signature
        Key CertSign
        Crl Sign
  Signature:
    Algorithm: SHA1withRSA - 1.2.840.113549.1.1.5
    Signature:
      AA:96:65:3D:10:FA:C7:0B:74:38:2D:93:54:32:C0:5B:
      2F:18:93:E9:7C:32:E6:A4:4F:4E:38:93:61:83:3A:6A:
      A2:11:91:C2:D2:A3:48:07:6C:07:54:A8:B8:42:0E:B4:
      E4:AE:42:B4:B5:36:24:46:4F:83:61:64:13:69:03:DF:
      41:88:0B:CB:39:57:8C:6B:9F:52:7E:26:F9:24:5E:E7:
      BC:FB:FD:93:13:AF:24:3A:8F:DB:E3:DC:C9:F9:1F:67:
      A8:BD:0B:95:84:9D:EB:FC:02:95:A0:49:2C:05:D4:B0:
      35:EA:A6:80:30:20:FF:B1:85:C8:4B:74:D9:DC:BB:50
```

An *object identifier* (OID) is a string of numbers identifying a unique object, such as a certificate extension or a company's certificate practice statement. The Certificate System comes with a set of extension-specific profile plug-in modules which enable X.509 certificate extensions to be added to the certificates the server issues. Some of the extensions contain fields for specifying OIDs.

The PKIX standard recommends that all objects, such as extensions and statements, that are used in certificates be included in the form of an OID. This promotes interoperability between organizations on a shared network. If certificates will be issued that will be used on shared networks, register the OID prefixes with the appropriate registration authority.

OIDs are controlled by the International Standards Organization (ISO) registration authority. In some cases, this authority is delegated by ISO to regional registration authorities. In the United States, the American National Standards Institute (ANSI) manages this registration.

Using an OID registered to another organization or failing to register an OID may carry legal consequences, depending the situation. Registration may be subject to fees. For more information, contact the appropriate registration authority.

To define or assign OIDs for custom objects, know the company's *arc*, an OID for a private enterprise. If the company does not have an arc, it needs to get one. The http://www.alvestrand.no/objectid/ has more information on registering and using OIDs.

For example, the Netscape-defined OID for an extension named **Netscape Certificate Comment** is 2.16.840.1.113730.1.13. The OID assigned to this extension is hierarchical and includes the former Netscape company arc, **2.16.840.1**. The OID definition entry is http://www.alvestrand.no/objectid/2.16.840.1.113730.1.13.html.

If an OID extension exists in a certificate and is marked critical, the application validating the certificate must be able to interpret the extension, including any optional qualifiers, or it must reject the certificate. Since it is unlikely that all applications will be able to interpret a company's custom extensions embedded in the form of OIDs, the PKIX standard recommends that the extension be always marked noncritical.

This section summarizes the extension types defined as part of the Internet X.509 version 3 standard and indicates which types are recommended by the PKIX working group.

This reference summarizes important information about each certificate. For complete details, see both the X.509 v3 standard, available from the ITU, and *Internet X.509 Public Key Infrastructure - Certificate and CRL Profile (RFC 3280)*, available at RFC 3280. The descriptions of extensions reference the RFC and section number of the standard draft that discusses the extension; the object identifier (OID) for each extension is also provided.

Each extension in a certificate can be designated as critical or noncritical. A certificate-using system, such as a web browser, must reject the certificate if it encounters a critical extension it does not recognize; however, a noncritical extension can be ignored if it is not recognized.

B.3.1. authorityInfoAccess

The Authority Information Access extension indicates how and where to access information about the issuer of the certificate. The extension contains an **accessMethod** and an **accessLocation** field. **accessMethod** specifies by OID the type and format of information about the issuer named in **accessLocation**.

PKIX Part 1 defines one **accessMethod** (**id-ad-caIssuers**) to get a list of CAs that have issued certificates higher in the CA chain than the issuer of the certificate using the extension. The **accessLocation** field then typically contains a URL indicating the location and protocol (LDAP, HTTP, or FTP) used to retrieve the list.

The Online Certificate Status Protocol (RFC 2560), available at RFC 2560, defines an *accessMethod* (**id-ad-ocsp**) for using OCSP to verify certificates. The **accessLocation** field then contains a URL indicating the location and protocol used to access an OCSP responder that can validate the certificate.

OID

1.3.6.1.5.5.7.1.1

Criticality

This extension must be noncritical.

B.3.2. authorityKeyIdentifier

The Authority Key Identifier extension identifies the public key corresponding to the private key used to sign a certificate. This extension is useful when an issuer has multiple signing keys, such as when a CA certificate is renewed.

The extension consists of one or both of the following:

- An explicit key identifier, set in the **keyIdentifier** field
- An issuer, set in the **authorityCertIssuer** field, and serial number, set in the **authorityCertSerialNumber** field, identifying a certificate

If the **keyIdentifier** field exists, it is used to select the certificate with a matching **subjectKeyIdentifier** extension. If the **authorityCertIssuer** and **authorityCertSerialNumber** fields are present, then they are used to identify the correct certificate by **issuer** and **serialNumber**.

If this extension is not present, then the issuer name alone is used to identify the issuer certificate.

PKIX Part 1 requires this extension for all certificates except self-signed root CA certificates. Where a key identifier has not been established, PKIX recommends that the **authorityCertIssuer** and **authorityCertSerialNumber** fields be specified. These fields permit construction of a complete certificate chain by matching the **SubjectName** and **CertificateSerialNumber** fields in the issuer's certificate against the **authortiyCertIssuer** and **authorityCertSerialNumber** in the Authority Key Identifier extension of the subject certificate.

OID

2.5.29.35

Criticality

This extension is always noncritical and is always evaluated.

B.3.3. basicConstraints

This extension is used during the certificate chain verification process to identify CA certificates and to apply certificate chain path length constraints. The **cA** component should be set to **true** for all CA certificates. PKIX recommends that this extension should not appear in end-entity certificates.

If the **pathLenConstraint** component is present, its value must be greater than the number of CA certificates that have been processed so far, starting with the end-entity certificate and moving up the chain. If **pathLenConstraint** is omitted, then all of the higher level CA certificates in the chain must not include this component when the extension is present.

OID

2.5.29.19

Criticality

PKIX Part 1 requires that this extension be marked critical. This extension is evaluated regardless of its criticality.

B.3.4. certificatePoliciesExt

The Certificate Policies extension defines one or more policies, each of which consists of an OID and optional qualifiers. The extension can include a URI to the issuer's Certificate Practice Statement or can embed issuer information, such as a user notice in text form. This information can be used by certificate-enabled applications.

If this extension is present, PKIX Part 1 recommends that policies be identified with an OID only, or, if necessary, only certain recommended qualifiers.

OID

2.5.29.32

Criticality

This extension may be critical or noncritical.

B.3.5. CRLDistributionPoints

This extension defines how CRL information is obtained. It should be used if the system is configured to use CRL issuing points.

If the extension contains a **`DistributionPointName`** with a type set to URI, the URI is assumed to be a pointer to the current CRL for the specified revocation reasons and will be issued by the named **`cRLIssuer`**. The expected values for the URI are those defined for the Subject Alternative Name extension. If the **`distributionPoint`** omits reasons, the CRL must include revocations for all reasons. If the **`distributionPoint`** omits **`cRLIssuer`**, the CRL must be issued by the CA that issued the certificate.

PKIX recommends that this extension be supported by CAs and applications.

OID

2.5.29.31

Criticality

PKIX recommends that this extension be marked noncritical and that it be supported for all certificates.

B.3.6. extKeyUsage

The Extended Key Usage extension indicates the purposes for which the certified public key may be used. These purposes may be in addition to or in place of the basic purposes indicated in the Key Usage extension.

The Extended Key Usage extension must include **`OCSP Signing`** in an OCSP responder's certificate unless the CA signing key that signed the certificates validated by the responder is also the OCSP signing key. The OCSP responder's certificate must be issued directly by the CA that signs certificates the responder will validate.

The Key Usage, Extended Key Usage, and Basic Constraints extensions act together to define the purposes for which the certificate is intended to be used. Applications can use these extensions to disallow the use of a certificate in inappropriate contexts.

Table B.36, “PKIX Extended Key Usage Extension Uses” lists the uses defined by PKIX for this extension, and Table B.37, “Private Extended Key Usage Extension Uses” lists uses privately defined by Netscape.

OID

2.5.29.37

Criticality

If this extension is marked critical, the certificate must be used for one of the indicated purposes only. If it is not marked critical, it is treated as an advisory field that may be used to identify keys but does not restrict the use of the certificate to the indicated purposes.

Table B.36. PKIX Extended Key Usage Extension Uses

Use	OID
Server authentication	1.3.6.1.5.5.7.3.1
Client authentication	1.3.6.1.5.5.7.3.2
Code signing	1.3.6.1.5.5.7.3.3
Email	1.3.6.1.5.5.7.3.4
Timestamping	1.3.6.1.5.5.7.3.8
OCSP Signing	1.3.6.1.5.5.7.3.9 [a]

[a] OCSP Signing is not defined in PKIX Part 1, but in RFC 2560, *X.509 Internet Public Key Infrastructure Online Certificate Status Protocol - OCSP*.

Table B.37. Private Extended Key Usage Extension Uses

Use	OID
Certificate trust list signing	1.3.6.1.4.1.311.10.3.1
Microsoft Server Gated Crypto (SGC)	1.3.6.1.4.1.311.10.3.3
Microsoft Encrypted File System	1.3.6.1.4.1.311.10.3.4

Use	OID
Netscape SGC	2.16.840.1.113730.4.1

B.3.7. issuerAltName Extension

The Issuer Alternative Name extension is used to associate Internet-style identities with the certificate issuer. Names must use the forms defined for the Subject Alternative Name extension.

OID

2.5.29.18

Criticality

PKIX Part 1 recommends that this extension be marked noncritical.

B.3.8. keyUsage

The Key Usage extension defines the purpose of the key contained in the certificate. The Key Usage, Extended Key Usage, and Basic Constraints extensions act together to specify the purposes for which a certificate can be used.

If this extension is included at all, set the bits as follows:

- **`digitalSignature`** (**0**) for SSL client certificates, S/MIME signing certificates, and object-signing certificates.
- **`nonRepudiation`** (**1**) for some S/MIME signing certificates and object-signing certificates.

> **Warning**
>
> Use of this bit is controversial. Carefully consider the legal consequences of its use before setting it for any certificate.

- **`keyEncipherment`** (**2**) for SSL server certificates and S/MIME encryption certificates.
- **`dataEncipherment`** (**3**) when the subject's public key is used to encrypt user data instead of key material.
- **`keyAgreement`** (**4**) when the subject's public key is used for key agreement.
- **`keyCertSign`** (**5**) for all CA signing certificates.
- **`cRLSign`** (**6**) for CA signing certificates that are used to sign CRLs.
- **`encipherOnly`** (**7**) if the public key is used only for enciphering data. If this bit is set, **`keyAgreement`** should also be set.

- **decipherOnly** (**8**) if the public key is used only for deciphering data. If this bit is set, **keyAgreement** should also be set.

Table B.38, "Certificate Uses and Corresponding Key Usage Bits" summarizes the guidelines for typical certificate uses.

If the **keyUsage** extension is present and marked critical, then it is used to enforce the usage of the certificate and key. The extension is used to limit the usage of a key; if the extension is not present or not critical, all types of usage are allowed.

If the **keyUsage** extension is present, critical or not, it is used to select from multiple certificates for a given operation. For example, it is used to distinguish separate signing and encryption certificates for users who have separate certificates and key pairs for operations.

OID

2.5.29.15

Criticality

This extension may be critical or noncritical. PKIX Part 1 recommends that it should be marked critical if it is used.

Table B.38. Certificate Uses and Corresponding Key Usage Bits

Purpose of Certificate	Required Key Usage Bit
CA Signing	• keyCertSign • cRLSign
SSL Client	digitalSignature
SSL Server	keyEncipherment
S/MIME Signing	digitalSignature
S/MIME Encryption	keyEncipherment
Certificate Signing	keyCertSign
Object Signing	digitalSignature

B.3.9. nameConstraints

This extension, which can used in CA certificates only, defines a name space within which all subject names in subsequent certificates in a certification path must be located.

OID

2.5.29.30

Criticality

PKIX Part 1 requires that this extension be marked critical.

B.3.10. OCSPNocheck

The extension is meant to be included in an OCSP signing certificate. The extension tells an OCSP client that the signing certificate can be trusted without querying the OCSP responder (since the reply would again be signed by the OCSP responder, and the client would again request the validity status of the signing certificate). This extension is null-valued; its meaning is determined by its presence or absence.

Since the presence of this extension in a certificate will cause OCSP clients to trust responses signed with that certificate, use of this extension should be managed carefully. If the OCSP signing key is compromised, the entire process of validating certificates in the PKI will be compromised for the duration of the validity period of the certificate. Therefore, certificates using **`OCSPNocheck`** should be issued with short lifetimes and be renewed frequently.

OID

1.3.6.1.5.5.7.48.4

Criticality

This extension should be noncritical.

B.3.11. policyConstraints

This extension, which is for CA certificates only, constrains path validation in two ways. It can be used to prohibit policy mapping or to require that each certificate in a path contain an acceptable policy identifier.

PKIX requires that, if present, this extension must never consist of a null sequence. At least one of the two available fields must be present.

OID

2.5.29.36

Criticality

This extension may be critical or noncritical.

B.3.12. policyMappings

The Policy Mappings extension is used in CA certificates only. It lists one or more pairs of OIDs used to indicate that the corresponding policies of one CA are equivalent to policies of another CA. It may be useful in the context of cross-pair certificates.

This extension may be supported by CAs and applications.

OID

2.5.29.33

Criticality

This extension must be noncritical.

B.3.13. privateKeyUsagePeriod

The Private Key Usage Period extension allows the certificate issuer to specify a different validity period for the private key than for the certificate itself. This extension is intended for use with digital signature keys.

> **Note**
>
> PKIX Part 1 recommends against the use of this extension. CAs conforming to PKIX Part 1 *must not* generate certificates with this extension.

OID

2.5.29.16

B.3.14. subjectAltName

The Subject Alternative Name extension includes one or more alternative (non-X.500) names for the identity bound by the CA to the certified public key. It may be used in addition to the certificate's subject name or as a replacement for it. Defined name forms include Internet electronic mail address (SMTP, as defined in RFC-822), DNS name, IP address (both IPv4 and IPv6), and uniform resource identifier (URI).

PKIX requires this extension for entities identified by name forms other than the X.500 distinguished name (DN) used in the subject field. PKIX Part 1 describes additional rules for the relationship between this extension and the subject field.

Email addresses may be provided in the Subject Alternative Name extension, the certificate subject name field, or both. If the email address is part of the subject name, it must be in the form of the **`EmailAddress`** attribute defined by PKCS #9. Software that supports S/MIME must be able to read an email address from either the Subject Alternative Name extension or from the subject name field.

OID

2.5.29.17

Criticality

If the certificate's subject field is empty, this extension must be marked critical.

B.3.15. subjectDirectoryAttributes

The Subject Directory Attributes extension conveys any desired directory attribute values for the subject of the certificate. It is not recommended as an essential part of the proposed PKIX standard but may be used in local environments.

OID

2.5.29.9

Criticality

PKIX Part 1 requires that this extension be marked noncritical.

B.3.16. subjectKeyIdentifier

The Subject Key Identifier extension identifies the public key certified by this certificate. This extension provides a way of distinguishing public keys if more than one is available for a given subject name.

The value of this extension should be calculated by performing a SHA-1 hash of the certificate's DER-encoded **`subjectPublicKey`**, as recommended by PKIX. The Subject Key Identifier extension is used in conjunction with the Authority Key Identifier extension for CA certificates. If the CA certificate has a Subject Key Identifier extension, the key identifier in the Authority Key Identifier extension of the certificate being verified should match the key identifier of the CA's Subject Key Identifier extension. It is not necessary for the verifier to recompute the key identifier in this case.

PKIX Part 1 requires this extension for all CA certificates and recommends it for all other certificates.

OID

2.5.29.14

Criticality

This extension is always noncritical.

B.4. CRL Extensions

B.4.1. About CRL Extensions

Since its initial publication, the X.509 standard for CRL formats has been amended to include additional information within a CRL. This information is added through CRL extensions.

The extensions defined by ANSI X9 and ISO/IEC/ITU for X.509 CRLs [X.509] [X9.55] allow additional attributes to be associated with CRLs. The *Internet X.509 Public Key Infrastructure Certificate and CRL Profile*, available at RFC 5280, recommends a set of extensions to be used in CRLs. These extensions are called *standard CRL extensions*.

The standard also allows custom extensions to be created and included in CRLs. These extensions are called *private*, *proprietary*, or *custom* CRL extensions and carry information unique to an organization or business. Applications may not able to validate CRLs that contain private critical extensions, so it is not recommended that custom extensions be used in a general context.

> **Note**
>
> Abstract Syntax Notation One (ASN.1) and Distinguished Encoding Rules (DER) standards are specified in the CCITT Recommendations X.208 and X.209. For a quick summary of ASN.1 and DER, see *A Layman's Guide to a Subset of ASN.1, BER, and DER*, which is available at RSA Laboratories' web site, http://www.rsa.com.

B.4.1.1. Structure of CRL Extensions

A CRL extension consists of the following parts:

- The object identifier (OID) for the extension. This identifier uniquely identifies the extension. It also determines the ASN.1 type of value in the value field and how the value is interpreted. When an extension appears in a CRL, the OID appears as the extension ID field (**`extnID`**) and the corresponding ASN.1 encoded structure appears as the value of the octet string (**`extnValue`**); examples are shown in Example B.3, “Sample Pretty-Print Certificate Extensions”.
- A flag or Boolean field called **`critical`**.

  The **`true`** or **`false`** value assigned to this field indicates whether the extension is critical or noncritical to the CRL.

  - If the extension is critical and the CRL is sent to an application that does not understand the extension based on the extension's ID, the application must reject the CRL.
  - If the extension is not critical and the CRL is sent to an application that does not understand the extension based on the extension's ID, the application can ignore the extension and accept the CRL.
- An octet string containing the DER encoding of the value of the extension.

The application receiving the CRL checks the extension ID to determine if it can recognize the ID. If it can, it uses the extension ID to determine the type of value used.

B.4.1.2. Sample CRL and CRL Entry Extensions

The following is an example of an X.509 CRL version 2 extension. The Certificate System can display CRLs in readable pretty-print format, as shown here. As shown in the example, CRL extensions appear in sequence and only one instance of a particular extension may appear per CRL; for example, a CRL may contain only one Authority Key Identifier extension. However, CRL-entry extensions appear in appropriate entries in the CRL.

```
Certificate Revocation List:
    Data:
        Version:  v2
        Signature Algorithm: SHA1withRSA - 1.2.840.113549.1.1.5
        Issuer: CN=Certificate Authority,O=Example Domain
        This Update: Wednesday, July 29, 2009 8:59:48 AM GMT-08:00
        Next Update: Friday, July 31, 2009 8:59:48 AM GMT-08:00
        Revoked Certificates: 1-3 of 3
            Serial Number: 0x11
            Revocation Date: Thursday, July 23, 2009 10:07:15 AM GMT-
08:00
            Extensions:
                Identifier: Revocation Reason - 2.5.29.21
                    Critical: no
                    Reason: Privilege_Withdrawn
            Serial Number: 0x1A
            Revocation Date: Wednesday, July 29, 2009 8:50:11 AM GMT-
08:00
            Extensions:
                Identifier: Revocation Reason - 2.5.29.21
                    Critical: no
                    Reason: Certificate_Hold
                Identifier: Invalidity Date - 2.5.29.24
                    Critical: no
                    Invalidity Date: Sun Jul 26 23:00:00 GMT-08:00 2009
            Serial Number: 0x19
            Revocation Date: Wednesday, July 29, 2009 8:50:49 AM GMT-
08:00
            Extensions:
                Identifier: Revocation Reason - 2.5.29.21
                    Critical: no
                    Reason: Key_Compromise
                Identifier: Invalidity Date - 2.5.29.24
                    Critical: no
                    Invalidity Date: Fri Jul 24 23:00:00 GMT-08:00 2009
    Extensions:
        Identifier: Authority Info Access: - 1.3.6.1.5.5.7.1.1
            Critical: no
            Access Description:
                Method #0: ocsp
                Location #0: URIName: http://example.com:9180/ca/ocsp
        Identifier: Issuer Alternative Name - 2.5.29.18
            Critical: no
            Issuer Names:
                DNSName: example.com
        Identifier: Authority Key Identifier - 2.5.29.35
            Critical: no
            Key Identifier:
                50:52:0C:AA:22:AC:8A:71:E3:91:0C:C5:77:21:46:9C:
                0F:F8:30:60
        Identifier: Freshest CRL - 2.5.29.46
            Critical: no
```

```
            Number of Points: 1
            Point 0
                Distribution Point: [URIName:
http://server.example.com:8443/ca/ee/ca/getCRL?
op=getDeltaCRL&crlIssuingPoint=MasterCRL]
        Identifier: CRL Number - 2.5.29.20
            Critical: no
            Number: 39
        Identifier: Issuing Distribution Point - 2.5.29.28
            Critical: yes
            Distribution Point:
                Full Name:
                    URIName: http://example.com:9180/ca/ee/ca/getCRL?
op=getCRL&crlIssuingPoint=MasterCRL
            Only Contains User Certificates: no
            Only Contains CA Certificates: no
            Indirect CRL: no
    Signature:
        Algorithm: SHA1withRSA - 1.2.840.113549.1.1.5
        Signature:
            47:D2:CD:C9:E5:F5:9D:56:0A:97:31:F5:D5:F2:51:EB:
            1F:CF:FA:9E:63:D4:80:13:85:E5:D8:27:F0:69:67:B5:
            89:4F:59:5E:69:E4:39:93:61:F2:E3:83:51:0B:68:26:
            CD:99:C4:A2:6C:2B:06:43:35:36:38:07:34:E4:93:80:
            99:2F:79:FB:76:E8:3D:4C:15:5A:79:4E:E5:3F:7E:FC:
            D8:78:0D:1D:59:A0:4C:14:42:B7:22:92:89:38:3A:4C:
            4A:3A:06:DE:13:74:0E:E9:63:74:D0:2F:46:A1:03:37:
            92:F0:93:D9:AA:F8:13:C5:06:25:02:B0:FD:3B:41:E7:
            62:6F:67:A3:9F:F5:FA:03:41:DA:8D:FD:EA:2F:E3:2B:
            3E:F8:E9:CC:3B:9F:E4:ED:73:F2:9E:B9:54:14:C1:34:
            68:A7:33:8F:AF:38:85:82:40:A2:06:97:3C:B4:88:43:
            7B:AF:5D:87:C4:47:63:4A:11:65:E3:75:55:4D:98:97:
            C2:2E:62:08:A4:04:35:5A:FE:0A:5A:6E:F1:DE:8E:15:
            27:1E:0F:87:33:14:16:2E:57:F7:DC:77:BE:D2:75:AB:
            A9:7C:42:1F:84:6D:40:EC:E7:ED:84:F8:14:16:28:33:
            FD:11:CD:C5:FC:49:B7:7B:39:57:B3:E6:36:E5:CD:B6
```

A *delta CRL* is a subset of the CRL which contains only the changes since the last CRL was published. Any CRL which contains the delta CRL indicator extension is a delta CRL.

```
ertificate Revocation List:
    Data:
        Version:  v2
        Signature Algorithm: SHA1withRSA - 1.2.840.113549.1.1.5
        Issuer: CN=Certificate Authority,O=SjcRedhat Domain
        This Update: Wednesday, July 29, 2009 9:02:28 AM GMT-08:00
        Next Update: Thursday, July 30, 2009 9:02:28 AM GMT-08:00
        Revoked Certificates:
            Serial Number: 0x1A
            Revocation Date: Wednesday, July 29, 2009 9:00:48 AM GMT-
08:00
            Extensions:
                Identifier: Revocation Reason - 2.5.29.21
                    Critical: no
                    Reason: Remove_from_CRL
            Serial Number: 0x17
```

```
            Revocation Date: Wednesday, July 29, 2009 9:02:16 AM GMT-
08:00
            Extensions:
                Identifier: Revocation Reason - 2.5.29.21
                    Critical: no
                    Reason: Certificate_Hold
                Identifier: Invalidity Date - 2.5.29.24
                    Critical: no
                    Invalidity Date: Mon Jul 27 23:00:00 GMT-08:00 2009
    Extensions:
        Identifier: Authority Info Access: - 1.3.6.1.5.5.7.1.1
            Critical: no
            Access Description:
                Method #0: ocsp
                Location #0: URIName:
http://server.example.com:8443/ca/ocsp
        Identifier: Delta CRL Indicator - 2.5.29.27
            Critical: yes
            Base CRL Number: 39
        Identifier: Issuer Alternative Name - 2.5.29.18
            Critical: no
            Issuer Names:
                DNSName: a-f8.sjc.redhat.com
        Identifier: Authority Key Identifier - 2.5.29.35
            Critical: no
            Key Identifier:
                50:52:0C:AA:22:AC:8A:71:E3:91:0C:C5:77:21:46:9C:
                0F:F8:30:60
        Identifier: CRL Number - 2.5.29.20
            Critical: no
            Number: 41
        Identifier: Issuing Distribution Point - 2.5.29.28
            Critical: yes
            Distribution Point:
                Full Name:
                    URIName:
http://server.example.com:8443/ca/ee/ca/getCRL?
op=getCRL&crlIssuingPoint=MasterCRL
            Only Contains User Certificates: no
            Only Contains CA Certificates: no
            Indirect CRL: no
    Signature:
        Algorithm: SHA1withRSA - 1.2.840.113549.1.1.5
        Signature:
            68:28:DA:90:D5:39:CB:6D:BE:42:04:77:C9:E4:09:60:
            C1:97:A6:99:AB:A0:5B:A2:F3:8B:5E:4E:D6:05:70:B0:
            87:1F:D7:0E:4B:C6:B2:DE:8B:92:D8:7C:3B:36:1C:79:
            96:2A:64:E6:7A:25:1D:E7:40:62:48:7A:24:C9:9D:11:
            A6:7F:BB:6B:03:A0:9C:1D:BC:1C:EE:9A:4B:A6:48:2C:
            3B:5E:2B:B1:70:3C:C3:42:96:28:26:AB:82:18:F2:E9:
            F2:55:48:A8:7E:7F:FE:D4:3D:0B:EA:A2:2F:4E:E6:C3:
            C3:C1:6A:E5:C6:85:5B:42:B1:70:2A:C6:E1:D9:0C:AF:
            DA:01:22:FF:80:6E:2E:A7:E5:34:DC:AF:E6:C2:B5:B3:
            1B:FC:28:36:8A:91:4A:22:E7:03:A5:ED:4E:62:0C:D9:
            7F:81:BB:80:99:B8:61:2A:02:C6:9C:41:2E:01:82:21:
            80:82:69:52:BD:B2:AA:DB:0F:80:0A:7E:2A:F3:15:32:
```

```
                69:D2:40:0D:39:59:93:75:A2:ED:24:70:FB:EE:19:C0:
                BE:A2:14:36:D0:AC:E8:E2:EE:23:83:DD:BC:DF:38:1A:
                9E:37:AF:E3:50:D9:47:9D:22:7C:36:35:BF:13:2C:16:
                A2:79:CF:05:41:88:8E:B6:A2:4E:B3:48:6D:69:C6:38
```

B.4.2. Standard X.509 v3 CRL Extensions Reference

In addition to certificate extensions, the X.509 proposed standard defines extensions to CRLs, which provide methods for associating additional attributes with Internet CRLs. These are one of two kinds: extensions to the CRL itself and extensions to individual certificate entries in the CRL.

B.4.2.1. Extensions for CRLs

The following CRL descriptions are defined as part of the Internet X.509 v3 Public Key Infrastructure proposed standard.

B.4.2.1.1. authorityInfoAccess

The Authority Information Access extension identifies how delta CRL information is obtained. The freshestCRL extension is placed in the full CRL to indicate where to find the latest delta CRL.

OID

1.3.6.1.5.5.7.1.1

Criticality

PKIX requires that this extension must not be critical.

Parameters

Table B.39. Authority Infomation Access Configuration Parameters

Parameter	Description
enable	Specifies whether the rule is enabled or disabled. The default is to have this extension disabled.
critical	Sets whether the extension is marked as critical; the default is noncritical.
numberOfAccessDescriptions	Indicates the number of access descriptions, from 0 to any positive integer; the default is 0. When setting this parameter to an integer other than 0, set the number, and then click OK to close the window. Re-open the edit window for the rule, and the fields to set the points will be present.
accessMethod*n*	The only accepted value for this parameter is calssuers. The calssuers method is used when the information available lists certificates that can be used to verify the signature on the CRL. No other method should be used when the AIA extension is included in a CRL.
accessLocationType*n*	Specifies the type of access location for the *n* access description. The options are either **`DirectoryName`** or **`URI`**.
accessLocation*n*	If **`accessLocationType`** is set to **`DirectoryName`**, the value must be a string in the form of an X.500 name, similar to the subject name in a certificate. For example, *CN=CACentral,OU=Research Dept,O=Example Corporation,C=US*. If **`accessLocationType`** is set to **`URI`**, the name must be a URI; the URI must be an absolute pathname and must specify the host. For example, *http://testCA.example.com/get/crls/here/*.

B.4.2.1.2. authorityKeyIdentifier

The Authority Key Identifier extension for a CRL identifies the public key corresponding to the private key used to sign the CRL. For details, see the discussion under certificate extensions at Section B.3.2, “authorityKeyIdentifier”.

The PKIX standard recommends that the CA must include this extension in all CRLs it issues because a CA's public key can change, for example, when the key gets updated, or the CA may have multiple signing keys because of multiple concurrent key pairs or key changeover. In these cases, the CA ends up with more than one key pair. When verifying a signature on a certificate, other applications need to know which key was used in the signature.

OID

2.5.29.35

Parameters

Table B.40. AuthorityKeyIdentifierExt Configuration Parameters

Parameter	Description
enable	Specifies whether the rule is enabled or disabled. The default is to have this extension disabled.
critical	Sets whether the extension is marked as critical; the default is noncritical.

B.4.2.1.3. CRLNumber

The CRLNumber extension specifies a sequential number for each CRL issued by a CA. It allows users to easily determine when a particular CRL supersedes another CRL. PKIX requires that all CRLs have this extension.

OID

2.5.29.20

Criticality

This extension must not be critical.

Parameters

Table B.41. CRLNumber Configuration Parameters

Parameter	Description
enable	Specifies whether the rule is enabled, which is the default.
critical	Sets whether the extension is marked as critical; the default is noncritical.

B.4.2.1.4. deltaCRLIndicator

The deltaCRLIndicator extension generates a delta CRL, a list only of certificates that have been revoked since the last CRL; it also includes a reference to the base CRL. This updates the local database while ignoring unchanged information already in the local database. This can significantly improve processing time for applications that store revocation information in a format other than the CRL structure.

OID

2.5.29.27

Criticality

PKIX requires that this extension be critical if it exists.

Parameters

Table B.42. DeltaCRL Configuration Parameters

Parameter	Description
enable	Sets whether the rule is enabled. By default, it is disabled.
critical	Sets whether the extension is critical or noncritical. By default, this is critical.

B.4.2.1.5. FreshestCRL

The freshestCRL extension identifies how delta CRL information is obtained. The freshestCRL extension is placed in the full CRL to indicate where to find the latest delta CRL.

OID

2.5.29.46

Criticality

PKIX requires that this extension must be noncritical.

Parameters

Table B.43. FreshestCRL Configuration Parameters

Parameter	Description
enable	Sets whether the extension rule is enabled. By default, this is disabled.
critical	Marks the extension as critical or noncritical. The default is noncritical.
numPoints	Indicates the number of issuing points for the delta CRL, from **0** to any positive integer; the default is **0**. When setting this to an integer other than 0, set the number, and then click **OK** to close the window. Re-open the edit window for the rule, and the fields to set these points will be present.
pointType*n*	Specifies the type of issuing point for the *n* issuing point. For each number specified in **numPoints**, there is an equal number of **pointType** parameters. The options are either **DirectoryName** or **URIName**.
pointName*n*	If **pointType** is set to **directoryName**, the value must be a string in the form of an X.500 name, similar to the subject name in a certificate. For example, *CN=CACentral,OU=Research Dept,O=Example Corporation,C=US*. If **pointType** is set to **URIName**, the name must be a URI; the URI must be an absolute pathname and must specify the host. For example, *http://testCA.example.com/get/crls/here/*.

B.4.2.1.6. issuerAltName

The Issuer Alternative Name extension allows additional identities to be associated with the issuer of the CRL, like binding attributes such as a mail address, a DNS name, an IP address (both IPv4 and IPv6), and a uniform resource indicator (URI), with the issuer of the CRL. For details, see the discussion under certificate extensions at Section B.3.7, “issuerAltName Extension”.

OID

2.5.29.18

Parameters

Table B.44. IssuerAlternativeName Configuration Parameters

Parameter	Description

Parameter	Description
enable	Sets whether the extension rule is enabled; by default, this is disabled.
critical	Sets whether the extension is critical; by default, this is noncritical.
numNames	Sets the total number of alternative names or identities permitted in the extension. Each name has a set of configuration parameters, **nameType** and **name**, which must have appropriate values or the rule returns an error. Change the total number of identities by changing the value specified in this field; there is no limit on the total number of identities that can be included in the extension. Each set of configuration parameters is distinguished by an integer derived from the value of this field. For example, if the **numNames** parameter is set to **2**, the derived integers are **0** and **1**.
nameType*n*	Specifies the general-name type; this can be any of the following: • **rfc822Name** if the name is an Internet mail address. • **directoryName** if the name is an X.500 directory name. • **dNSName** if the name is a DNS name. • **ediPartyName** if the name is a EDI party name. • **URL** if the name is a URI (default). • **iPAddress** if the name is an IP address. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*. • **OID** if the name is an object identifier. • **otherName** if the name is in any other name form; this supports **PrintableString**, **IA5String**, **UTF8String**, **BMPString**, **Any**, and **KerberosName**.
name*n*	Specifies the general-name value; the allowed values depend on the name type specified in the **nameType** field.

Parameter	Description
	* For **rfc822Name**, the value must be a valid Internet mail address in the *local-part@domain* format. * For **directoryName**, the value must be a string X.500 name, similar to the subject name in a certificate. For example, *CN=CACentral,OU=Research Dept,O=Example Corporation,C=US*. * For **dNSName**, the value must be a valid domain name in the DNS format. For example, *testCA.example.com*. * For **ediPartyName**, the name must be an IA5String. For example, *Example Corporation*. * For **URL**, the value must be a non-relative URI. For example, *http://testCA.example.com*. * For **iPAddress**, the value must be a valid IP address specified in dot-separated numeric component notation. It can be the IP address or the IP address including the netmask. An IPv4 address must be in the format *n.n.n.n* or *n.n.n.n,m.m.m.m*. For example, *128.21.39.40* or *128.21.39.40,255.255.255.00*. An IPv6 address uses a 128-bit namespace, with the IPv6 address separated by colons and the netmask separated by periods. For example, *0:0:0:0:0:0:13.1.68.3*, *FF01::43*, *0:0:0:0:0:0:13.1.68.3,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:255.255.255.0*, and *FF01::43,FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FF00:0000*. * For **OID**, the value must be a unique, valid OID specified in the dot-separated numeric component notation. For example, *1.2.3.4.55.6.5.99*. Although custom OIDs can be used to evaluate and test the server, in a production environment, comply with the ISO rules for defining OIDs and for registering subtrees of IDs. * For **otherName**, the names can be any other format; this supports **PrintableString**, **IA5String**, **UTF8String**, **BMPString**, **Any**, and **KerberosName**. **PrintableString**, **IA5String**, **UTF8String**, **BMPString**, and **Any** set a string to a base-64 encoded file specifying the subtree, such as */var/lib/pki/pki-tomcat/ca/othername.txt*. **KerberosName** has the format *Realm|NameType|NameStrings*, such as *realm1|0|userID1,userID2*. The name

Parameter	Description
	must be the absolute path to the file that contains the general name in its base-64 encoded format. For example, */var/lib/pki/pki-tomcat/ca/extn/ian/othername.txt*.

B.4.2.1.7. issuingDistributionPoint

The Issuing Distribution Point CRL extension identifies the CRL distribution point for a particular CRL and indicates what kinds of revocation it covers, such as revocation of end-entity certificates only, CA certificates only, or revoked certificates that have a limited set of reason codes.

PKIX Part I does not require this extension.

OID

2.5.29.28

Criticality

PKIX requires that this extension be critical if it exists.

Parameters

Table B.45. IssuingDistributionPoint Configuration Parameters

Parameter	Description
enable	Sets whether the extension is enabled; the default is disabled.
critical	Marks the extension as critical, the default, or noncritical.
pointType	Specifies the type of the issuing distribution point from the following: • **`directoryName`** specifies that the type is an X.500 directory name. • **`URIName`** specifies that the type is a uniform resource indicator.

Parameter	Description
pointName	Gives the name of the issuing distribution point. The name of the distribution point depends on the value specified for the **pointType** parameter. » For **directoryName**, the name must be an X.500 name. For example, *cn=CRLCentral,ou=Research Dept,o=Example Corporation,c=US*. » For **URIName**, the name must be a URI that is an absolute pathname and specifies the host. For example, *http://testCA.example.com/get/crls/here/*. **Note** The CRL may be stored in the directory entry corresponding to the CRL issuing point, which may be different than the directory entry of the CA.
onlySomeReasons	Specifies the reason codes associated with the distribution point. Permissible values are a combination of reason codes (**unspecified**, **keyCompromise**, **cACompromise**, **affiliationChanged**, **superseded**, **cessationOfOperation**, **certificateHold**, and **removeFromCRL**) separated by commas. Leave the field blank if the distribution point contains revoked certificates with all reason codes (default).
onlyContainsCACerts	Specifies that the distribution point contains user certificates only if set. By default, this is not set, which means the distribution point contains all types of certificates.
indirectCRL	Specifies that the distribution point contains an indirect CRL; by default, this is not selected.

B.4.2.2. CRL Entry Extensions

The sections that follow lists the CRL entry extension types that are defined as part of the Internet X.509 v3 Public Key Infrastructure proposed standard. All of these extensions are noncritical.

B.4.2.2.1. certificateIssuer

The Certificate Issuer extension identifies the certificate issuer associated with an entry in an indirect CRL.

This extension is used only with indirect CRLs, which are not supported by the Certificate System.

OID

2.5.29.29

B.4.2.2.2. invalidityDate

The Invalidity Date extension provides the date on which the private key was compromised or that the certificate otherwise became invalid.

OID

2.5.29.24

Parameters

Table B.46. InvalidityDate Configuration Parameters

Parameter	Description
enable	Sets whether the extension rule is enabled or disabled. By default, this is enabled.
critical	Marks the extension as critical or noncritical; by default, this is noncritical.

B.4.2.2.3. CRLReason

The Reason Code extension identifies the reason for certificate revocation.

OID

2.5.29.21

Parameters

Table B.47. CRLReason Configuration Parameters

Parameter	Description
enable	Sets whether the extension rule is enabled or disabled. By default, this is enabled.
critical	Marks the extension as critical or noncritical. By default, this is noncritical.

B.4.3. Netscape-Defined Certificate Extensions Reference

Netscape defined certain certificate extensions for its products. Some of the extensions are now obsolete, and others have been superseded by the extensions defined in the X.509 proposed standard. All Netscape extensions should be tagged as noncritical, so that their presence in a certificate does not make that certificate incompatible with other clients.

B.4.3.1. netscape-cert-type

The Netscape Certificate Type extension can be used to limit the purposes for which a certificate can be used. It has been replaced by the X.509 v3 extensions Section B.3.6, “extKeyUsage” and Section B.3.3, “basicConstraints”.

If the extension exists in a certificate, it limits the certificate to the uses specified in it. If the extension is not present, the certificate can be used for all applications, except for object signing.

The value is a bit-string, where the individual bit positions, when set, certify the certificate for particular uses as follows:

- bit 0: SSL Client certificate
- bit 1: SSL Server certificate
- bit 2: S/MIME certificate
- bit 3: Object Signing certificate
- bit 4: reserved
- bit 5: SSL CA certificate
- bit 6: S/MIME CA certificate
- bit 7: Object Signing CA certificate

OID

2.16.840.1.113730.1.1

B.4.3.2. netscape-comment

The value of this extension is an IA5String. It is a comment that can be displayed to the user when the certificate is viewed.

OID

2.16.840.1.113730.13

Appendix C. Publishing Module Reference

Several publisher, mapper, and rule modules are configured by default with the Certificate Manager.

C.1. Publisher Plug-in Modules

This section describes the publisher modules provided for the Certificate Manager. The modules are used by the Certificate Manager to enable and configure specific publisher instances.

C.1.1. FileBasedPublisher

The **FileBasedPublisher** plug-in module configures a Certificate Manager to publish certificates and CRLs to file. This plug-in can publish base-64 encoded files, DER-encoded files, or both, depending on the checkboxes selected when the publisher is configured. The certificate and CRL content can be viewed by converting the files using the **PrettyPrintCert** and **PrettyPrintCRL** tools. For details on viewing the content in base-64 and DER-encoded certificates and CRLs, see Section 7.11, "Viewing Certificates and CRLs Published to File".

By default, the Certificate Manager does not create an instance of the **FileBasedPublisher** module.

Table C.1. FileBasedPublisher Configuration Parameters

Parameter	Description
Publisher ID	Specifies a name for the publisher, an alphanumeric string with no spaces. For example, **PublishCertsToFile**.
directory	Specifies the complete path to the directory to which the Certificate Manager creates the files; the path can be an absolute path or can be relative to the Certificate System instance directory. For example, **/export/CS/certificates**.

C.1.2. LdapCaCertPublisher

The **LdapCaCertPublisher** plug-in module configures a Certificate Manager to publish or unpublish a CA certificate to the **caCertificate;binary** attribute of the CA's directory entry.

The module converts the object class of the CA's entry to **pkiCA** or **certificationAuthority**, if it is not used already. Similarly, it also removes the **pkiCA** or **certificationAuthority** object class when unpublishing if the CA has no other certificates.

During installation, the Certificate Manager automatically creates an instance of the **LdapCaCertPublisher** module for publishing the CA certificate to the directory.

Table C.2. LdapCaCertPublisher Configuration Parameters

Parameter	Description
caCertAttr	Specifies the LDAP directory attribute to publish the CA certificate. This must be **caCertificate;binary**.
caObjectClass	Specifies the object class for the CA's entry in the directory. This must be **pkiCA** or **certificationAuthority**.

C.1.3. LdapUserCertPublisher

The **LdapUserCertPublisher** plug-in module configures a Certificate Manager to publish or unpublish a user certificate to the **userCertificate;binary** attribute of the user's directory entry.

This module is used to publish any end-entity certificate to an LDAP directory. Types of end-entity certificates include SSL client, S/MIME, SSL server, and OCSP responder.

During installation, the Certificate Manager automatically creates an instance of the **LdapUserCertPublisher** module for publishing end-entity certificates to the directory.

Table C.3. LdapUserCertPublisher Configuration Parameters

Parameter	Description
certAttr	Specifies the directory attribute of the mapped entry to which the Certificate Manager should publish the certificate. This must be **userCertificate;binary**.

C.1.4. LdapCrlPublisher

The **LdapCrlPublisher** plug-in module configures a Certificate Manager to publish or unpublish the CRL to the **certificateRevocationList;binary** attribute of a directory entry.

During installation, the Certificate Manager automatically creates an instance of the **LdapCrlPublisher** module for publishing CRLs to the directory.

Table C.4. LdapCrlPublisher Configuration Parameters

Parameter	Description
crlAttr	Specifies the directory attribute of the mapped entry to which the Certificate Manager should publish the CRL. This must be **certificateRevocationList;binary**.

C.1.5. LdapDeltaCrlPublisher

The **LdapDeltaCrlPublisher** plug-in module configures a Certificate Manager to publish or unpublish a delta CRL to the **deltaRevocationList** attribute of a directory entry.

During installation, the Certificate Manager automatically creates an instance of the **LdapDeltaCrlPublisher** module for publishing CRLs to the directory.

Table C.5. LdapDeltaCrlPublisher Configuration Parameters

Parameter	Description
crlAttr	Specifies the directory attribute of the mapped entry to which the Certificate Manager should publish the delta CRL. This must be **deltaRevocationList;binary**.

C.1.6. LdapCertificatePairPublisher

The **LdapCertificatePairPublisher** plug-in module configures a Certificate Manager to publish or unpublish a cross-signed certificate to the **crossCertPair;binary** attribute of the CA's directory entry.

The module also converts the object class of the CA's entry to a **pkiCA** or **certificationAuthority**, if it is not used already. Similarly, it also removes the **pkiCA** or **certificationAuthority** object class when unpublishing if the CA has no other certificates.

During installation, the Certificate Manager automatically creates an instance of the **LdapCertificatePairPublisher** module named **LdapCrossCertPairPublisher** for publishing the cross-signed certificates to the directory.

Table C.6. LdapCertificatePairPublisher Parameters

Parameter	Description
crossCertPairAttr	Specifies the LDAP directory attribute to publish the CA certificate. This must be **crossCertificatePair;binary**.
caObjectClass	Specifies the object class for the CA's entry in the directory. This must be **pkiCA** or **certificationAuthority**.

C.1.7. OCSPPublisher

The **OCSPPublisher** plug-in module configures a Certificate Manager to publish its CRLs to an Online Certificate Status Manager.

The Certificate Manager does not create any instances of the **OCSPPublisher** module at installation.

Table C.7. OCSPPublisher Parameters

Parameter	Description
host	Specifies the fully qualified hostname of the Online Certificate Status Manager.
port	Specifies the port number on which the Online Certificate Status Manager is listening to the Certificate Manager. This is the Online Certificate Status Manager's SSL port number.
path	Specifies the path for publishing the CRL. This must be the default path, **/ocsp/agent/ocsp/addCRL**.
enableClientAuth	Sets whether to use client (certificate-based) authentication to access the OCSP service.
nickname	Gives the nickname of the certificate in the OCSP service's database to use for client authentication. This is only used if the **enableClientAuth** option is set to true.

C.2. Mapper Plug-in Modules

This section describes the mapper plug-in modules provided for the Certificate Manager. These modules configure a Certificate Manager to enable and configure specific mapper instances.

The available mapper plug-in modules include the following:

- Section C.2.1, “LdapCaSimpleMap”
- Section C.2.2, “LdapDNExactMap”
- Section C.2.3, “LdapSimpleMap”
- Section C.2.4, “LdapSubjAttrMap”
- Section C.2.5, “LdapDNCompsMap”

C.2.1. LdapCaSimpleMap

The **LdapCaSimpleMap** plug-in module configures a Certificate Manager to create an entry for the CA in an LDAP directory automatically and then map the CA's certificate to the directory entry by formulating the entry's DN from components specified in the certificate request, certificate subject name, certificate extension, and attribute variable assertion (AVA) constants. For more information on AVAs, check the directory documentation.

The CA certificate mapper specifies whether to create an entry for the CA, to map the certificate to an existing entry, or to do both.

If a CA entry already exists in the publishing directory and the value assigned to the **dnPattern** parameter of this mapper is changed, but the **uid** and **o** attributes are the same, the mapper fails to create the second CA entry. For example, if the directory already has a CA entry for **uid=CA,ou=Marketing,o=example.com** and a mapper is configured to create another CA entry with **uid=CA,ou=Engineering,o=example.com**, the operation fails.

The operation may fail because the directory has the *UID Uniqueness* plug-in set to a specific base DN. This setting prevents the directory from having two entries with the same UID under that base DN. In this example, it prevents the directory from having two entries under **o=example.com** with the same UID, **CA**.

If the mapper fails to create a second CA entry, check the base DN to which the UID Uniqueness plug-in is set, and check if an entry with the same UID already exists in the directory. If necessary, adjust the mapper setting, remove the old CA entry, comment out the plug-in, or create the entry manually.

During installation, the Certificate Manager automatically creates two instances of the CA certificate mapper module. The mappers are named as follows:

- **LdapCrlMap** for CRLs (see Section C.2.1.2, “LdapCrlMap”)
- **LdapCaCertMap** for CA certificates (see Section C.2.1.1, “LdapCaCertMap”).

Table C.8. LdapCaSimpleMap Configuration Parameters

Parameter	Description
createCAEntry	Creates a CA's entry, if selected (default). If selected, the Certificate Manager first attempts to create an entry for the CA in the directory. If the Certificate Manager succeeds in creating the entry, it then attempts to publish the CA's certificate to the entry. If this is not selected, the entry must already be present in order to publish to it.

Parameter	Description
dnPattern	Specifies the DN pattern the Certificate Manager should use to construct to search for the CA's entry in the publishing directory. The value of **dnPattern** can be a list of AVAs separated by commas. An AVA can be a variable, such as **cn=$subj.cn**, that the Certificate Manager can derive from the certificate subject name or a constant, such as **o=Example Corporation**. If the CA certificate does not have the **cn** component in its subject name, adjust the CA certificate mapping DN pattern to reflect the DN of the entry in the directory where the CA certificate is to be published. For example, if the CA certificate subject DN is **o=Example Corporation** and the CA's entry in the directory is **cn=Certificate Authority, o=Example Corporation**, the pattern is **cn=Certificate Authority, o=$subj.o**. - Example 1: **uid=CertMgr, o=Example Corporation** - Example 2: **cn=$subj.cn,ou=$subj.ou,o=$subj.o,c=US** - Example 3: **uid=$req.HTTP_PARAMS.uid, e=$ext.SubjectAlternativeName.RFC822Name,ou=$subj.ou** In the above examples, **$req** takes the attribute from the certificate request, **$subj** takes the attribute from the certificate subject name, and **$ext** takes the attribute from the certificate extension.

C.2.1.1. LdapCaCertMap

The **LdapCaCertMap** mapper is an instance of the **LdapCaSimpleMap** module. The Certificate Manager automatically creates this mapper during installation.

This mapper creates an entry for the CA in the directory and maps the CA certificate to the CA's entry in the directory.

By default, the mapper is configured to create an entry for the CA in the directory, The default DN pattern for locating the CA's entry is as follows:

```
uid=$subj.cn,ou=people,o=$subj.o
```

C.2.1.2. LdapCrlMap

The **LdapCrlMap** mapper is an instance of the **LdapCaSimpleMap** module. The Certificate Manager automatically creates this mapper during installation.

This mapper creates an entry for the CA in the directory and maps the CRL to the CA's entry in the directory.

By default, the mapper is configured to create an entry for the CA in the directory. The default DN pattern for locating the CA's entry is as follows:

```
uid=$subj.cn,ou=people,o=$subj.o
```

C.2.2. LdapDNExactMap

The **LdapDNExactMap** plug-in module configures a Certificate Manager to map a certificate to an LDAP directory entry by searching for the LDAP entry DN that matches the certificate subject name. To use this mapper, each certificate subject name must exactly match a DN in a directory entry. For example, if the certificate subject name is **uid=jdoe, o=Example Corporation, c=US**, when searching the directory for the entry, the Certificate Manager only searches for an entry with the DN **uid=jdoe, o=Example Corporation, c=US**.

If no matching entries are found, the server returns an error and does not publish the certificate.

This mapper does not require any values for any parameters because it obtains all values from the certificate.

C.2.3. LdapSimpleMap

The **LdapSimpleMap** plug-in module configures a Certificate Manager to map a certificate to an LDAP directory entry by deriving the entry's DN from components specified in the certificate request, certificate's subject name, certificate extension, and attribute variable assertion (AVA) constants. For more information on AVAs, see the directory documentation.

By default, the Certificate Manager uses mapper rules that are based on the simple mapper. During installation, the Certificate Manager automatically creates an instance of the simple mapper module, named **LdapUserCertMap**. The default mapper maps various types of end-entity certificates to their corresponding directory entries.

The simple mapper requires one parameter, **dnPattern**. The value of **dnPattern** can be a list of AVAs separated by commas. An AVA can be a variable, such as **uid=$subj.UID**, or a constant, such as **o=Example Corporation**.

- Example 1: **uid=CertMgr, o=Example Corporation**
- Example 2: **cn=$subj.cn,ou=$subj.ou,o=$subj.o,c=US**
- Example 3: uid=**$req.HTTP_PARAMS.uid, e=$ext.SubjectAlternativeName.RFC822Name,ou=$subj.ou**

In the examples, **$req** takes the attribute from the certificate request, **$subj** takes the attribute from the certificate subject name, and **$ext** takes the attribute from the certificate extension.

C.2.4. LdapSubjAttrMap

The **LdapSubjAttrMap** plug-in module configures a Certificate Manager to map a certificate to an LDAP directory entry using a configurable LDAP attribute. To use this mapper, the directory entries must include the specified LDAP attribute.

This mapper requires the exact pattern of the subject DN because the Certificate Manager searches the directory for the attribute with a value that exactly matches the entire subject DN. For example, if the specified LDAP attribute is **certSubjectDN** and the certificate subject name is **uid=jdoe, o=Example Corporation, c=US**, the Certificate Manager searches the directory for entries that have the attribute **certSubjectDN=uid=jdoe, o=Example Corporation, c=US**.

If no matching entries are found, the server returns an error and writes it to the log.

Table C.9, “LdapSubjAttrMap Parameters” describes these parameters.

Table C.9. LdapSubjAttrMap Parameters

Parameter	Description
certSubjNameAttr	Specifies the name of the LDAP attribute that contains a certificate subject name as its value. The default is **certSubjectName**, but this can be configured to any LDAP attribute.
searchBase	Specifies the base DN for starting the attribute search. The permissible value is a valid DN of an LDAP entry, such as **o=example.com, c=US**.

C.2.5. LdapDNCompsMap

The **LdapDNCompsMap** plug-in module implements the DN components mapper. This mapper maps a certificate to an LDAP directory entry by constructing the entry's DN from components, such as **cn**, **ou**, **o**, and **c**, specified in the certificate subject name, and then uses it as the search DN to locate the entry in the directory. The mapper locates the following entries:

- The CA's entry in the directory for publishing the CA certificate and the CRL.
- End-entity entries in the directory for publishing end-entity certificates.

The mapper takes DN components to build the search DN. The mapper also takes an optional root search DN. The server uses the DN components to form an LDAP entry to begin a subtree search and the filter components to form a search filter for the subtree. If none of the DN components are configured, the server uses the base DN for the subtree. If the base DN is null and none of the DN components match, an error is returned. If none of the DN components and filter components match, an error is returned. If the filter components are null, a base search is performed.

Both the **DNComps** and **filterComps** parameters accept valid DN components or attributes separated by commas. The parameters do not accept multiple entries of an attribute; for example, **filterComps** can be set to **cn,ou** but not to **cn,ou2,ou1**. To create a filter with multiple instances of the same attribute, such as if directory entries contain multiple **ou** s, modify the source code for the **LdapDNCompsMap** module.

The following components are commonly used in DNs:

- **uid** represents the user ID of a user in the directory.

- **cn** represents the common name of a user in the directory.
- **ou** represents an organizational unit in the directory.
- **o** represents an organization in the directory.
- **l** represents a locality (city).
- **st** represents a state.
- **c** represents a country.

For example, the following DN represents the user named Jane Doe who works for the Sales department at Example Corporation, which is located in Mountain View, California, United States:

```
cn=Jane Doe, ou=Sales, o=Example Corporation, l=Mountain View,
st=California, c=US
```

The Certificate Manager can use some or all of these components (**cn**, **ou**, **o**, **l**, **st**, and **c**) to build a DN for searching the directory. When creating a mapper rule, these components can be specified for the server to use to build a DN; that is, components to match attributes in the directory. This is set through the **dnComps** parameter.

For example, the components **cn**, **ou**, **o**, and **c** are set as values for the **dnComps** parameter. To locate Jane Doe's entry in the directory, the Certificate Manager constructs the following DN by reading the DN attribute values from the certificate, and uses the DN as the base for searching the directory:

```
cn=Jane Doe, ou=Sales, o=Example Corporation, c=US
```

- A subject name does not need to have all of the components specified in the **dnComps** parameter. The server ignores any components that are not part of the subject name, such as **l** and **st** in this example.
- Unspecified components are not used to build the DN. In the example, if the **ou** component is not included, the server uses this DN as the base for searching the directory:

  ```
  cn=Jane Doe, o=Example Corporation, c=US
  ```

For the **dnComps** parameter, enter those DN components that the Certificate Manager can use to form the LDAP DN exactly. In certain situations, however, the subject name in a certificate may match more than one entry in the directory. Then, the Certificate Manager might not get a single, distinct matching entry from the DN. For example, the subject name **cn=Jane Doe, ou=Sales, o=Example Corporation, c=US** might match two users with the name Jane Doe in the directory. If that occurs, the Certificate Manager needs additional criteria to determine which entry corresponds to the subject of the certificate.

To specify the components the Certificate Manager must use to distinguish between different entries in the directory, use the **filterComps** parameter; for details, see Table C.10, “LdapDNCompsMap Configuration Parameters”. For example, if **cn**, **ou**, **o**, and **c** are values for the **dnComps** parameter, enter **l** for the **filterComps** parameter only if the **l** attribute can be used to distinguish between entries with identical **cn**, **ou**, **o**, and **c** values.

If the two Jane Doe entries are distinguished by the value of the **uid** attribute - one entry's **uid** is **janedoe1**, and the other entry's **uid** is **janedoe2** - the subject names of certificates can be set to include the **uid** component.

Note

The **e**, **l**, and **st** components are not included in the standard set of certificate request forms provided for end entities. These components can be added to the forms, or the issuing agents can be required to insert these components when editing the subject name in the certificate issuance forms.

C.2.5.1. Configuration Parameters of LdapDNCompsMap

With this configuration, a Certificate Manager maps its certificates with the ones in the LDAP directory by using the **dnComps** values to form a DN and the **filterComps** values to form a search filter for the subtree.

- If the formed DN is null, the server uses the **baseDN** value for the subtree. If both the formed DN and base DN are null, the server logs an error.
- If the filter is null, the server uses the **baseDN** value for the search. If both the filter and base DN are null, the server logs an error.

Table C.10, "LdapDNCompsMap Configuration Parameters" describes these parameters.

Table C.10. LdapDNCompsMap Configuration Parameters

Parameter	Description
baseDN	Specifies the DN to start searching for an entry in the publishing directory. If the **dnComps** field is blank, the server uses the base DN value to start its search in the directory.
dnComps	Specifies where in the publishing directory the Certificate Manager should start searching for an LDAP entry that matches the CA's or the end entity's information. For example, if **dnComps** uses the **o** and **c** attributes of the DN, the server starts the search from the **o=***org*, **c=***country* entry in the directory, where *org* and *country* are replaced with values from the DN in the certificate. If the **dnComps** field is empty, the server checks the **baseDN** field and searches the directory tree specified by that DN for entries matching the filter specified by **filterComps** parameter values. The permissible values are valid DN components or attributes separated by commas.

Parameter	Description
filterComps	Specifies components the Certificate Manager should use to filter entries from the search result. The server uses the **filterComps** values to form an LDAP search filter for the subtree. The server constructs the filter by gathering values for these attributes from the certificate subject name; it uses the filter to search for and match entries in the LDAP directory. If the server finds more than one entry in the directory that matches the information gathered from the certificate, the search is successful, and the server optionally performs a verification. For example, if **filterComps** is set to use the email and user ID attributes (**filterComps=e,uid**), the server searches the directory for an entry whose values for email and user ID match the information gathered from the certificate. The permissible values are valid directory attributes in the certificate DN separated by commas. The attribute names for the filters need to be attribute names from the certificate, not from ones in the LDAP directory. For example, most certificates have an **e** attribute for the user's email address; LDAP calls that attribute **mail**.

C.3. Rule Instances

This section discusses the rule instances that have been set.

C.3.1. LdapCaCertRule

The **LdapCaCertRule** can be used to publish CA certificates to an LDAP directory.

Table C.11. LdapCaCert Rule Configuration Parameters

Parameter	Value	Description
type	**cacert**	Specifies the type of certificate that will be published.
predicate		Specifies a predicate for the publisher.
enable	**yes**	Enables the rule.
mapper	**LdapCaCertMap**	Specifies the mapper used with the rule. See Section C.2.1.1, "LdapCaCertMap" for details on the mapper.
publisher	**LdapCaCertPublisher**	Specifies the publisher used with the rule. See Section C.1.2, "LdapCaCertPublisher" for details on the publisher.

C.3.2. LdapXCertRule

The **LdapXCertRule** is used to publish cross-pair certificates to an LDAP directory.

Table C.12. LdapXCert Rule Configuration Parameters

Parameter	Value	Description
type	**xcert**	Specifies the type of certificate that will be published.
predicate		Specifies a predicate for the publisher.
enable	**yes**	Enables the rule.
mapper	**LdapCaCertMap**	Specifies the mapper used with the rule. See Section C.2.1.1, "LdapCaCertMap" for details on the mapper.
publisher	**LdapCrossCertPairPublisher**	Specifies the publisher used with the rule. See Section C.1.6, "LdapCertificatePairPublisher" for details on this publisher.

C.3.3. LdapUserCertRule

The **LdapUserCertRule** is used to publish user certificates to an LDAP directory.

Table C.13. LdapUserCert Rule Configuration Parameters

Parameter	Value	Description
type	**certs**	Specifies the type of certificate that will be published.
predicate		Specifies a predicate for the publisher.
enable	**yes**	Enables the rule.
mapper	**LdapUserCertMap**	Specifies the mapper used with the rule. See Section C.2.3, “LdapSimpleMap” for details on the mapper.
publisher	**LdapUserCertPublisher**	Specifies the publisher used with the rule. See Section C.1.3, “LdapUserCertPublisher” for details on the publisher.

C.3.4. LdapCRLRule

The **LdapCRLRule** is used to publish CRLs to an LDAP directory.

Table C.14. LdapCRL Rule Configuration Parameters

Parameter	Value	Description
type	**crl**	Specifies the type of certificate that will be published.
predicate		Specifies a predicate for the publisher.
enable	**yes**	Enables the rule.
mapper	**LdapCrlMap**	Specifies the mapper used with the rule. See Section C.2.1.2, “LdapCrlMap” for details on the mapper.
publisher	**LdapCrlPublisher**	Specifies the publisher used with the rule. See Section C.1.4, “LdapCrlPublisher” for details on the publisher.

Appendix D. ACL Reference

This section describes what each resource controls, lists the possible operations describing the outcome of those operations, and provides the default ACIs for each ACL resource defined. Each subsystem contains only those ACLs that are relevant to that subsystem.

D.1. About ACL Configuration Files

Access control is the method to set rules on who can access part of a server and the operations that user can perform. The four subsystems which depend on the LDAP directory service and use a Java console — the CA, KRA, OCSP, and TKS — all implement LDAP-style access control to access their resources. These *access control lists* (ACLs) are located in the **acl.ldif** files in the instance's ***/var/lib/pki/instance_name/conf*** directory.

> **Note**
>
> This section provides only a very brief overview of access control concepts. Access control is described in much more detail in chapter 6, "Managing Access Control," in the Red Hat Directory Server 8.2 *Administration Guide*.

The Certificate System ACL files are LDIF files that are loaded by the internal database. The individual ACLs are defined as ***resourceACLS*** attributes which identify the area of the subsystem being protected and then a list of all of the specific access controls being set.

```
resourceACLS: class_name:all rights: allow|deny (rights) type=target
description
```

Each rule which allows or denies access to a resource is called an *access control instruction* (ACI). (The sum of all of the ACIs for a resource is an access control list.) Before defining the actual ACI, the ACL attribute is first applied to a specific plug-in class used by the Certificate System subsystem. This focuses each ACL to a specific function performed by the subsystem, providing both more security for the instance and better control over applying ACLs.

Example D.1. Default ACL to List Certificate Profiles

```
resourceACLS: certServer.ca.profiles:list:allow (list)
group="Certificate Manager Agents":Certificate Manager agents may list
profiles
```

Because each subsystem (CA, KRA, OCSP, and TKS) has different resources for its operations, each subsystem instance has its own **acl.ldif** file and its own defined ACLs.

Each ACI defines what access or behavior can be done (the *right*) and who the ACI applies to (the *target*). The basic format of an ACI is, then:

```
allow|deny (rights) user|group
```

Rights are types of operations that the ACI allows a user to perform. For LDAP ACIs, there is a relatively limited list of rights to directory entries, like search, read, write, and delete. The Certificate System uses additional rights that cover common PKI tasks, like revoke, submit, and assign.

If an operation is not explicitly allowed in an ACI, then it is implicitly denied. If an operation is explicitly denied in one ACI, then it trumps any ACI which explicitly allows it. Deny rules are always superior to allow rules to provide additional security.

Each ACI has to apply to specific users or groups. This is set using a couple of common conditions, usually **user=** or **group=**, though there are other options, like **ipaddress=** which defines client-based access rather than entry-based access. If there is more than one condition, the conditions can be composed using the double pipe (||) operator, signifying logical disjunction ("or"), and the double ampersand (&&) operator, signifying logical conjunction ("and"). For example, **group="group1" || "group2"**.

Each area of the ***resourceACLS*** attribute value is defined in Table D.1, "Sections of the ACL Attribute Value".

Table D.1. Sections of the ACL Attribute Value

Value	Description
class_name	The plug-in class to which the ACI is applied.
all operations	The list of every operation covered in the ACI definition. There can be multiple operations in a single ACI and multiple ACIs in a single ***resourceACLS*** attribute.
allow|deny	Whether the action is being allowed for the target user or group or denied to the target user or group.
(*operations*)	The operations being allowed or denied.
type=target	The target to identify who this applies to. This is commonly a user (such as **user=**"*name*") or a group (**group=**"*group*"). If there is more than one condition, the conditions can be composed using the double pipe (||) operator (logical "or") and the double ampersand (&&) operator (logical "and"). For example, **group="group1" || "group2"**.
description	A description of what the ACL is doing.

D.2. Common ACLs

This section covers the default access control configuration that is common for all four subsystem types. These access control rules manage access to basic and common configuration settings, such as logging and adding users and groups.

Important

These ACLs are common in that the same ACLs occur in each subsystem instance's **acl.ldif** file. These are not *shared* ACLs in the sense that the configuration files or settings are held in common by all subsystem instances. As with all other instance configuration, these ACLs are maintained independently of other subsystem instances, in the instance-specific **acl.ldif** file.

D.2.1. certServer.acl.configuration

Controls operations to the ACL configuration. The default configuration is:

```
allow (read) group="Administrators" || group="Certificate Manager
Agents" || group="Registration Manager Agents" || group="Key Recovery
Authority Agents" || group="Online Certificate Status Manager Agents" ||
group="Auditors";allow (modify) group="Administrators"
```

Table D.2. certServer.acl.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View ACL resources and list ACL resources, ACL listing evaluators, and ACL evaluator types.	Allow	Administrators Agents Auditors
modify	Add, delete, and update ACL evaluators.	Allow	Administrators

D.2.2. certServer.admin.certificate

Controls which users can import a certificate through a Certificate Manager. By default, this operation is allowed to everyone. The default configuration is:

```
allow (import) user="anybody"
```

Note

This entry is associated with the CA administration web interface which is used to configure the instance. This ACL is only available during instance configuration and is unavailable after the CA is running.

Table D.3. certServer.admin.certificate ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
import	Import a CA administrator certificate, and retrieve certificates by serial number.	Allow	Anyone

D.2.3. certServer.auth.configuration

Controls operations on the authentication configuration.

```
allow (read) group="Administrators" || group="Certificate Manager
Agents" || group="Registration Manager Agents" || group="Key Recovery
Authority Agents" || group="Online Certificate Status Manager Agents" ||
group="Auditors";allow (modify) group="Administrators
```

Table D.4. certServer.auth.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View authentication plug-ins, authentication type, configured authentication manager plug-ins, and authentication instances. List authentication manager plug-ins and authentication manager instances.	Allow	Administrators Agents Auditors
modify	Add or delete authentication plug-ins and authentication instances. Modify authentication instances.	Allow	Administrators

D.2.4. certServer.clone.configuration

Controls who can read and modify the configuration information used in cloning. The default setting is:

```
allow (modify,read) group="Enterprise CA Administrators" ||
group="Enterprise KRA Administrators" || group="Enterprise RA
Administrators" || group="Enterprise OCSP Administrators" ||
group="Enterprise TKS Administrators"
```

Table D.5. certServer.clone.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View original instance configuration.	Allow	Enterprise Administrators
modify	Modify original instance configuration.	Allow	Enterprise Administrators

D.2.5. certServer.general.configuration

Controls access to the general configuration of the subsystem instance, including who can view and edit the CA's settings.

```
allow (read) group="Administrators" || group="Auditors" ||
group="Certificate Manager Agents" || group="Registration Manager
Agents" || group="Key Recovery Authority Agents" || group="Online
Certificate Status Manager Agents";allow (modify) group="Administrators"
```

Table D.6. certServer.general.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View the operating environment, LDAP configuration, SMTP configuration, server statistics, encryption, token names, subject name of certificates, certificate nicknames, all subsystems loaded by the server, CA certificates, and all certificates for management.	Allow	Administrators Agents Auditors

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Modify the settings for the LDAP database, SMTP, and encryption. Issue import certificates, install certificates, trust and untrust CA certificates, import cross-pair certificates, and delete certificates. Perform server restart and stop operations. Log in all tokens and check token status. Run self-tests on demand. Get certificate information. Process the certificate subject name. Validate the certificate subject name, certificate key length, and certificate extension.	Allow	Administrators

D.2.6. certServer.log.configuration

Controls access to the log configuration for the Certificate Manager, including changing the log settings.

```
allow (read) group="Administrators" || group="Auditors" ||
group="Certificate Manager Agents" || group="Registration Manager
Agents" || group="Key Recovery Authority Agents" || group="Online
Certificate Status Manager Agents";allow (modify) group="Administrators"
```

Table D.7. certServer.log.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View log plug-in information, log plug-in configuration, and log instance configuration. List log plug-ins and log instances (excluding NTEventLog).	Allow	Administrators Agents Auditors

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Add and delete log plug-ins and log instances. Modify log instances, including log rollover parameters and log level.	Allow	Administrators

D.2.7. certServer.log.configuration.fileName

Restricts access to change the file name of a log for the instance.

```
allow (read) group="Administrators" || group="Auditors" ||
group="Certificate Manager Agents" || group="Registration Manager
Agents" || group="Key Recovery Authority Agents" || group="Online
Certificate Status Manager Agents";deny (modify) user=anybody
```

Table D.8. certServer.log.configuration.fileName ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View the value of the **fileName** parameter for a log instance.	Allow	Administrators Agents Auditors
modify	Change the value of the **fileName** parameter for a log instance.	Deny	Anyone

D.2.8. certServer.log.content.system

Controls who can view the instance's logs.

```
allow (read) group="Administrators" || group="Certificate Manager
Agents" || group="Registration Manager Agents" || group="Key Recovery
Authority Agents" || group="Online Certificate Status Manager Agents" ||
group="Auditors"
```

Table D.9. certServer.log.content.system ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View log content. List all logs.	Allow	Administrators Agents Auditors

D.2.9. certServer.log.content.transactions

Controls who can view the instance's transactions logs.

```
allow (read) group="Administrators" || group="Certificate Manager
Agents" || group="Registration Manager Agents" || group="Key Recovery
Authority Agents" || group="Online Certificate Status Manager Agents" ||
group="Auditors"
```

Table D.10. certServer.log.content.transactions ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View log content. List all logs.	Allow	Administrators Agents Auditors

D.2.10. certServer.log.content.signedAudit

Controls who has access to the signed audit logs. The default setting is:

```
allow (read) group="Auditors"
```

Table D.11. certServer.log.content.signedAudit ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View log content. List logs.	Allow	Auditors

D.2.11. certServer.registry.configuration

Controls access to the administration registry, the file that is used to register plug-in modules. Currently, this is only used to register certificate profile plug-ins.

```
allow (read) group="Administrators" || group="Certificate Manager
Agents" || group="Registration Manager Agents" || group="Key Recovery
Authority Agents" || group="Online Certificate Status Manager Agents" ||
group="Auditors";allow (modify) group="Administrators"
```

Table D.12. certServer.registry.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View the administration registry, supported policy constraints, profile plug-in configuration, and the list of profile plug-ins.	Allow	Administrators Agents Auditors
modify	Register individual profile implementation plug-ins.	Allow	Administrators

D.3. Certificate Manager-Specific ACLs

This section covers the default access control configuration attributes which are set specifically for the Certificate Manager. The CA ACL configuration also includes all of the common ACLs listed in Section D.2, “Common ACLs”.

There are access control rules set for each of the CA's interfaces (administrative console and agents and end-entities services pages) and for common operations like listing and downloading certificates.

D.3.1. certServer.admin.ocsp

Limits access to the Certificate Manager's OCSP configuration to members of the enterprise OCSP administrators group.

```
allow (modify,read) group="Enterprise OCSP Administrators"
```

Table D.13. certServer.admin.ocsp ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Modify the OCSP configuration, OCSP stores configuration, and default OCSP store.	Allow	Enterprise OCSP Administrators
read	Read the OCSP configuration.	Allow	Enterprise OCSP Administrators

D.3.2. certServer.ca.certificate

Controls basic management operations for certificates in the agents services interface, including importing and revoking certificates. The default configuration is:

```
allow (import,unrevoke,revoke,read) group="Certificate Manager Agents"
```

Table D.14. certServer.ca.certificate ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
import	Retrieve a certificate by serial number.	Allow	Certificate Manager Agents
unrevoke	Change the status of a certificate from revoked.	Allow	Certificate Manager Agents
revoke	Change the status of a certificate to revoked.	Allow	Certificate Manager Agents
read	Retrieve certificates based on the request ID, and display certificate details based on the request ID or serial number.	Allow	Certificate Manager Agents

D.3.3. certServer.ca.certificates

Controls operations for listing or revoking certificates through the agent services interface. The default configuration is:

```
allow (revoke,list) group="Certificate Manager Agents"||
group="Registration Manager Agents"
```

Table D.15. certServer.ca.certificates ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
revoke	Revoke a certificates, or approve certificate revocation requests. Revoke a certificate from the TPS. Prompt users for additional data about a revocation request.	Allow	Certificate Manager Agents Registration Manager Agents
list	List certificates based on a search. Retrieve details about a range of certificates based on a range of serial numbers.	Allow	Certificate Manager Agents Registration Manager Agents

D.3.4. certServer.ca.configuration

Controls operations on the general configuration for a Certificate Manager. The default configuration is:

```
allow (read) group="Administrators" || group="Certificate Manager
Agents" || group="Registration Manager Agents" || group="Key Recovery
Authority Agents" || group="Online Certificate Status Manager Agents" ||
group="Auditors";allow (modify) group="Administrators"
```

Table D.16. certServer.ca.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View CRL plug-in information, general CA configuration, CA connector configuration, CRL issuing points configuration, CRL profile configuration, request notification configuration, revocation notification configuration, request in queue notification configuration, and CRL extensions configuration. List CRL extensions configuration and CRL issuing points configuration.	Allow	Administrators Agents Auditors
modify	Add and delete CRL issuing points. Modify general CA settings, CA connector configuration, CRL issuing points configuration, CRL configuration, request notification configuration, revocation notification configuration, request in queue notification configuration, and CRL extensions configuration.	Allow	Administrators

D.3.5. certServer.ca.connector

Controls operations to submit requests over a special connector to the CA. The default configuration is:

```
allow (submit) group="Trusted Managers"
```

Table D.17. certServer.ca.connector ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
submit	Submit requests from remote trusted managers.	Allow	Trusted Managers

D.3.6. certServer.ca.connectorInfo

Controls access to the connector information to manage trusted relationships between a CA and KRA. These trust relationships are special configurations which allow a CA and KRA to automatically connect to perform key archival and recovery operations. These trust relationships are configured through special connector plug-ins.

```
allow (read) group="Enterprise KRA Administrators";allow (modify)
group="Enterprise KRA Administrators" || group="Subsystem Group"
```

Table D.18. certServer.ca.connectorInfo ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	Read connector plug-in settings.	Allow	Enterprise KRA Administrators
modify	Modify connector plug-in settings.	Allow	Enterprise KRA Administrators Subsystem Group

D.3.7. certServer.ca.crl

Controls access to read or update CRLs through the agent services interface. The default setting is:

```
allow (read,update) group="Certificate Manager Agents"
```

Table D.19. certServer.ca.crl ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	Display CRLs and get detailed information about CA CRL processing.	Allow	Certificate Manager Agents
update	Update CRLs.	Allow	Certificate Manager Agents

D.3.8. certServer.ca.directory

Controls access to the LDAP directory used for publishing certificates and CRLs.

```
allow (update) group="Certificate Manager Agents"
```

Table D.20. certServer.ca.directory ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
update	Publish CA certificates, CRLs, and user certificates to the LDAP directory.	Allow	Certificate Manager Agents

D.3.9. certServer.ca.group

Controls access to the internal database for adding users and groups for the Certificate Manager instance.

```
allow (modify,read) group="Administrators"
```

Table D.21. certServer.ca.group ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Create, edit, or delete user and group entries for the instance. Add or modify a user certificate within attributes	Allow	Administrators
read	View user and group entries for the instance.	Allow	Administrators

D.3.10. certServer.ca.ocsp

Controls the ability to access and read OCSP information, such as usage statistics, through the agent services interface.

```
allow (read) group="Certificate Manager Agents"
```

Table D.22. certServer.ca.ocsp ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	Retrieve OCSP usage statistics.	Allow	Certificate Manager Agents

D.3.11. certServer.ca.profile

Controls access to certificate profile configuration in the agent services pages.

```
allow (read,approve) group="Certificate Manager Agents"
```

Table D.23. certServer.ca.profile ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View the details of the certificate profiles.	Allow	Certificate Manager Agents
approve	Approve and enable certificate profiles.	Allow	Certificate Manager Agents

D.3.12. certServer.ca.profiles

Controls access to list certificate profiles in the agent services interface.

```
allow (list) group="Certificate Manager Agents"
```

Table D.24. certServer.ca.profiles ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
list	List certificate profiles.	Allow	Certificate Manager Agents

D.3.13. certServer.ca.registerUser

Defines which group or user can create an agent user for the instance. The default configuration is:

```
allow (modify,read) group="Enterprise CA Administrators" ||
group="Enterprise KRA Administrators" || group="Enterprise RA
Administrators" || group="Enterprise OCSP Administrators" ||
group="Enterprise TKS Administrators" || group="Enterprise TPS
Administrators"
```

Table D.25. certServer.ca.registerUser ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Register a new agent.	Allow	Enterprise Administrators
read	Read existing agent information.	Allow	Enterprise Administrators

D.3.14. certServer.ca.request.enrollment

Controls how the enrollment request are handled and assigned. The default setting is:

```
allow (submit) user="anybody";allow (read,execute,assign,unassign)
group="Certificate Manager Agents"
```

Table D.26. certServer.ca.request.enrollment ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View an enrollment request.	Allow	Certificate Manager Agents
execute	Modify the approval state of a request.	Allow	Certificate Manager Agents
submit	Sumbit a request.	Allow	Anybody
assign	Assign a request to a Certificate Manager agent.	Allow	Certificate Manager Agents
unassign	Change the assignment of a request.	Allow	Certificate Manager Agents

D.3.15. certServer.ca.request.profile

Controls the handling of certificate profile-based requests. The default setting is:

```
allow (approve,read) group="Certificate Manager Agents"
```

Table D.27. certServer.ca.request.profile ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
approve	Modify the approval state of a certificate profile-based certificate request.	Allow	Certificate Manager Agents
read	View a certificate profile-based certificate request.	Allow	Certificate Manager Agents

D.3.16. certServer.ca.requests

Controls who can list certificate requests in the agents services interface.

```
allow (list) group="Certificate Manager Agents"|| group="Registration
Manager Agents"
```

Table D.28. certServer.ca.requests ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups

Operations	Description	Allow/Deny Access	Targeted Users/Groups
list	Retrieve details on a range of requests, and search for certificates using a complex filter.	Allow	Certificate Manager Agents Registration Manager Agents

D.3.17. certServer.ca.systemstatus

Controls who can view the statistics for the Certificate Manager instance.

```
allow (read) group="Certificate Manager Agents"
```

Table D.29. certServer.ca.systemstatus ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View statistics.	Allow	Certificate Manager Agents

D.3.18. certServer.ee.certchain

Controls who can access the CA certificate chain in the end-entities page.

```
allow (download,read) user="anybody"
```

Table D.30. certServer.ee.certchain ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
download	Download the CA's certificate chain.	Allow	Anyone
read	View the CA's certificate chain.	Allow	Anyone

D.3.19. certServer.ee.certificate

Controls who can access certificates, for most operations like importing or revoking certificates, through the end-entities page.

```
allow (renew,revoke,read,import) user="anybody"
```

Table D.31. certServer.ee.certificate ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups

Operations	Description	Allow/Deny Access	Targeted Users/Groups
renew	Submit a request to renew an existing certificate.	Allow	Anyone
revoke	Submit a revocation request for a user certificate.	Allow	Anyone
read	Retrieve and view certificates based on the certificate serial number or request ID.	Allow	Anyone
import	Import a certificate based on serial number.	Allow	Anyone

D.3.20. certServer.ee.certificates

Controls who can list revoked certificates or submit a revocation request in the end-entities page.

```
allow (revoke,list) user="anybody"
```

Table D.32. certServer.ee.certificates ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
revoke	Submit a list of certificates to revoke.	Allow	Subject of Certificate to be Revoked must match Certificate presented to authenticate to the CA.
list	Search for certificates matching specified criteria.	Allow	Anyone

D.3.21. certServer.ee.crl

Controls access to CRLs through the end-entities page.

```
allow (read,add) user="anybody"
```

Table D.33. certServer.ee.crl ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	Retrieve and view the certificate revocation list.	Allow	Anyone

Operations	Description	Allow/Deny Access	Targeted Users/Groups
add	Add CRLs to the OCSP server.	Allow	Anyone

D.3.22. certServer.ee.profile

Controls some access to certificate profiles in the end-entities page, including who can view details about a profile or submit a request through the profile.

```
allow (submit,read) user="anybody"
```

Table D.34. certServer.ee.profile ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
submit	Submit a certificate request through a certificate profile.	Allow	Anyone
read	Displaying details of a certificate profile.	Allow	Anyone

D.3.23. certServer.ee.profiles

Controls who can list active certificate profiles in the end-entities page.

```
allow (list) user="anybody"
```

Table D.35. certServer.ee.profiles ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
list	List certificate profiles.	Allow	Anyone

D.3.24. certServer.ee.request.ocsp

Controls access, based on IP address, on which clients submit OCSP requests.

```
allow (submit) ipaddress=".*"
```

Table D.36. certServer.ee.request.ocsp ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
submit	Submit OCSP requests.	Allow	All IP addresses

D.3.25. certServer.ee.request.revocation

Controls what users can submit certificate revocation requests in the end-entities page.

```
allow (submit) user="anybody"
```

Table D.37. certServer.ee.request.revocation ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
submit	Submit a request to revoke a certificate.	Allow	Anyone

D.3.26. certServer.ee.requestStatus

Controls who can view the status for a certificate request in the end-entities page.

```
allow (read) user="anybody"
```

Table D.38. certServer.ee.requestStatus ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	Retrieve the status of a request and serial numbers of any certificates that have been issued against that request.	Allow	Anyone

D.3.27. certServer.job.configuration

Controls who can configure jobs for the Certificate Manager.

```
allow (read) group="Administrators" || group="Certificate Manager
Agents" || group="Registration Manager Agents" || group="Key Recovery
Authority Agents" || group="Online Certificate Status Manager Agents" ||
group="Auditors";allow (modify) group="Administrators"
```

Table D.39. certServer.job.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View basic job settings, job instance settings, and job plug-in settings. List job plug-ins and job instances.	Allow	Administrators Agents Auditors

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Add and delete job plug-ins and job instances. Modify job plug-ins and job instances.	Allow	Administrators

D.3.28. certServer.profile.configuration

Controls access to the certificate profile configuration. The default setting is:

```
allow (read) group="Administrators" || group="Certificate Manager
Agents" || group="Registration Manager Agents" || group="Key Recovery
Authority Agents" || group="Online Certificate Status Manager Agents" ||
group="Auditors";allow (modify) group="Administrators"
```

Table D.40. certServer.profile.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View certificate profile defaults and constraints, input, output, input configuration, output configuration, default configuration, policy constraints configuration, and certificate profile instance configuration. List certificate profile plug-ins and certificate profile instances.	Allow	Administrators Agents Auditors
modify	Add, modify, and delete certificate profile defaults and constraints, input, output, and certificate profile instances. Add and modify default policy constraints configuration.	Allow	Administrators

D.3.29. certServer.publisher.configuration

Controls who can view and edit the publishing configuration for the Certificate Manager. The default configuration is:

```
allow (read) group="Administrators" || group="Auditors" ||
group="Certificate Manager Agents" || group="Registration Manager
Agents" || group="Key Recovery Authority Agents" || group="Online
Certificate Status Manager Agents";allow (modify) group="Administrators"
```

Table D.41. certServer.publisher.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View LDAP server destination information, publisher plug-in configuration, publisher instance configuration, mapper plug-in configuration, mapper instance configuration, rules plug-in configuration, and rules instance configuration. List publisher plug-ins and instances, rules plug-ins and instances, and mapper plug-ins and instances.	Allow	Administrators Agents Auditors
modify	Add and delete publisher plug-ins, publisher instances, mapper plug-ins, mapper instances, rules plug-ins, and rules instances. Modify publisher instances, mapper instances, rules instances, and LDAP server destination information.	Allow	Administrators

D.3.30. certServer.securitydomain.domainxml

Controls access to the security domain information maintained in a registry by the domain host Certificate Manager. The security domain configuration is directly accessed and modified by subsystem instances during configuration, so appropriate access must always be allowed to subsystems, or configuration could fail.

```
allow (read) user="anybody";allow (modify) group="Subsystem Group"
```

Table D.42. certServer.securitydomain.domainxml ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View the security domain configuration.	Allow	Anybody
modify	Modify the security domain configuration by changing instance information and adding and removing instances.	Allow	Subsystem Groups Enterprise Administrators

D.4. Key Recovery Authority-Specific ACLs

This section covers the default access control configuration which apply specifically to the KRA. The KRA ACL configuration also includes all of the common ACLs listed in Section D.2, "Common ACLs".

There are access control rules set for each of the KRA's interfaces (administrative console and agents and end-entities services pages) and for common operations like listing and downloading keys.

D.4.1. certServer.job.configuration

Controls who can configure jobs for the KRA.

```
allow (read) group="Administrators" || group="Key Recovery Authority
Agents" ||  group="Auditors";allow (modify) group="Administrators"
```

Table D.43. certServer.job.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View basic job settings, job instance settings, and job plug-in settings. List job plug-ins and job instances.	Allow	Administrators Agents Auditors
modify	Add and delete job plug-ins and job instances. Modify job plug-ins and job instances.	Allow	Administrators

D.4.2. certServer.kra.certificate.transport

Controls who can view the transport certificate for the KRA.

```
allow (read) user="anybody"
```

Table D.44. certServer.kra.certificate.transport ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View the transport certificate for the KRA instance.	Allow	Anyone

D.4.3. certServer.kra.configuration

Controls who can configure and manage the setup for the KRA.

```
allow (read) group="Administrators" || group="Auditors" || group="Key
Recovery Authority Agents" || allow (modify) group="Administrators"
```

Table D.45. certServer.kra.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	Read the number of required recovery agent approvals.	Allow	Administrators Agents Auditors
modify	Change the number of required recovery agent approvals.	Allow	Administrators

D.4.4. certServer.kra.connector

Controls what entities can submit requests over a special connector configured on the CA to connect to the KRA. The default configuration is:

```
allow (submit) group="Trusted Managers"
```

Table D.46. certServer.kra.connector ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
submit	Submit a new key archival request (for non-TMS only).	Allow	Trusted Managers

D.4.5. certServer.kra.GenerateKeyPair

Controls who can submit key recovery requests to the KRA. The default configuration is:

```
allow (execute) group="Key Recovery Authority Agents"
```

Table D.47. certServer.kra.GenerateKeyPair ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
Execute	Execute server-side key generation (TMS only).	Allow	KRA Agents

D.4.6. certServer.kra.getTransportCert

Controls who can submit key recovery requests to the KRA. The default configuration is:

```
allow (download) group="Enterprise CA Administrators" ||
group="Enterprise KRA Administrators" || group="Enterprise OCSP
Administrators" || group="Enterprise TKS Administrators" ||
group="Enterprise TPS Administrators"
```

Table D.48. certServer.kra.getTransportCert ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
download	Retrieve KRA transport certificate.	Allow	Enterprise Administrators

D.4.7. certServer.kra.group

Controls access to the internal database for adding users and groups for the KRA instance.

```
allow (modify,read) group="Administrators"
```

Table D.49. certServer.kra.group ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Create, edit, or delete user and group entries for the instance.	Allow	Administrators
read	View user and group entries for the instance.	Allow	Administrators

D.4.8. certServer.kra.key

Controls who can access key information through viewing, recovering, or downloading keys. The default configuration is:

```
allow (read,recover,download) group="Key Recovery Authority Agents"
```

Table D.50. certServer.kra.key ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	Display public information about key archival record.	Allow	KRA Agents
recover	Retrieve key information from the database to perform a recovery operation.	Allow	KRA Agents
download	Download key information through the agent services pages.	Allow	KRA Agents

D.4.9. certServer.kra.keys

Controls who can list archived keys through the agent services pages.

```
allow (list) group="Key Recovery Authority Agents"
```

Table D.51. certServer.kra.keys ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
list	Search for and list a range of archived keys.	Allow	KRA Agents

D.4.10. certServer.kra.registerUser

Defines which group or user can create an agent user for the instance. The default configuration is:

```
allow (modify,read) group="Enterprise CA Administrators" ||
group="Enterprise KRA Administrators" || group="Enterprise OCSP
Administrators" || group="Enterprise TKS Administrators" ||
group="Enterprise TPS Administrators"
```

Table D.52. certServer.kra.registerUser ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Register a new user.	Allow	Enterprise Administrators
read	Read existing user info.	Allow	Enterprise Administrators

D.4.11. certServer.kra.request

Controls who can view key archival and recovery requests in the agents services interface.

```
allow (read) group="Key Recovery Authority Agents"
```

Table D.53. certServer.kra.request ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View a key archival or recovery request.	Allow	KRA Agents

D.4.12. certServer.kra.request.status

Controls who can view the status for a key recovery request in the end-entities page.

```
allow (read) group="Key Recovery Authority Agents"
```

Table D.54. certServer.kra.request.status ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	Retrieve the status of a key recovery request in the agents services pages.	Allow	KRA Agents

D.4.13. certServer.kra.requests

Controls who can list key archival and recovery requests in the agents services interface.

```
allow (list) group="Key Recovery Authority Agents"
```

Table D.55. certServer.kra.requests ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
list	Retrieve details on a range of key archival and recovery requests.	Allow	KRA Agents

D.4.14. certServer.kra.systemstatus

Controls who can view the statistics for the KRA instance.

```
allow (read) group="Key Recovery Authority Agents"
```

Table D.56. certServer.kra.systemstatus ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View statistics.	Allow	KRA Agents

D.4.15. certServer.kra.TokenKeyRecovery

Controls who can submit key recovery requests for a token to the KRA. This is a common request for replacing a lost token. The default configuration is:

```
allow (submit) group="Key Recovery Authority Agents"
```

Table D.57. certServer.kra.TokenKeyRecovery ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
submit	Submit or initiate key recovery requests for a token recovery.	Allow	KRA Agents

D.5. Online Certificate Status Manager-Specific ACLs

This section covers the default access control configuration attributes which are set specifically for the Online Certificate Status Manager. The OCSP responder's ACL configuration also includes all of the common ACLs listed in Section D.2, “Common ACLs”.

There are access control rules set for each of the OCSP's interfaces (administrative console and agents and end-entities services pages) and for common operations like listing and downloading CRLs.

D.5.1. certServer.ee.crl

Controls access to CRLs through the end-entities page.

```
allow (read) user="anybody"
```

Table D.58. certServer.ee.crl ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	Retrieve and view the certificate revocation list.	Allow	Anyone

D.5.2. certServer.ee.request.ocsp

Controls access, based on IP address, on which clients submit OCSP requests.

```
allow (submit) ipaddress=".*"
```

Table D.59. certServer.ee.request.ocsp ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
submit	Submit OCSP requests.	Allow	All IP addresses

D.5.3. certServer.ocsp.ca

Controls who can instruct the OCSP responder. The default setting is:

```
allow (add) group="Online Certificate Status Manager Agents"
```

Table D.60. certServer.ocsp.ca ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
Add	Instruct the OCSP responder to respond to OCSP requests for a new CA.	Allow	OCSP Manager Agents

D.5.4. certServer.ocsp.cas

Controls who can list, in the agent services interface, all of the Certificate Managers which publish CRLs to the Online Certificate Status Manager. The default setting is:

```
allow (list) group="Online Certificate Status Manager Agents"
```

Table D.61. certServer.ocsp.cas ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
list	Lists all of the Certificate Managers which publish CRLs to the OCSP responder.	Allow	Agents

D.5.5. certServer.ocsp.certificate

Controls who can validate the status of a certificate. The default setting is:

```
allow (validate) group="Online Certificate Status Manager Agents"
```

Table D.62. certServer.ocsp.certificate ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups

Operations	Description	Allow/Deny Access	Targeted Users/Groups
validate	Verifies the status of a specified certificate.	Allow	OCSP Agents

D.5.6. certServer.ocsp.configuration

Controls who can access, view, or modify the configuration for the Certificate Manager's OCSP services. The default configuration is:

```
allow (read) group="Administrators" || group="Online Certificate Status
Manager Agents" || group="Auditors";allow (modify)
group="Administrators"
```

Table D.63. certServer.ocsp.configuration ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View OCSP plug-in information, OCSP configuration, and OCSP stores configuration. List OCSP stores configuration.	Allow	Administrators Online Certificate Status Manager Agents Auditors
modify	Modify the OCSP configuration, OCSP stores configuration, and default OCSP store.	Allow	Administrators

D.5.7. certServer.ocsp.crl

Controls access to read or update CRLs through the agent services interface. The default setting is:

```
allow (add) group="Online Certificate Status Manager Agents" ||
group="Trusted Managers"
```

Table D.64. certServer.ocsp.crl ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
add	Add new CRLs to those managed by the OCSP responder.	Allow	OCSP Agents Trusted Managers

D.5.8. certServer.ocsp.group

Controls access to the internal database for adding users and groups for the Online Certificate Status Manager instance.

```
allow (modify,read) group="Administrators"
```

Table D.65. certServer.ocsp.group ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Create, edit or delete user and group entries for the instance.	Allow	Administrators
read	View user and group entries for the instance.	Allow	Administrators

D.5.9. certServer.ocsp.info

Controls who can read information about the OCSP responder.

```
allow (read) group="Online Certificate Status Manager Agents"
```

Table D.66. certServer.ocsp.info ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
read	View OCSP responder information.	Allow	OCSP Agents

D.6. Token Key Service-Specific ACLs

This section covers the default access control configuration attributes which are set specifically for the Token Key Service (TKS). The TKS ACL configuration also includes all of the common ACLs listed in Section D.2, “Common ACLs”.

There are access control rules set for the TKS's administrative console and for access by other subsystems to the TKS.

D.6.1. certServer.tks.encrypteddata

Controls who can encrypt data.

```
allow(execute) group="Token Key Service Manager Agents"
```

Table D.67. certServer.tks.encrypteddata ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups

Operations	Description	Allow/Deny Access	Targeted Users/Groups
Execute	Encrypted data stored in the TKS.	Allow	TKS Agents

D.6.2. certServer.tks.group

Controls access to the internal database for adding users and groups for the TKS instance.

```
allow (modify,read) group="Administrators"
```

Table D.68. certServer.tks.group ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Create, edit, or delete user and group entries for the instance.	Allow	Administrators
read	View user and group entries for the instance.	Allow	Administrators

D.6.3. certServer.tks.importTransportCert

Controls who can import the transport certificate used by the TKS to deliver keys.

```
allow (modify,read) group="Enterprise CA Administrators" ||
group="Enterprise KRA Administrators" || group="Enterprise OCSP
Administrators" || group="Enterprise TKS Administrators" ||
group="Enterprise TPS Administrators"
```

Table D.69. certServer.tks.importTransportCert ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Update the transport certificate.	Allow	Enterprise Administrators
read	Import the transport certificate.	Allow	Enterprise Administrators

D.6.4. certServer.tks.keysetdata

Controls who can view information about key sets derived and stored by the TKS.

```
allow (execute) group="Token Key Service Manager Agents"
```

Table D.70. certServer.tks.keysetdata ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
Execute	Create diversified key set data.	Allow	TKS Agents

D.6.5. certServer.tks.registerUser

Defines which group or user can create an agent user for the instance. The default configuration is:

```
allow (modify,read) group="Enterprise CA Administrators" ||
group="Enterprise KRA Administrators" || group="Enterprise OCSP
Administrators" || group="Enterprise TKS Administrators" ||
group="Enterprise TPS Administrators"
```

Table D.71. certServer.tks.registerUser ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
modify	Register a new agent.	Allow	Enterprise Administrators
read	Read existing agent information.	Allow	Enterprise Administrators

D.6.6. certServer.tks.sessionkey

Controls who can create the session keys used by the TKS instance to connections to the TPS.

```
allow (execute) group="Token Key Service Manager Agents"
```

Table D.72. certServer.tks.sessionkey ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups
Execute	Create session keys generated by the TKS.	Allow	TKS Agents

D.6.7. certServer.tks.randomdata

Controls who can create random data.

```
allow (execute) group="Token Key Service Manager Agents"
```

Table D.73. certServer.tks.randomdata ACL Summary

Operations	Description	Allow/Deny Access	Targeted Users/Groups

Operations	Description	Allow/Deny Access	Targeted Users/Groups
Execute	Generate random data.	Allow	TKS Agents

Chapter 17. Troubleshooting

This chapter covers some of the more common usage problems that are encountered when installing Certificate System.

Q:

The init script returned an OK status, but my CA instance does not respond. Why?

A: This should not happen. Usually (but not always), this indicates a listener problem with the CA, but it can have many different causes. Check in the **catalina.out**, **system**, and **debug** log files for the instance to see what errors have occurred. This lists a couple of common errors.

One situation is when there is a PID for the CA, indicating the process is running, but that no listeners have been opened for the server. This would return Java invocation class errors in the **catalina.out** file:

```
Oct 29, 2010 4:15:44 PM org.apache.coyote.http11.Http11Protocol init
INFO: Initializing Coyote HTTP/1.1 on http-9080
java.lang.reflect.InvocationTargetException
        at sun.reflect.NativeMethodAccessorImpl.invoke0(Native
Method)
        at
sun.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl
.java:64)
        at
sun.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAcce
ssorImpl.java:43)
        at java.lang.reflect.Method.invoke(Method.java:615)
        at
org.apache.catalina.startup.Bootstrap.load(Bootstrap.java:243)
        at
org.apache.catalina.startup.Bootstrap.main(Bootstrap.java:408)
Caused by: java.lang.UnsatisfiedLinkError: jss4
```

This could mean that you have the wrong version of JSS or NSS. The process requires **libnss3.so** in the path. Check this with this command:

```
ldd /usr/lib64/libjss4.so
```

If **libnss3.so** is not found, try unsetting the **LD_LIBRARY_PATH** variable and restart the CA.

```
unset LD_LIBRARY_PATH
systemctl restart pki-tomcatd@instance_name.service
```

Q:

I can't open the pkiconsole and I'm seeing Java exceptions in stdout.

A: This probably means that you have the wrong JRE installed or the wrong JRE set as the default. Run **alternatives --config java** to see what JRE is selected. Red Hat Certificate System requires OpenJDK 1.6.

Q:

I tried to run pkiconsole, and I got Socket exceptions in stdout. Why?

A: This means that there is a port problem. Either there are incorrect SSL settings for the administrative port (meaning there is bad configuration in the **server.xml**) or the wrong port was given to access the admin interface.

Port errors will look like the following:

```
NSS Cipher Supported '0xff04'
java.io.IOException: SocketException cannot read on socket
        at org.mozilla.jss.ssl.SSLSocket.read(SSLSocket.java:1006)
        at
org.mozilla.jss.ssl.SSLInputStream.read(SSLInputStream.java:70)
        at
com.netscape.admin.certsrv.misc.HttpInputStream.fill(HttpInputStream
.java:303)
        at
com.netscape.admin.certsrv.misc.HttpInputStream.readLine(HttpInputSt
ream.java:224)
        at
com.netscape.admin.certsrv.connection.JSSConnection.readHeader(JSSCo
nnection.java:439)
        at
com.netscape.admin.certsrv.connection.JSSConnection.initReadResponse
(JSSConnection.java:430)
        at
com.netscape.admin.certsrv.connection.JSSConnection.sendRequest(JSSC
onnection.java:344)
        at
com.netscape.admin.certsrv.connection.AdminConnection.processRequest
(AdminConnection.java:714)
        at
com.netscape.admin.certsrv.connection.AdminConnection.sendRequest(Ad
minConnection.java:623)
        at
com.netscape.admin.certsrv.connection.AdminConnection.sendRequest(Ad
minConnection.java:590)
        at
com.netscape.admin.certsrv.connection.AdminConnection.authType(Admin
Connection.java:323)
        at
com.netscape.admin.certsrv.CMSServerInfo.getAuthType(CMSServerInfo.j
ava:113)
        at
com.netscape.admin.certsrv.CMSAdmin.run(CMSAdmin.java:499)
        at
com.netscape.admin.certsrv.CMSAdmin.run(CMSAdmin.java:548)
        at
com.netscape.admin.certsrv.Console.main(Console.java:1655)
```

Q:

I tried to enroll for a certificate, and I got the error "request is not submitted...Subject Name Not Found"?

A: This most often occurs with a custom LDAP directory authentication profile and it shows that the directory operation failed. Particularly, it failed because it could not construct a working DN. The error will be in the CA's **debug** log. For example, this profile used a custom attribute (***MYATTRIBUTE***) that the directory didn't recognize:

```
[14/Feb/2011:15:52:25][http-1244-Processor24]: BasicProfile:
populate() policy
setid =userCertSet
[14/Feb/2011:15:52:25][http-1244-Processor24]:
AuthTokenSubjectNameDefault:
populate start
[14/Feb/2011:15:52:25][http-1244-Processor24]:
AuthTokenSubjectNameDefault:
java.io.IOException: Unknown AVA keyword 'MYATTRIBUTE'.
[14/Feb/2011:15:52:25][http-1244-Processor24]: ProfileSubmitServlet:
populate
Subject Name Not Found
[14/Feb/2011:15:52:25][http-1244-Processor24]: CMSServlet:
curDate=Mon Feb 14
15:52:25 PST 2011 id=caProfileSubmit time=13
```

Any custom components — attributes, object classes, and unregistered OIDs — which are used in the subject DN can cause a failure. For most cases, the X.509 attributes defined in RHC 2253 should be used in subject DNs instead of custom attributes.

Q:

I can't open the `pkiconsole` and I'm seeing Java exceptions in stdout.

A: This probably means that you have the wrong JRE installed or the wrong JRE set as the default. Run **`alternatives --config java`** to see what JRE is selected. Red Hat Certificate System requires OpenJDK 1.6.

Q:

Why are my enrolled certificates not being published?

A: This usually indicates that the CA is misconfigured. The main place to look for errors is the **debug** log, which can indicate where the misconfiguration is. For example, this has a problem with the mappers:

```
[31/Jul/2010:11:18:29][Thread-29]: LdapSimpleMap: cert subject
dn:UID=me,E=me@example.com,CN=yes
[31/Jul/2010:11:18:29][Thread-29]: Error mapping:
mapper=com.netscape.cms.publish.mappers.LdapSimpleMap@258fdcd0
error=Cannot
find a match in the LDAP server for certificate.
netscape.ldap.LDAPException:
error result (32); matchedDN = ou=people,c=test; No such object
```

Check the publishing configuration in the CA's **CS.cfg** file or in the **Publishing** tab of the CA console. In this example, the problem was in the mapping parameter, which must point to an *existing* LDAP suffix:

```
ca.publish.mapper.instance.LdapUserCertMap.dnPattern=UID=$subj.UID,d
c=publish
```

Q:

I can't open the pkiconsole and I'm seeing Java exceptions in stdout.

A: This probably means that you have the wrong JRE installed or the wrong JRE set as the default. Run **alternatives --config java** to see what JRE is selected. Red Hat Certificate System requires OpenJDK 1.6.

Glossary

A

access control

The process of controlling what particular users are allowed to do. For example, access control to servers is typically based on an identity, established by a password or a certificate, and on rules regarding what that entity can do. See also access control list (ACL).

access control instructions (ACI)

An access rule that specifies how subjects requesting access are to be identified or what rights are allowed or denied for a particular subject. See access control list (ACL).

access control list (ACL)

A collection of access control entries that define a hierarchy of access rules to be evaluated when a server receives a request for access to a particular resource. See access control instructions (ACI).

administrator

The person who installs and configures one or more Certificate System managers and sets up privileged users, or agents, for them. See also agent.

Advanced Encryption Standard (AES)

The Advanced Encryption Standard (AES), like its predecessor Data Encryption Standard (DES), is a FIPS-approved symmetric-key encryption standard. AES was adopted by the US government in 2002. It defines three block ciphers, AES-128, AES-192 and AES-256. The National Institute of Standards and Technology (NIST) defined the AES standard in U.S. FIPS PUB 197. For more information, see http://csrc.nist.gov/publications/fips/fips197/fips-197.pdf.

agent

A user who belongs to a group authorized to manage agent services for a Certificate System manager. See also Certificate Manager agent, Key Recovery Authority agent.

agent services

1. Services that can be administered by a Certificate System agent through HTML pages served by the Certificate System subsystem for which the agent has been assigned the necessary privileges.

2. The HTML pages for administering such services.

agent-approved enrollment

An enrollment that requires an agent to approve the request before the certificate is issued.

APDU

Application protocol data unit. A communication unit (analogous to a byte) that is used in communications between a smart card and a smart card reader.

attribute value assertion (AVA)

An assertion of the form *attribute* = *value*, where *attribute* is a tag, such as **o** (organization) or **uid** (user ID), and *value* is a value such as "Red Hat, Inc." or a login name. AVAs are used to form the distinguished name (DN) that identifies the subject of a certificate, called the subject name of the certificate.

audit log

A log that records various system events. This log can be signed, providing proof that it was not tampered with, and can only be read by an auditor user.

auditor

A privileged user who can view the signed audit logs.

authentication

Confident identification; assurance that a party to some computerized transaction is not an impostor. Authentication typically involves the use of a password, certificate, PIN, or other information to validate identity over a computer network. See also password-based authentication, certificate-based authentication, client authentication, server authentication.

authentication module

A set of rules (implemented as a Java™ class) for authenticating an end entity, agent, administrator, or any other entity that needs to interact with a Certificate System subsystem. In the case of typical end-user enrollment, after the user has supplied the information requested by the enrollment form, the enrollment servlet uses an authentication module associated with that form to validate the information and authenticate the user's identity. See servlet.

authorization

Permission to access a resource controlled by a server. Authorization typically takes place after the ACLs associated with a resource have been evaluated by a server. See access control list (ACL).

automated enrollment

A way of configuring a Certificate System subsystem that allows automatic authentication for end-entity enrollment, without human intervention. With this form of authentication, a certificate request that completes authentication module processing successfully is automatically approved for profile processing and certificate issuance.

B

bind DN

A user ID, in the form of a distinguished name (DN), used with a password to authenticate to Red Hat Directory Server.

C

CA certificate

A certificate that identifies a certificate authority. See also certificate authority (CA), subordinate CA, root CA.

CA hierarchy

A hierarchy of CAs in which a root CA delegates the authority to issue certificates to subordinate CAs. Subordinate CAs can also expand the hierarchy by delegating issuing status to other CAs. See also certificate authority (CA), subordinate CA, root CA.

CA server key

The SSL server key of the server providing a CA service.

CA signing key

The private key that corresponds to the public key in the CA certificate. A CA uses its signing key to sign certificates and CRLs.

certificate

Digital data, formatted according to the X.509 standard, that specifies the name of an individual, company, or other entity (the subject name of the certificate) and certifies that a public key, which is also included in the certificate, belongs to that entity. A certificate is issued and digitally signed by a certificate authority (CA). A certificate's validity can be verified by checking the CA's digital signature through public-key cryptography techniques. To be trusted within a public-key infrastructure (PKI), a certificate must be issued and signed by a CA that is trusted by other entities enrolled in the PKI.

certificate authority (CA)

A trusted entity that issues a certificate after verifying the identity of the person or entity the certificate is intended to identify. A CA also renews and revokes certificates and generates CRLs. The entity named in the issuer field of a certificate is always a CA. Certificate authorities can be independent third parties or a person or organization using certificate-issuing server software, such as Red Hat Certificate System.

certificate chain

A hierarchical series of certificates signed by successive certificate authorities. A CA certificate identifies a certificate authority (CA) and is used to sign certificates issued by that authority. A CA certificate can in turn be signed by the CA certificate of a parent CA, and so on up to a root CA. Certificate System allows any end entity to retrieve all the certificates in a certificate chain.

certificate extensions

An X.509 v3 certificate contains an extensions field that permits any number of additional fields to be added to the certificate. Certificate extensions provide a way of adding information such as alternative subject names and usage restrictions to certificates. A number of standard extensions have been defined by the PKIX working group.

certificate fingerprint

A one-way hash associated with a certificate. The number is not part of the certificate itself, but is produced by applying a hash function to the contents of the certificate. If the contents of the certificate changes, even by a single character, the same function produces a different number. Certificate fingerprints can therefore be used to verify that certificates have not been tampered with.

Certificate Management Message Formats (CMMF)

Message formats used to convey certificate requests and revocation requests from end entities to a Certificate Manager and to send a variety of information to end entities. A proposed standard from the Internet Engineering Task Force (IETF) PKIX working group. CMMF is subsumed by another proposed standard, Certificate Management Messages over Cryptographic Message Syntax (CMC). For detailed information, see http://www.ietf.org/internet-drafts/draft-ietf-pkix-cmmf-02.txt.

Certificate Management Messages over Cryptographic Message Syntax (CMC)

Message format used to convey a request for a certificate to a Certificate Manager. A proposed standard from the Internet Engineering Task Force (IETF) PKIX working group. For detailed information, see http://www.ietf.org/internet-drafts/draft-ietf-pkix-cmc-02.txt.

Certificate Manager

An independent Certificate System subsystem that acts as a certificate authority. A Certificate Manager instance issues, renews, and revokes certificates, which it can publish along with CRLs to an LDAP directory. It accepts requests from end entities. See certificate authority (CA).

Certificate Manager agent

A user who belongs to a group authorized to manage agent services for a Certificate Manager. These services include the ability to access and modify (approve and reject) certificate requests and issue certificates.

certificate profile

A set of configuration settings that defines a certain type of enrollment. The certificate profile sets policies for a particular type of enrollment along with an authentication method in a certificate profile.

Certificate Request Message Format (CRMF)

Format used for messages related to management of X.509 certificates. This format is a subset of CMMF. See also Certificate Management Message Formats (CMMF). For detailed information, see ftp://ftp.isi.edu/in-notes/rfc2511.txt.

certificate revocation list (CRL)

As defined by the X.509 standard, a list of revoked certificates by serial number, generated and signed by a certificate authority (CA).

Certificate System

See Red Hat Certificate System, Cryptographic Message Syntax (CS).

Certificate System console

A console that can be opened for any single Certificate System instance. A Certificate System console allows the Certificate System administrator to control configuration settings for the corresponding Certificate System instance.

Certificate System subsystem

One of the five Certificate System managers: Certificate Manager, Online Certificate Status Manager, Key Recovery Authority, Token Key Service, or Token Processing System.

certificate-based authentication

Authentication based on certificates and public-key cryptography. See also password-based authentication.

chain of trust

See certificate chain.

chained CA

See linked CA.

cipher

See cryptographic algorithm.

client authentication

The process of identifying a client to a server, such as with a name and password or with a certificate and some digitally signed data. See certificate-based authentication, password-based authentication, server authentication.

client SSL certificate

A certificate used to identify a client to a server using the SSL protocol. See Secure Sockets Layer (SSL).

CMC

See Certificate Management Messages over Cryptographic Message Syntax (CMC).

CMC Enrollment

Features that allow either signed enrollment or signed revocation requests to be sent to a Certificate Manager using an agent's signing certificate. These requests are then automatically processed by the Certificate Manager.

CMMF

See Certificate Management Message Formats (CMMF).

Common Criteria

A certification standard that evaluates computer security, both for software and hardware components. The software or hardware vendor defines the operating environment and specified configuration, identifies any threats, and outlines both the development and deployment processes for the target of evaluation (the thing being evaluated). The Common Criteria certification laboratory then tests the implementation design to look for any vulnerabilities.

CRL

See certificate revocation list (CRL).

CRMF

See Certificate Request Message Format (CRMF).

cross-certification

The exchange of certificates by two CAs in different certification hierarchies, or chains. Cross-certification extends the chain of trust so that it encompasses both hierarchies. See also certificate authority (CA).

cross-pair certificate

A certificate issued by one CA to another CA which is then stored by both CAs to form a circle of trust. The two CAs issue certificates to each other, and then store both cross-pair certificates as a certificate pair.

cryptographic algorithm

A set of rules or directions used to perform cryptographic operations such as encryption and decryption.

Cryptographic Message Syntax (CS)

The syntax used to digitally sign, digest, authenticate, or encrypt arbitrary messages, such as CMMF.

cryptographic module

See PKCS #11 module.

cryptographic service provider (CSP)

A cryptographic module that performs cryptographic services, such as key generation, key storage, and encryption, on behalf of software that uses a standard interface such as that defined by PKCS #11 to request such services.

CSP

See cryptographic service provider (CSP).

D

decryption

Unscrambling data that has been encrypted. See encryption.

delta CRL

A CRL containing a list of those certificates that have been revoked since the last full CRL was issued.

digital ID

See certificate.

digital signature

To create a digital signature, the signing software first creates a one-way hash from the data to be signed, such as a newly issued certificate. The one-way hash is then encrypted with the private key of the signer. The resulting digital signature is unique for each piece of data signed. Even a single comma added to a message changes the digital signature for that message. Successful decryption of the digital signature with the signer's public key and comparison with another hash of the same data provides tamper detection. Verification of the certificate chain for the certificate containing the public key provides authentication of the signer. See also nonrepudiation, encryption.

distinguished name (DN)

A series of AVAs that identify the subject of a certificate. See attribute value assertion (AVA).

distribution points

Used for CRLs to define a set of certificates. Each distribution point is defined by a set of certificates that are issued. A CRL can be created for a particular distribution point.

dual key pair

Two public-private key pairs, four keys altogether, corresponding to two separate certificates. The private key of one pair is used for signing operations, and the public and private keys of the other pair are used for encryption and decryption operations. Each pair corresponds to a separate certificate. See also encryption key, public-key cryptography, signing key.

Key Recovery Authority

An optional, independent Certificate System subsystem that manages the long-term archival and recovery of RSA encryption keys for end entities. A Certificate Manager can be configured to archive end entities' encryption keys with a Key Recovery Authority before issuing new certificates. The Key Recovery Authority is useful only if end entities are encrypting data, such as sensitive email, that the organization may need to recover someday. It can be used only with end entities that support dual key pairs: two separate key pairs, one for encryption and one for digital signatures.

Key Recovery Authority agent

A user who belongs to a group authorized to manage agent services for a Key Recovery Authority, including managing the request queue and authorizing recovery operation using HTML-based administration pages.

Key Recovery Authority recovery agent

One of the *m of n* people who own portions of the storage key for the Key Recovery Authority.

Key Recovery Authority storage key

Special key used by the Key Recovery Authority to encrypt the end entity's encryption key after it has been decrypted with the Key Recovery Authority's private transport key. The storage key never leaves the Key Recovery Authority.

Key Recovery Authority transport certificate

Certifies the public key used by an end entity to encrypt the entity's encryption key for transport to the Key Recovery Authority. The Key Recovery Authority uses the private key corresponding to the certified public key to decrypt the end entity's key before encrypting it with the storage key.

E

eavesdropping

Surreptitious interception of information sent over a network by an entity for which the information is not intended.

Elliptic Curve Cryptography (ECC)

A cryptographic algorithm which uses elliptic curves to create additive logarithms for the mathematical problems which are the basis of the cryptographic keys. ECC ciphers are more efficient to use than RSA ciphers and, because of their intrinsic complexity, are stronger at smaller bits than RSA ciphers. For more information, see http://ietfreport.isoc.org/idref/draft-ietf-tls-ecc/.

encryption

Scrambling information in a way that disguises its meaning. See decryption.

encryption key

A private key used for encryption only. An encryption key and its equivalent public key, plus a signing key and its equivalent public key, constitute a dual key pair.

end entity

In a public-key infrastructure (PKI), a person, router, server, or other entity that uses a certificate to identify itself.

enrollment

The process of requesting and receiving an X.509 certificate for use in a public-key infrastructure (PKI). Also known as *registration*.

extensions field

See certificate extensions.

F

Federal Bridge Certificate Authority (FBCA)

A configuration where two CAs form a circle of trust by issuing cross-pair certificates to each other and storing the two cross-pair certificates as a single certificate pair.

fingerprint

See certificate fingerprint.

FIPS PUBS 140

Federal Information Standards Publications (FIPS PUBS) 140 is a US government standard for implementations of cryptographic modules, hardware or software that encrypts and decrypts data or performs other cryptographic operations, such as creating or verifying digital signatures. Many products sold to the US government must comply with one or more of the FIPS standards. See http://www.nist.gov/itl/fipscurrent.cfm.

firewall

A system or combination of systems that enforces a boundary between two or more networks.

I

impersonation

The act of posing as the intended recipient of information sent over a network. Impersonation can take two forms: spoofing and misrepresentation.

input

In the context of the certificate profile feature, it defines the enrollment form for a particular certificate profile. Each input is set, which then dynamically creates the enrollment form from all inputs configured for this enrollment.

intermediate CA

A CA whose certificate is located between the root CA and the issued certificate in a certificate chain.

in a certificate chain.

IP spoofing

The forgery of client IP addresses.

J

JAR file

A digital envelope for a compressed collection of files organized according to the Java™ archive (JAR) format.

Java™ archive (JAR) format

A set of conventions for associating digital signatures, installer scripts, and other information with files in a directory.

Java™ Cryptography Architecture (JCA)

The API specification and reference developed by Sun Microsystems for cryptographic services. See http://java.sun.com/products/jdk/1.2/docs/guide/security/CryptoSpec.Introduction.

Java™ Development Kit (JDK)

Software development kit provided by Sun Microsystems for developing applications and applets using the Java™ programming language.

Java™ Native Interface (JNI)

A standard programming interface that provides binary compatibility across different implementations of the Java™ Virtual Machine (JVM) on a given platform, allowing existing code written in a language such as C or C++ for a single platform to bind to Java™. See http://java.sun.com/products/jdk/1.2/docs/guide/jni/index.html.

Java™ Security Services (JSS)

A Java™ interface for controlling security operations performed by Netscape Security Services (NSS).

K

KEA

See Key Exchange Algorithm (KEA).

key

A large number used by a cryptographic algorithm to encrypt or decrypt data. A person's public key, for example, allows other people to encrypt messages intended for that person. The messages must then be decrypted by using the corresponding private key.

key exchange

A procedure followed by a client and server to determine the symmetric keys they will both use during an SSL session.

Key Exchange Algorithm (KEA)

An algorithm used for key exchange by the US Government.

L

Lightweight Directory Access Protocol (LDAP)

A directory service protocol designed to run over TCP/IP and across multiple platforms. LDAP is a simplified version of Directory Access Protocol (DAP), used to access X.500 directories. LDAP is under IETF change control and has evolved to meet Internet requirements.

linked CA

An internally deployed certificate authority (CA) whose certificate is signed by a public, third-party CA. The internal CA acts as the root CA for certificates it issues, and the third- party CA acts as the root CA for certificates issued by other CAs that are linked to the same third-party root CA. Also known as "chained CA" and by other terms used by different public CAs.

M

manual authentication

A way of configuring a Certificate System subsystem that requires human approval of each certificate request. With this form of authentication, a servlet forwards a certificate request to a request queue after successful authentication module processing. An agent with appropriate privileges must then approve each request individually before profile processing and certificate issuance can proceed.

MD5

A message digest algorithm that was developed by Ronald Rivest. See also one-way hash.

message digest

See one-way hash.

misrepresentation

The presentation of an entity as a person or organization that it is not. For example, a website might pretend to be a furniture store when it is really a site that takes credit-card payments but never sends any goods. Misrepresentation is one form of impersonation. See also spoofing.

N

Netscape Security Services (NSS)

A set of libraries designed to support cross-platform development of security-enabled communications applications. Applications built using the NSS libraries support the Secure Sockets Layer (SSL) protocol for authentication, tamper detection, and encryption, and the PKCS #11 protocol for cryptographic token interfaces. NSS is also available separately as a software development kit.

non-TMS

Non-token management system. Refers to a configuration of subsystems (the CA and, optionally, KRA and OCSP) which do *not* handle smart cards directly.

See Also token management system (TMS).

nonrepudiation

The inability by the sender of a message to deny having sent the message. A digital signature provides one form of nonrepudiation.

O

object signing

A method of file signing that allows software developers to sign Java code, JavaScript scripts, or any kind of file and allows users to identify the signers and control access by signed code to local system resources.

object-signing certificate

A certificate whose associated private key is used to sign objects; related to object signing.

OCSP

Online Certificate Status Protocol.

one-way hash

1. A number of fixed-length generated from data of arbitrary length with the aid of a hashing algorithm. The number, also called a message digest, is unique to the hashed data. Any change in the data, even deleting or altering a single character, results in a different value.

2. The content of the hashed data cannot be deduced from the hash.

operation

The specific operation, such as read or write, that is being allowed or denied in an access control instruction.

output

In the context of the certificate profile feature, it defines the resulting form from a successful certificate enrollment for a particular certificate profile. Each output is set, which then dynamically creates the form from all outputs configured for this enrollment.

P

password-based authentication

Confident identification by means of a name and password. See also authentication, certificate-based authentication.

PKCS #10

The public-key cryptography standard that governs certificate requests.

PKCS #11

The public-key cryptography standard that governs cryptographic tokens such as smart cards.

PKCS #11 module

A driver for a cryptographic device that provides cryptographic services, such as encryption and decryption, through the PKCS #11 interface. A PKCS #11 module, also called a *cryptographic module* or *cryptographic service provider*, can be implemented in either hardware or software. A PKCS #11 module always has one or more slots, which may be implemented as physical hardware slots in some form of physical reader, such as for smart cards, or as conceptual slots in software. Each slot for a PKCS #11 module can in turn contain a token, which is the hardware or software device that actually provides cryptographic services and optionally stores certificates and keys. Red Hat provides a built-in PKCS #11 module with Certificate System.

PKCS #12

The public-key cryptography standard that governs key portability.

PKCS #7

The public-key cryptography standard that governs signing and encryption.

private key

One of a pair of keys used in public-key cryptography. The private key is kept secret and is used to decrypt data encrypted with the corresponding public key.

proof-of-archival (POA)

Data signed with the private Key Recovery Authority transport key that contains information about an archived end-entity key, including key serial number, name of the Key Recovery Authority, subject name of the corresponding certificate, and date of archival. The signed proof-of-archival data are the response returned by the Key Recovery Authority to the Certificate Manager after a successful key archival operation. See also Key Recovery Authority transport certificate.

public key

One of a pair of keys used in public-key cryptography. The public key is distributed freely and published as part of a certificate. It is typically used to encrypt data sent to the public key's owner, who then decrypts the data with the corresponding private key.

public-key cryptography

A set of well-established techniques and standards that allow an entity to verify its identity electronically or to sign and encrypt electronic data. Two keys are involved, a public key and a private key. A public key is published as part of a certificate, which associates that key with a particular identity. The corresponding private key is kept secret. Data encrypted with the public key can be decrypted only with the private key.

public-key infrastructure (PKI)

The standards and services that facilitate the use of public-key cryptography and X.509 v3 certificates in a networked environment.

R

RC2, RC4

Cryptographic algorithms developed for RSA Data Security by Rivest. See also cryptographic algorithm.

Red Hat Certificate System

A highly configurable set of software components and tools for creating, deploying, and managing certificates. Certificate System is comprised of five major subsystems that can be installed in different Certificate System instances in different physical locations: Certificate Manager, Online Certificate Status Manager, Key Recovery Authority, Token Key Service, and Token Processing System.

registration

See enrollment.

root CA

The certificate authority (CA) with a self-signed certificate at the top of a certificate chain. See also CA certificate, subordinate CA.

RSA algorithm

Short for Rivest-Shamir-Adleman, a public-key algorithm for both encryption and authentication. It was developed by Ronald Rivest, Adi Shamir, and Leonard Adleman and introduced in 1978.

RSA key exchange

A key-exchange algorithm for SSL based on the RSA algorithm.

S

sandbox

A Java™ term for the carefully defined limits within which Java™ code must operate.

secure channel

A security association between the TPS and the smart card which allows encrypted communciation based on a shared master key generated by the TKS and the smart card APDUs.

Secure Sockets Layer (SSL)

A protocol that allows mutual authentication between a client and server and the establishment of an authenticated and encrypted connection. SSL runs above TCP/IP and below HTTP, LDAP, IMAP, NNTP, and other high-level network protocols.

security domain

A centralized repository or inventory of PKI subsystems. Its primary purpose is to facilitate the installation and configuration of new PKI services by automatically establishing trusted relationships between subsystems.

self tests

A feature that tests a Certificate System instance both when the instance starts up and on-demand.

server authentication

The process of identifying a server to a client. See also client authentication.

server SSL certificate

A certificate used to identify a server to a client using the Secure Sockets Layer (SSL) protocol.

servlet

Java™ code that handles a particular kind of interaction with end entities on behalf of a Certificate System subsystem. For example, certificate enrollment, revocation, and key recovery requests are each handled by separate servlets.

SHA-1

Secure Hash Algorithm, a hash function used by the US government.

signature algorithm

A cryptographic algorithm used to create digital signatures. Certificate System supports the MD5 and SHA-1 signing algorithms. See also cryptographic algorithm, digital signature.

signed audit log

See audit log.

signing certificate

A certificate whose public key corresponds to a private key used to create digital signatures. For example, a Certificate Manager must have a signing certificate whose public key corresponds to the private key it uses to sign the certificates it issues.

signing key

A private key used for signing only. A signing key and its equivalent public key, plus an encryption key and its equivalent public key, constitute a dual key pair.

single sign-on

1. In Certificate System, a password that simplifies the way to sign on to Red Hat Certificate System by storing the passwords for the internal database and tokens. Each time a user logs on, he is required to enter this single password.

2. The ability for a user to log in once to a single computer and be authenticated automatically by a variety of servers within a network. Partial single sign-on solutions can take many forms, including mechanisms for automatically tracking passwords used with different servers. Certificates support single sign-on within a public-key infrastructure (PKI). A user can log in once to a local client's private-key database and, as long as the client software is running, rely on certificate-based authentication to access each server within an organization that the user is allowed to access.

slot

The portion of a PKCS #11 module, implemented in either hardware or software, that contains a token.

smart card

A small device that contains a microprocessor and stores cryptographic information, such as keys and certificates, and performs cryptographic operations. Smart cards implement some or all of the PKCS #11 interface.

spoofing

Pretending to be someone else. For example, a person can pretend to have the email address **jdoe@example.com**, or a computer can identify itself as a site called **www.redhat.com** when it is not. Spoofing is one form of impersonation. See also misrepresentation.

SSL

See Secure Sockets Layer (SSL).

subject

The entity identified by a certificate. In particular, the subject field of a certificate contains a subject name that uniquely describes the certified entity.

subject name

A distinguished name (DN) that uniquely describes the subject of a certificate.

subordinate CA

A certificate authority whose certificate is signed by another subordinate CA or by the root CA. See CA certificate, root CA.

symmetric encryption

An encryption method that uses the same cryptographic key to encrypt and decrypt a given message.

T

tamper detection

A mechanism ensuring that data received in electronic form entirely corresponds with the original version of the same data.

token

A hardware or software device that is associated with a slot in a PKCS #11 module. It provides cryptographic services and optionally stores certificates and keys.

token key service (TKS)

A subsystem in the token management system which derives specific, separate keys for every smart card based on the smart card APDUs and other shared information, like the token CUID.

token management system (TMS)

The interrelated subsystems — CA, TKS, TPS, and, optionally, the KRA — which are used to manage certificates on smart cards (tokens).

token processing system (TPS)

A subsystem which interacts directly the Enterprise Security Client and smart cards to manage the keys and certificates on those smart cards.

tree hierarchy

The hierarchical structure of an LDAP directory.

trust

Confident reliance on a person or other entity. In a public-key infrastructure (PKI), trust refers to the relationship between the user of a certificate and the certificate authority (CA) that issued the certificate. If a CA is trusted, then valid certificates issued by that CA can be trusted.

V

virtual private network (VPN)

A way of connecting geographically distant divisions of an enterprise. The VPN allows the divisions to communicate over an encrypted channel, allowing authenticated, confidential transactions that would normally be restricted to a private network.

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A

Appendix E. Revision History

Note that revision numbers relate to the edition of this manual, not to version numbers of Red Hat Certificate System.

Revision 9.0-0	Mon Aug 15 2016	Petr Bokoč

Initial release for Red Hat Directory Server 9.0.