

Red Hat Enterprise Linux 6

Managing Single Sign-On and Smart Cards

For Red Hat Enterprise Linux 6

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Red Hat Enterprise Linux 6 Managing Single Sign-On and Smart Cards

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Edition 6.2

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This guide is for both users and administrators for Red Hat Enterprise Linux 6 to learn how to manage personal certificates and keys using the Enterprise Security Client. The Enterprise Security Client is a simple GUI which works as a frontend for the Red Hat Certificate System token management system. The Enterprise Security Client allows users of Red Hat Enterprise Linux 6 to format and manage smart cards easily as part of a single sign-on solution.

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About This Guide

The **Enterprise Security Client** is a simple user interface which formats and manages smart cards. This guide is intended for everyday users of Certificate System, who use the **Enterprise Security Client** to manage their smart cards. Certificate System agents should read the *Certificate System Agent's Guide* for information on how to perform agent tasks, such as handling certificate requests and revoking certificates.

Before reading this guide, be familiar with the following concepts:

- Public-key cryptography and the Secure Sockets Layer (SSL) protocol
- Intranet, extranet, Internet security, and the role of digital certificates in a secure enterprise
- LDAP and Red Hat Directory Server

1. Additional Reading

This guide covers information on managing smart cards, security and single sign-on related services in Red Hat Enterprise Linux, PAM, and Kerberos.

To understand the complete range of security concepts inherent in Red Hat Enterprise Linux 6, including using SELinux, refer to these guides in the Red Hat Enterprise Linux documentation set:

- *Red Hat Enterprise Linux Deployment Guide* covers a comprehensive selection of security and configuration topics, including access controls, network configuration, SELinux, and single sign-on, along with other deployment and management considerations.
- *Red Hat Enterprise Linux Security Guide* provides an overview of security concepts, such as server security and potential network threats, and describes how to configure Red Hat Enterprise Linux 6 servers and workstations, virtual private networks, and firewalls for effective security. It also covers how to assess vulnerabilities in the system and to detect and respond to intrusions.
- *Red Hat Enterprise Linux SELinux Guide* gives an overview of SELinux concepts and details how to configure and use SELinux effectively on a Red Hat Enterprise Linux system.
- *Red Hat Enterprise Linux Installation Guide* provides procedures and options for installing Red Hat Enterprise Linux 6.

Some very basic information on using other end user web services for the Certificate System CA and RA systems is covered in [Using End User Services](#)¹. For basic certificate management, that is all many users need to know. *Managing Smart Cards with the Enterprise Security Client* and the *End User's Guide*, together, are both for end users of Red Hat Certificate System.

For more information on the basic concepts of certificates, public key infrastructure, and Certificate System itself, see the [Certificate System Deployment, Planning, and Installation Guide](#)².

More detailed information about the concepts behind public key cryptography, as well as a more detailed overview of the Certificate System subsystems and how Certificate System manages certificates and smart cards, is available in the [Certificate System Administrator's Guide](#)³. This is also

¹ http://docs.redhat.com/docs/en-US/Red_Hat_Certificate_System/8.1/html/Using_End_User_Services/index.html

² http://docs.redhat.com/docs/en-US/Red_Hat_Certificate_System/8.1/html/Deploy_and_Install_Guide/index.html

³ http://docs.redhat.com/docs/en-US/Red_Hat_Certificate_System/8.1/html/Admin_Guide/index.html

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the guide for administrators to manage the Certificate System server. Installation is covered in the [Certificate System Deployment, Planning, and Installation Guide](#)⁴.

The [Certificate System Agent's Guide](#)⁵ covers how agents can approve and reject certificate requests and manage user certificates through other Certificate System subsystems, such as the Online Certificate Status Responder (which checks the revocation status) and the Data Recovery Manager (which recovers the certificate information if a token or a certificate is lost).

The latest information about Red Hat Certificate System, including current release notes and other updates, is always available at the Certificate System documentation page, http://docs.redhat.com/docs/en-US/Red_Hat_Certificate_System/index.html.

2. Examples and Formatting

2.1. Formatting for Examples and Commands

All of the examples for Red Hat Certificate System commands, file locations, and other usage are given for Red Hat Enterprise Linux 6 systems. Be certain to use the appropriate commands and files for your platform.

Example 1. Example Command

To start the Red Hat Certificate System Certificate Manager:

```
service pki-ca start
```

2.2. Tool Locations

All of the tools for Red Hat Certificate System are located in the `/usr/bin` directory. These tools can be run from any location without specifying the tool location.

2.3. Guide Formatting

Certain words are represented in different fonts, styles, and weights. Different character formatting is used to indicate the function or purpose of the phrase being highlighted.

Formatting Style
Monospace font
Monospace with a background
<i>Italicized text</i>
Bolded text

⁴ http://docs.redhat.com/docs/en-US/Red_Hat_Certificate_System/8.1/html/Deploy_and_Install_Guide/index.html

⁵ http://docs.redhat.com/docs/en-US/Red_Hat_Certificate_System/8.1/html/Agents_Guide/index.html

Other formatting styles draw attention to important text.



NOTE

A note provides additional information that can help illustrate the behavior of the system or provide more detail for a specific issue.



IMPORTANT

Important information is necessary, but possibly unexpected, such as a configuration change that will not persist after a reboot.



WARNING

A warning indicates potential data loss, as may happen when tuning hardware for maximum performance.

3. Giving Feedback

If there is any error in this guide or there is any way to improve the documentation, please let us know. Bugs can be filed against the documentation for Red Hat Enterprise Linux through Bugzilla, <http://bugzilla.redhat.com/bugzilla>. Make the bug report as specific as possible, so we can be more effective in correcting any issues:

1. Select the Red Hat Enterprise Linux product.
2. Set the component to **doc-Managing_Smart_Cards**.
3. Set the version number to 6.
4. For errors, give the page number (for the PDF) or URL (for the HTML), and give a succinct description of the problem, such as incorrect procedure or typo.

For enhancements, put in what information needs to be added and why.

5. Give a clear title for the bug. For example, "**Incorrect command example for setup script options**" is better than "**Bad example**".

We appreciate receiving any feedback — requests for new sections, corrections, improvements, enhancements, even new ways of delivering the documentation or new styles of docs. You are welcome to contact Red Hat Content Services directly at docs@redhat.com.

4. Document History

About This Guide

Release for GA of Red Hat Enterprise Linux 6.2.
Added PIV and CAC card to supported smart cards list, per Errata RHEA-2011:11755.

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Updated draft for Red Hat Enterprise Linux 6.1.
Added note on formatting `enable_ocsp=true` so that smart card authentication properly triggers OCSP requests, per Bugzilla 583109 and 590689.
Fixed typos, per Bugzilla 630533, 683705, 695205.
Found or removed references to missing images, per Bugzilla 630523 and 695207.
Updated Kerberos directory paths for new locations in RHEL 6, per Bugzilla 630525, 630526, and 630527.
Added instructions to install meta package 'Smart card support' for smart card configuration, per Bugzilla 693750.
Updated the packages to install to get the required `rlogin` and `rsh` files, per Bugzilla 695544.
Updated the default `esc-prefs.js` file for the Enterprise Security Client, removed references to a separate `xulrunner` installation, updated the Enterprise Security Client menu location, and updated the Enterprise Security Client directory paths, per Bugzilla 630528, 630529, 630530, and 605812.
Updated the browser and mail client configuration procedures for the current versions of Firefox and Thunderbird, per Bugzilla 630531 and 630532.
Removed references to `50-default.perms`, since this file was removed in Red Hat Enterprise Linux 6, per Bugzilla 630524.
Updates to the procedures for enabling Security Officer Mode, per Bugzilla 688402.
Minor edits to the Kerberos and PAM sections after development review for Red Hat Enterprise Linux 6.1.
Added new information for installing Kerberos-related packages, per feedback from QE.

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Ella Deon Lackey d1lackey@redhat.com

Initial draft for Red Hat Enterprise Linux 6.

Introduction to the Enterprise Security Client

The Enterprise Security Client is a tool for Red Hat Certificate System which simplifies managing smart cards. End users can use security tokens (smart cards) to store user certificates used for applications such as single sign-on access and client authentication. End users are issued the tokens containing certificates and keys required for signing, encryption, and other cryptographic functions.

After a token is enrolled, applications such as Mozilla Firefox and Thunderbird can be configured to recognize the token and use it for security operations, like client authentication and S/MIME mail. The Enterprise Security Client provides the following capabilities:

- Supports Global Platform-compliant smart cards.
- Enrolls security tokens so they are recognized by the token management system in Red Hat Certificate System.
- Maintains the security token, such as re-enrolling a token.
- Provides information about the current status of the token or tokens being managed.
- Supports server-side key generation through the Certificate System subsystems so that keys can be archived and recovered on a separate token if a token is lost.

1.1. Red Hat Enterprise Linux, Single Sign-On, and Authentication

Network users frequently have to submit multiple passwords for the various services they use, such as email, web browsing and intranets, and servers on the network. Maintaining multiple passwords, and constantly being prompted to enter them, is a hassle for users and administrators. *Single sign-on* is a configuration which allows administrators to create a single password store so that users can log in once, using a single password, and be authenticated to all network resources.

Red Hat Enterprise Linux 6 supports single sign-on for several resources, including logging into workstations and unlocking screensavers, accessing encrypted web pages using Mozilla Firefox, and sending encrypted email using Mozilla Thunderbird.

Single sign-on is both a convenience to users and another layer of security for the server and the network. Single sign-on hinges on secure and effective authentication. Red Hat Enterprise Linux provides two authentication mechanisms which can be used to enable single sign-on:

- Kerberos-based authentication
- Smart card-based authentication, using the Enterprise Security Client tied into the public-key infrastructure implemented by Red Hat Certificate System

One of the cornerstones of establishing a secure network environment is making sure that access is restricted to people who have the right to access the network. If access is allowed, users can *authenticate* to the system, meaning they can verify their identities.

Many systems use Kerberos to establish a system of short-lived credentials, called *tickets*, which are generated ad hoc at a user request. The user is required to present credentials in the form of a username-password pair that identify the user and indicate to the system that the user can be issued a ticket. This ticket can be referenced repeatedly by other services, like websites and email, requiring the user to go through only a single authentication process.

An alternative method of verifying an identity is presenting a certificate. A certificate is an electronic document which identifies the entity which presents it. With smart card-based authentication, these certificates are stored on a small hardware device called a smart card or token. When a user inserts a smart card, the smart card presents the certificates to the system and identifies the user so the user can be authenticated.

Single sign-on using smart cards goes through three steps:

1. A user inserts a smart card into the card reader. This is detected by the pluggable authentication modules (PAM) on Red Hat Enterprise Linux.
2. The system maps the certificate to the user entry and then compares the presented certificates on the smart card to the certificates stored in the user entry.
3. If the certificate is successfully validated against the key distribution center (KDC), then the user is allowed to log in.

Smart card-based authentication builds on the simple authentication layer established by Kerberos by adding additional identification mechanisms (certificates) and physical access requirements.

1.2. Red Hat Certificate System and the Enterprise Security Client

Red Hat Certificate System creates, manages, renews, and revokes certificates and keys. For managing smart cards, the Certificate System has a token management system to generate keys, create certificate requests, and receive certificates.

Two subsystems — the Token Key Service (TKS) and Token Processing System (TPS) — are used to process token-related operations. The Enterprise Security Client is the interface which allows the smart card and user to access the token management system.

A total of four Certificate System subsystems are involved with managing tokens, two for managing the tokens (TKS and TPS) and two for managing the keys and certificates within the public-key infrastructure (CA and DRM).

- The Token Processing System (TPS) interacts with smart cards to help them generate and store keys and certificates for a specific entity, such as a user or device. Smart card operations go through the TPS and are forwarded to the appropriate subsystem for action, such as the Certificate Authority to generate certificates or the Data Recovery Manager to archive and recover keys.
- The Token Key Service (TKS) generates, or derives, symmetric keys used for communication between the TPS and smart card. Each set of keys generated by the TKS is unique because they are based on the card's unique ID. The keys are formatted on the smart card and are used to encrypt communications, or provide authentication, between the smart card and TPS.
- The Certificate Authority (CA) creates and revokes user certificates stored on the smart card.
- Optionally, the Data Recovery Manager (DRM) archives and recovers keys for the smart card.

Using Pluggable Authentication Modules (PAM)

Pluggable authentication modules are a common framework for authentication and security. Both of Red Hat Enterprise Linux's single sign-on methods — Kerberos and smart cards — depend on underlying PAM configuration.

Understanding and using PAM can be very beneficial for planning and implementing a secure, efficient single sign-on solution.

2.1. About PAM

Programs that grant users access to a system use *authentication* to verify each other's identity (that is, to establish that a user is who they say they are).

Historically, each program had its own way of authenticating users. In Red Hat Enterprise Linux, many programs are configured to use a centralized authentication mechanism called *Pluggable Authentication Modules (PAM)*.

PAM uses a pluggable, modular architecture, which affords the system administrator a great deal of flexibility in setting authentication policies for the system. PAM is a useful system for developers and administrators for several reasons:

- PAM provides a common authentication scheme that can be used with a wide variety of applications.
- PAM provides significant flexibility and control over authentication for both system administrators and application developers.
- PAM provides a single, fully-documented library which allows developers to write programs without having to create their own authentication schemes.

PAM has an extensive documentation set with much more detail about both using PAM and writing modules to extend or integrate PAM with other applications. Almost all of the major modules and configuration files with PAM have their own manpages. Additionally, the `/usr/share/doc/pam-version#` directory contains a *System Administrators' Guide*, a *Module Writers' Manual*, and the *Application Developers' Manual*, as well as a copy of the PAM standard, DCE-RFC 86.0.

The libraries for PAM are available at <http://www.kernel.org/pub/linux/libs/pam/>. This is the primary distribution website for the Linux-PAM project, containing information on various PAM modules, frequently asked questions, and additional PAM documentation.

2.2. PAM Configuration Files

The `/etc/pam.d/` directory contains the PAM configuration files for each PAM-aware application.

2.2.1. PAM Service Files

Each PAM-aware application or *service* has a file in the `/etc/pam.d/` directory. Each file in this directory has the same name as the service to which it controls access.

The PAM-aware program is responsible for defining its service name and installing its own PAM configuration file in the `/etc/pam.d/` directory. For example, the `login` program defines its service name as `login` and installs the `/etc/pam.d/login` PAM configuration file.

2.2.2. PAM Configuration File Format

Each PAM configuration file contains a group of directives that define the module and any controls or arguments with it.

The directives all have a simple syntax that identifies the module purpose (interface) and the configuration settings for the module.

```
module_interface control_flag module_name module_arguments
```

2.2.2.1. PAM Module Interfaces

Four types of PAM module interface are available. Each of these corresponds to a different aspect of the authorization process:

- **auth** — This module interface authenticates use. For example, it requests and verifies the validity of a password. Modules with this interface can also set credentials, such as group memberships or Kerberos tickets.
- **account** — This module interface verifies that access is allowed. For example, it checks if a user account has expired or if a user is allowed to log in at a particular time of day.
- **password** — This module interface is used for changing user passwords.
- **session** — This module interface configures and manages user sessions. Modules with this interface can also perform additional tasks that are needed to allow access, like mounting a user's home directory and making the user's mailbox available.



NOTE

An individual module can provide any or all module interfaces. For instance, **pam_unix.so** provides all four module interfaces.

In a PAM configuration file, the module interface is the first field defined. For example:

```
auth required pam_unix.so
```

This instructs PAM to use the **pam_unix.so** module's **auth** interface.

Module interface directives can be *stacked*, or placed upon one another, so that multiple modules are used together for one purpose. If a module's control flag uses the **sufficient** or **requisite** value, then the order in which the modules are listed is important to the authentication process.

Stacking makes it easy for an administrator to require specific conditions to exist before allowing the user to authenticate. For example, the **reboot** command normally uses several stacked modules, as seen in its PAM configuration file:

```
[root@MyServer ~]# cat /etc/pam.d/reboot
##PAM-1.0
auth sufficient pam_rootok.so
auth required pam_console.so
#auth include system-auth
```

```
account required pam_permit.so
```

- The first line is a comment and is not processed.
- **auth sufficient pam_rootok.so** — This line uses the **pam_rootok.so** module to check whether the current user is root, by verifying that their UID is 0. If this test succeeds, no other modules are consulted and the command is executed. If this test fails, the next module is consulted.
- **auth required pam_console.so** — This line uses the **pam_console.so** module to attempt to authenticate the user. If this user is already logged in at the console, **pam_console.so** checks whether there is a file in the **/etc/security/console.apps/** directory with the same name as the service name (reboot). If such a file exists, authentication succeeds and control is passed to the next module.
- **#auth include system-auth** — This line is commented and is not processed.
- **account required pam_permit.so** — This line uses the **pam_permit.so** module to allow the root user or anyone logged in at the console to reboot the system.

2.2.2.2. PAM Control Flags

All PAM modules generate a success or failure result when called. Control flags tell PAM what do with the result. Modules can be stacked in a particular order, and the control flags determine how important the success or failure of a particular module is to the overall goal of authenticating the user to the service.

There are several simple flags, which use only a keyword to set the configuration:

- **required** — The module result must be successful for authentication to continue. If the test fails at this point, the user is not notified until the results of all module tests that reference that interface are complete.
- **requisite** — The module result must be successful for authentication to continue. However, if a test fails at this point, the user is notified immediately with a message reflecting the first failed **required** or **requisite** module test.
- **sufficient** — The module result is ignored if it fails. However, if the result of a module flagged **sufficient** is successful *and* no previous modules flagged **required** have failed, then no other results are required and the user is authenticated to the service.
- **optional** — The module result is ignored. A module flagged as **optional** only becomes necessary for successful authentication when no other modules reference the interface.
- **include** — Unlike the other controls, this does not relate to how the module result is handled. This flag pulls in all lines in the configuration file which match the given parameter and appends them as an argument to the module.



IMPORTANT

The order in which **required** modules are called is not critical. Only the **sufficient** and **requisite** control flags cause order to become important.

There are many complex control flags that can be set. These are set in *attribute=value* pairs; a complete list of attributes is available in the **pam.d** manpage.

2.2.2.3. PAM Module Names

The module name provides PAM with the name of the pluggable module containing the specified module interface. The directory name is omitted because the application is linked to the appropriate version of **libpam**, which can locate the correct version of the module.

2.2.2.4. PAM Module Arguments

PAM uses *arguments* to pass information to a pluggable module during authentication for some modules.

For example, the **pam_userdb.so** module uses information stored in a Berkeley DB file to authenticate the user. Berkeley DB is an open source database system embedded in many applications. The module takes a **db** argument so that Berkeley DB knows which database to use for the requested service. For example:

```
auth required pam_userdb.so db=/path/to/BerkeleyDB_file
```

Invalid arguments are generally ignored and do not otherwise affect the success or failure of the PAM module. Some modules, however, may fail on invalid arguments. Most modules report errors to the **/var/log/secure** file.

2.2.3. Sample PAM Configuration Files

Example 2.1, “Simple PAM Configuration” is a sample PAM application configuration file:

Example 2.1. Simple PAM Configuration

```
##PAM-1.0
auth required pam_securetty.so
auth required pam_unix.so nullok
auth required pam_nologin.so
account required pam_unix.so
password required pam_cracklib.so retry=3
password required pam_unix.so shadow nullok use_authtok
session required pam_unix.so
```

- The first line is a comment, indicated by the hash mark (#) at the beginning of the line.
- Lines two through four stack three modules for login authentication.

auth required pam_securetty.so — This module ensures that *if* the user is trying to log in as root, the tty on which the user is logging in is listed in the **/etc/securetty** file, *if* that file exists.

If the tty is not listed in the file, any attempt to log in as root fails with a **Login incorrect** message.

auth required pam_unix.so nullok — This module prompts the user for a password and then checks the password using the information stored in **/etc/passwd** and, if it exists, **/etc/shadow**.

The argument **nullok** instructs the **pam_unix.so** module to allow a blank password.

- **auth required pam_nologin.so** — This is the final authentication step. It checks whether the **/etc/nologin** file exists. If it exists and the user is not root, authentication fails.

**NOTE**

In this example, all three **auth** modules are checked, even if the first **auth** module fails. This prevents the user from knowing at what stage their authentication failed. Such knowledge in the hands of an attacker could allow them to more easily deduce how to crack the system.

- **account required pam_unix.so** — This module performs any necessary account verification. For example, if shadow passwords have been enabled, the account interface of the **pam_unix.so** module checks to see if the account has expired or if the user has not changed the password within the allowed grace period.
- **password required pam_cracklib.so retry=3** — If a password has expired, the password component of the **pam_cracklib.so** module prompts for a new password. It then tests the newly created password to see whether it can easily be determined by a dictionary-based password cracking program.

The argument **retry=3** specifies that if the test fails the first time, the user has two more chances to create a strong password.

- **password required pam_unix.so shadow nullok use_authtok** — This line specifies that if the program changes the user's password, using the **password** interface of the **pam_unix.so** module.
 - The argument **shadow** instructs the module to create shadow passwords when updating a user's password.
 - The argument **nullok** instructs the module to allow the user to change their password *from* a blank password, otherwise a null password is treated as an account lock.
 - The final argument on this line, **use_authtok**, provides a good example of the importance of order when stacking PAM modules. This argument instructs the module not to prompt the user for a new password. Instead, it accepts any password that was recorded by a previous password module. In this way, all new passwords must pass the **pam_cracklib.so** test for secure passwords before being accepted.
- **session required pam_unix.so** — The final line instructs the session interface of the **pam_unix.so** module to manage the session. This module logs the user name and the service type to **/var/log/secure** at the beginning and end of each session. This module can be supplemented by stacking it with other session modules for additional functionality.

2.3. Creating PAM Modules

New PAM modules can be created or added at any time for use by PAM-aware applications. PAM-aware programs can immediately use the new module and any methods it defines without being recompiled or otherwise modified. This allows developers and system administrators to mix-and-match, as well as test, authentication methods for different programs without recompiling them.

Documentation on writing modules is included in the **/usr/share/doc/pam-version#** directory.

2.4. PAM and Administrative Credential Caching

A number of graphical administrative tools in Red Hat Enterprise Linux provide users with elevated privileges for up to five minutes using the `pam_timestamp.so` module. It is important to understand how this mechanism works, because a user who walks away from a terminal while `pam_timestamp.so` is in effect leaves the machine open to manipulation by anyone with physical access to the console.

In the PAM timestamp scheme, the graphical administrative application prompts the user for the root password when it is launched. When the user has been authenticated, the `pam_timestamp.so` module creates a timestamp file. By default, this is created in the `/var/run/sudo/` directory. If the timestamp file already exists, graphical administrative programs do not prompt for a password. Instead, the `pam_timestamp.so` module freshens the timestamp file, reserving an extra five minutes of unchallenged administrative access for the user.

You can verify the actual state of the timestamp file by inspecting the file in the `/var/run/sudo/user` directory. For the desktop, the relevant file is `unknown:root`. If it is present and its timestamp is less than five minutes old, the credentials are valid.

The existence of the timestamp file is indicated by an authentication icon, which appears in the notification area of the panel.



Figure 2.1. The Authentication Icon

2.4.1. Removing the Timestamp File

Before abandoning a console where a PAM timestamp is active, it is recommended that the timestamp file be destroyed. To do this from a graphical environment, click the authentication icon on the panel. This causes a dialog box to appear. Click the **Forget Authorization** button to destroy the active timestamp file.

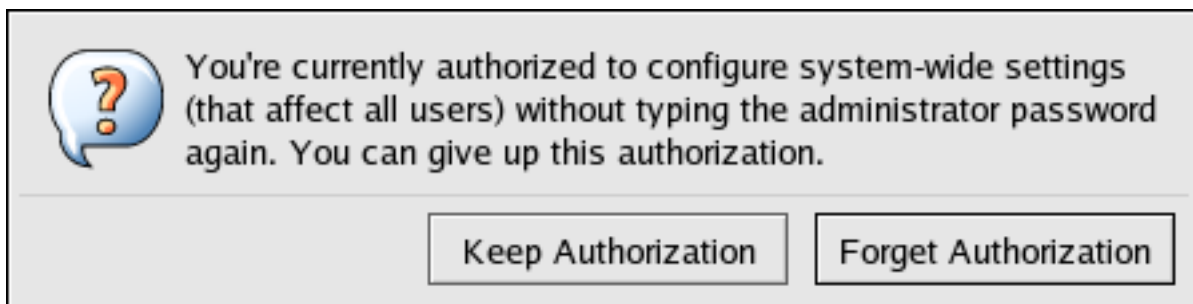


Figure 2.2. Dismiss Authentication Dialog

The PAM timestamp file has some important characteristics:

- If logged in to the system remotely using `ssh`, use the `/sbin/pam_timestamp_check -k root` command to destroy the timestamp file.
- Run the `/sbin/pam_timestamp_check -k root` command from the same terminal window where the privileged application was launched.
- The logged in user who originally invoked the `pam_timestamp.so` module must be the user who runs the `/sbin/pam_timestamp_check -k` command. Do not run this command as root.
- Killing the credentials on the desktop without using the **Forget Authorization** action on the icon can be done with the `/sbin/pam_timestamp_chec` command.

```
/sbin/pam_timestamp_check -k root </dev/null >/dev/null 2>/dev/null
```

Any other method only removes the credentials from the pty where the command was run.

Refer to the **pam_timestamp_check** man page for more information about destroying the timestamp file using **pam_timestamp_check**.

2.4.2. Common pam_timestamp Directives

The **pam_timestamp.so** module accepts several directives, with two used most commonly:

- **timestamp_timeout** — Specifies the period (in seconds) for which the timestamp file is valid. The default value is 300 (five minutes).
- **timestampdir** — Specifies the directory in which the timestamp file is stored. The default value is **/var/run/sudo/**.

Using Kerberos

Maintaining system security and integrity within a network is critical, and it encompasses every user, application, service, and server within the network infrastructure. It requires an understanding of everything that is running on the network and the manner in which these services are used. At the core of maintaining this security is maintaining access to these applications and services and enforcing that access.

Kerberos provides a mechanism that allows both users and machines to identify themselves to network and receive defined, limited access to the areas and services that the administrator configured. Kerberos *authenticates* entities by verifying their identity, and Kerberos also secures this authenticating data so that it cannot be accessed and used or tampered with by an outsider.

3.1. About Kerberos

Kerberos is a network authentication protocol created by MIT, and uses symmetric-key cryptography¹ to authenticate users to network services, which means passwords are never actually sent over the network.

Consequently, when users authenticate to network services using Kerberos, unauthorized users attempting to gather passwords by monitoring network traffic are effectively thwarted.

3.1.1. How Kerberos Works

Most conventional network services use password-based authentication schemes, where a user supplies a password to access a given network server. However, the transmission of authentication information for many services is unencrypted. For such a scheme to be secure, the network has to be inaccessible to outsiders, and all computers and users on the network must be trusted and trustworthy.

With simple, password-based authentication, a network that is connected to the Internet cannot be assumed to be secure. Any attacker who gains access to the network can use a simple packet analyzer, or *packet sniffer*, to intercept usernames and passwords, compromising user accounts and, therefore, the integrity of the entire security infrastructure.

Kerberos eliminates the transmission of unencrypted passwords across the network and removes the potential threat of an attacker sniffing the network.

Rather than authenticating each user to each network service separately as with simple password authentication, Kerberos uses symmetric encryption and a trusted third party (a *key distribution center* or KDC) to authenticate users to a suite of network services. The computers managed by that KDC and any secondary KDCs constitute a *realm*.

When a user authenticates to the KDC, the KDC sends a set of credentials (a *ticket*) specific to that session back to the user's machine, and any Kerberos-aware services look for the ticket on the user's machine rather than requiring the user to authenticate using a password.

As shown in [Figure 3.1, "Kerberos Authentication, in Steps"](#), each user is identified to the KDC with a unique identity, called a *principal*. When a user on a Kerberos-aware network logs into his workstation, his principal is sent to the KDC as part of a request for a *ticket-getting ticket* (or TGT) from the authentication server. This request can be sent by the login program so that it is transparent to the user or can be sent manually by a user through the **kinit** program after the user logs in.

¹ A system where both the client and the server share a common key that is used to encrypt and decrypt network communication.

The KDC then checks for the principal in its database. If the principal is found, the KDC creates a TGT, encrypts it using the user's key, and sends the TGT to that user.

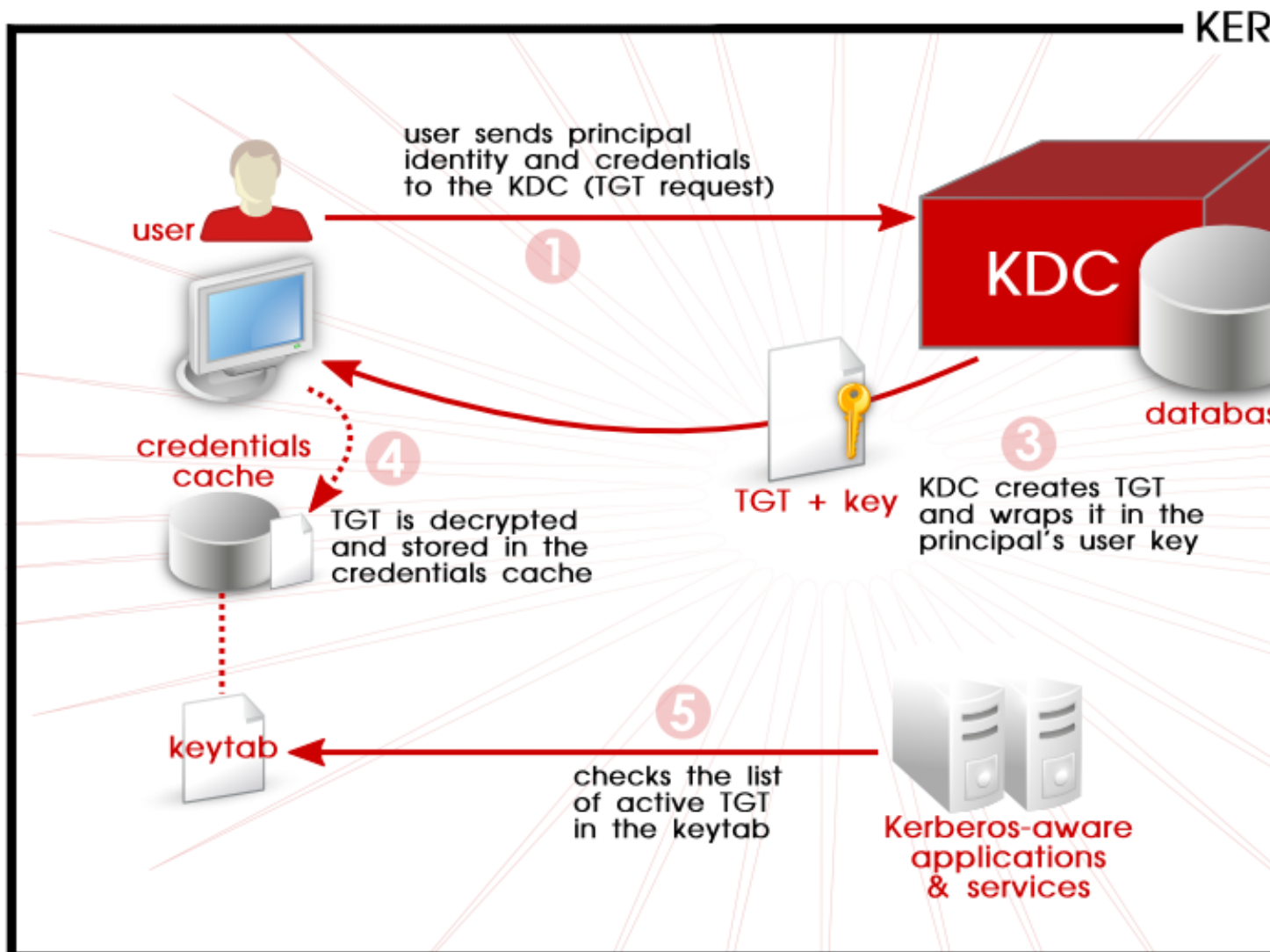


Figure 3.1. Kerberos Authentication, in Steps

The login or **kinit** program on the client then decrypts the TGT using the user's key, which it computes from the user's password. The user's key is used only on the client machine and is *not* transmitted over the network. The ticket (or credentials) sent by the KDC are stored in a local file, the *credentials cache*, which can be checked by Kerberos-aware services.

After authentication, servers can check an unencrypted list of recognized principals and their keys rather than checking **kinit**; this is kept in a *keytab*.

The TGT is set to expire after a certain period of time (usually ten to twenty-four hours) and is stored in the client machine's credentials cache. An expiration time is set so that a compromised TGT is of use to an attacker for only a short period of time. After the TGT has been issued, the user does not have to re-enter their password until the TGT expires or until they log out and log in again.

Whenever the user needs access to a network service, the client software uses the TGT to request a new ticket for that specific service from the ticket-granting server (TGS). The service ticket is then used to authenticate the user to that service transparently.



WARNING

The Kerberos system can be compromised if a user on the network authenticates against a non-Kerberos aware service by transmitting a password in plain text. The use of non-Kerberos aware services (including telnet and FTP) is highly discouraged. Other encrypted protocols, such as SSH or SSL-secured services, is preferred to unencrypted services, but this is still not ideal.

Kerberos relies on being able to resolve machine names and on accurate timestamps to issue and expire tickets. Thus, Kerberos requires both adequate clock synchronization and a working domain name service (DNS) to function correctly.

- Approximate clock synchronization between the machines on the network can be set up using a service such as **ntpd**, which is documented in `/usr/share/doc/ntp-version-number/html/index.html`.
- Both DNS entries and hosts on the network must be properly configured, which is covered in the Kerberos documentation in `/usr/share/doc/krb5-server-version-number`.

3.1.2. Considerations for Deploying Kerberos

Although Kerberos removes a common and severe security threat, it is difficult to implement for a variety of reasons:

- Migrating user passwords from a standard UNIX password database, such as `/etc/passwd` or `/etc/shadow`, to a Kerberos password database can be tedious. There is no automated mechanism to perform this task. This is covered in [question 2.23²](#) in the online Kerberos FAQ for the US Navy.
- Kerberos assumes that each user is trusted but is using an untrusted host on an untrusted network. Its primary goal is to prevent unencrypted passwords from being transmitted across that network. However, if anyone other than the proper user has access to the one host that issues tickets used for authentication — the KDC — the entire Kerberos authentication system are at risk.
- For an application to use Kerberos, its source must be modified to make the appropriate calls into the Kerberos libraries. Applications modified in this way are considered to be *Kerberos-aware*, or *kerberized*. For some applications, this can be quite problematic due to the size of the application or its design. For other incompatible applications, changes must be made to the way in which the server and client communicate. Again, this can require extensive programming. Closed-source applications that do not have Kerberos support by default are often the most problematic.
- Kerberos is an all-or-nothing solution. If Kerberos is used on the network, any unencrypted passwords transferred to a non-Kerberos aware service are at risk. Thus, the network gains no benefit from the use of Kerberos. To secure a network with Kerberos, one must either use Kerberos-aware versions of *all* client/server applications that transmit passwords unencrypted, or not use that client/server application at all.

3.1.3. Additional Resources for Kerberos

Kerberos can be a complex service to implement, with a lot of flexibility in how it is deployed.

[Table 3.1, “External Kerberos Documentation”](#) and [Table 3.2, “Important Kerberos Manpages”](#) list of a few of the most important or most useful sources for more information on using Kerberos.

Table 3.1. External Kerberos Documentation

Documentation	Location
Kerberos V5 Installation Guide (in both PostScript and HTML)	<i>/usr/share/doc/krb5-server-version-number</i>
Kerberos V5 System Administrator's Guide (in both PostScript and HTML)	<i>/usr/share/doc/krb5-server-version-number</i>
Kerberos V5 UNIX User's Guide (in both PostScript and HTML)	<i>/usr/share/doc/krb5-workstation-version-number</i>
"Kerberos: The Network Authentication Protocol" webpage from MIT	http://web.mit.edu/kerberos/www/
The Kerberos Frequently Asked Questions (FAQ)	http://www.cmf.nrl.navy.mil/CCS/people/kenh/kerberos-faq.html
<i>Kerberos: An Authentication Service for Open Network Systems</i> by Jennifer G. Steiner, Clifford Neuman, and Jeffrey I. Schille, the original paper describing Kerberos. In PostScript format.	ftp://athena-dist.mit.edu/pub/kerberos/doc/usenix.PS
<i>Designing an Authentication System: a Dialogue in Four Scenes</i> , originally by Bill Bryant in 1988, modified by Theodore Ts'o in 1997. This document is a conversation between two developers who are thinking through the creation of a Kerberos-style authentication system. The conversational style of the discussion makes this a good starting place for people who are completely unfamiliar with Kerberos.	http://web.mit.edu/kerberos/www/dialogue.html
A how-to article for kerberizing a network.	http://www.ornl.gov/~jar/HowToKerb.html
<i>Kerberos Network Design Manual</i> is a thorough overview of the Kerberos system.	http://www.networkcomputing.com/netdesign/kerb1.html

Any of the manpage files can be opened by running `man command_name`.

Table 3.2. Important Kerberos Manpages

Manpage	Description
Client Applications	
kerberos	An introduction to the Kerberos system which describes how credentials work and provides recommendations for obtaining and destroying Kerberos tickets. The bottom of the man page references a number of related man pages.
kinit	Describes how to use this command to obtain and cache a ticket-granting ticket.
kdestroy	Describes how to use this command to destroy Kerberos credentials.
klist	Describes how to use this command to list cached Kerberos credentials.
Administrative Applications	
kadmin	Describes how to use this command to administer the Kerberos V5 database.

Manpage	Description
kdb5_util	Describes how to use this command to create and perform low-level administrative functions on the Kerberos V5 database.
Server Applications	
krb5kdc	Describes available command line options for the Kerberos V5 KDC.
kadmind	Describes available command line options for the Kerberos V5 administration server.
Configuration Files	
krb5.conf	Describes the format and options available within the configuration file for the Kerberos V5 library.
kdc.conf	Describes the format and options available within the configuration file for the Kerberos V5 AS and KDC.

3.2. Installing Kerberos

Kerberos packages may be installed by default, but make sure that the appropriate packages are installed for the Kerberos server or client being configured.

To install packages for a Kerberos server:

```
# yum install krb5-server krb5-libs krb5-auth-dialog
```

To install packages for a Kerberos client:

```
# yum install krb5-workstation krb5-libs krb5-auth-dialog
```

If the Red Hat Enterprise Linux system will use Kerberos as part of single sign-on with smart cards, then also install the required PKI/OpenSSL package:

```
# yum install krb5-pkinit-openssl
```

3.3. Configuring a Kerberos 5 Server

When setting up Kerberos, install the master KDC first and then install any necessary secondary servers after the master is set up.

3.3.1. Configuring the Master KDC Server

1. Ensure that time synchronization and DNS are functioning correctly on all client and server machines before configuring Kerberos.

Pay particular attention to time synchronization between the Kerberos server and its clients. If the time difference between the server and client is greater than the configured limit (five minutes by default), Kerberos clients cannot authenticate to the server. This time synchronization is necessary to prevent an attacker from using an old Kerberos ticket to masquerade as a valid user.

The NTP documentation is located at `/usr/share/doc/ntp-version-number/html/index.html` and online at <http://www.ntp.org>.

2. Install the **krb5-libs**, **krb5-server**, and **krb5-workstation** packages on the dedicated machine which runs the KDC. This machine needs to be very secure — if possible, it should not run any services other than the KDC.
3. Edit the **/etc/krb5.conf** and **/var/kerberos/krb5kdc/kdc.conf** configuration files to reflect the realm name and domain-to-realm mappings. A simple realm can be constructed by replacing instances of *EXAMPLE.COM* and *example.com* with the correct domain name — being certain to keep uppercase and lowercase names in the correct format — and by changing the KDC from *kerberos.example.com* to the name of the Kerberos server. By convention, all realm names are uppercase and all DNS hostnames and domain names are lowercase. The man pages of these configuration files have full details about the file formats.
4. Create the database using the **kdb5_util** utility.

```
/usr/sbin/kdb5_util create -s
```

The **create** command creates the database that stores keys for the Kerberos realm. The **-s** argument creates a *stash* file in which the master server key is stored. If no stash file is present from which to read the key, the Kerberos server (**krb5kdc**) prompts the user for the master server password (which can be used to regenerate the key) every time it starts.

5. Edit the **/var/kerberos/krb5kdc/kadm5.ac1** file. This file is used by **kadmin** to determine which principals have administrative access to the Kerberos database and their level of access. Most organizations can be accommodated by a single line:

```
*/admin@EXAMPLE.COM *
```

Most users are represented in the database by a single principal (with a *NULL*, or empty, instance, such as *joe@EXAMPLE.COM*). In this configuration, users with a second principal with an instance of *admin* (for example, *joe/admin@EXAMPLE.COM*) are able to exert full administrative control over the realm's Kerberos database.

After **kadmin** has been started on the server, any user can access its services by running **kadmin** on any of the clients or servers in the realm. However, only users listed in the **kadm5.ac1** file can modify the database in any way, except for changing their own passwords.



NOTE

The **kadmin** utility communicates with the **kadmin** server over the network, and uses Kerberos to handle authentication. Consequently, the first principal must already exist before connecting to the server over the network to administer it. Create the first principal with the **kadmin.local** command, which is specifically designed to be used on the same host as the KDC and does not use Kerberos for authentication.

6. Create the first principal using **kadmin.local** at the KDC terminal:

```
/usr/sbin/kadmin.local -q "addprinc username/admin"
```

7. Start Kerberos using the following commands:

```
/sbin/service krb5kdc start
/sbin/service kadmind start
```

8. Add principals for the users using the **addprinc** command within **kadmin**. **kadmin** and **kadmin.local** are command line interfaces to the KDC. As such, many commands — such as **addprinc** — are available after launching the **kadmin** program. Refer to the **kadmin** man page for more information.
9. Verify that the KDC is issuing tickets. First, run **kinit** to obtain a ticket and store it in a credential cache file. Next, use **klist** to view the list of credentials in the cache and use **kdestroy** to destroy the cache and the credentials it contains.



NOTE

By default, **kinit** attempts to authenticate using the same system login username (not the Kerberos server). If that username does not correspond to a principal in the Kerberos database, **kinit** issues an error message. If that happens, supply **kinit** with the name of the correct principal as an argument on the command line:

```
kinit principal
```

3.3.2. Setting up Secondary KDCs

When there are multiple KDCs for a given realm, one KDC (the *master KDC*) keeps a writable copy of the realm database and runs **kadmind**. The master KDC is also the realm's *admin server*. Additional secondary KDCs keep read-only copies of the database and run **kpropd**.

The master-slave propagation procedure entails the master KDC dumping its database to a temporary dump file and then transmitting that file to each of its slaves, which then overwrite their previously-received read-only copies of the database with the contents of the dump file.

To set up a secondary KDC:

1. Copy the master KDC's **krb5.conf** and **kdc.conf** files to the secondary KDC.
2. Start **kadmin.local** from a root shell on the master KDC.
 - a. Use the **kadmin.local add_principal** command to create a new entry for the master KDC's *host* service.
 - b. Use the **kadmin.local ktadd** command to set a random key for the service and store the random key in the master's default keytab file.

**NOTE**

This key is used by the **kprop** command to authenticate to the secondary servers. You will only need to do this once, regardless of how many secondary KDC servers you install.

```
# kadmin.local -r EXAMPLE.COM
Authenticating as principal root/admin@EXAMPLE.COM with password.
kadmin: add_principal -randkey host/masterkdc.example.com
Principal "host/masterkdc.example.com@EXAMPLE.COM" created.
kadmin: ktadd host/masterkdc.example.com
Entry for principal host/masterkdc.example.com with kvno 3, encryption type Triple
DES cbc mode with HMAC/sha1 added to keytab WRFILE:/etc/krb5.keytab.
Entry for principal host/masterkdc.example.com with kvno 3, encryption type ArcFour
with HMAC/md5 added to keytab WRFILE:/etc/krb5.keytab.
Entry for principal host/masterkdc.example.com with kvno 3, encryption type DES with
HMAC/sha1 added to keytab WRFILE:/etc/krb5.keytab.
Entry for principal host/masterkdc.example.com with kvno 3, encryption type DES cbc
mode with RSA-MD5 added to keytab WRFILE:/etc/krb5.keytab.
kadmin: quit
```

3. Start **kadmin** from a root shell on the secondary KDC.
 - a. Use the **kadmin.local add_principal** command to create a new entry for the secondary KDC's *host* service.
 - b. Use the **kadmin.local ktadd** command to set a random key for the service and store the random key in the secondary KDC server's default keytab file. This key is used by the **kpropd** service when authenticating clients.

```
# kadmin -p jsmith/admin@EXAMPLE.COM -r EXAMPLE.COM
Authenticating as principal jsmith/admin@EXAMPLE.COM with password.
Password for jsmith/admin@EXAMPLE.COM:
kadmin: add_principal -randkey host/slavekdc.example.com
Principal "host/slavekdc.example.com@EXAMPLE.COM" created.
kadmin: ktadd host/slavekdc.example.com@EXAMPLE.COM
Entry for principal host/slavekdc.example.com with kvno 3, encryption type Triple DES
cbc mode with HMAC/sha1 added to keytab WRFILE:/etc/krb5.keytab.
Entry for principal host/slavekdc.example.com with kvno 3, encryption type ArcFour
with HMAC/md5 added to keytab WRFILE:/etc/krb5.keytab.
Entry for principal host/slavekdc.example.com with kvno 3, encryption type DES with
HMAC/sha1 added to keytab WRFILE:/etc/krb5.keytab.
Entry for principal host/slavekdc.example.com with kvno 3, encryption type DES cbc
mode with RSA-MD5 added to keytab WRFILE:/etc/krb5.keytab.
kadmin: quit
```

4. With its service key, the secondary KDC could authenticate any client which would connect to it. Obviously, not all potential clients should be allowed to provide the **kprop** service with a new realm database. To restrict access, the **kprop** service on the secondary KDC will only accept updates from clients whose principal names are listed in **/var/kerberos/krb5kdc/kpropd.ac1**.

Add the master KDC's host service's name to that file.

```
# echo host/masterkdc.example.com@EXAMPLE.COM > /var/kerberos/krb5kdc/kpropd.ac1
```

5. Once the secondary KDC has obtained a copy of the database, it will also need the master key which was used to encrypt it. If the KDC database's master key is stored in a stash file on the master KDC (typically named `/var/kerberos/krb5kdc/.k5.REALM`), either copy it to the secondary KDC using any available secure method, or create a dummy database and identical stash file on the secondary KDC by running `kdb5_util create -s` and supplying the same password. The dummy database will be overwritten by the first successful database propagation.
6. Ensure that the secondary KDC's firewall allows the master KDC to contact it using TCP on port 754 (`krb5_prop`), and start the `kprop` service.
7. Double-check that the `kadmin` service is *disabled*.
8. Perform a manual database propagation test by dumping the realm database on the master KDC to the default data file which the `kprop` command will read (`/var/kerberos/krb5kdc/slave_datatrans`).

```
# /usr/sbin/kdb5_util dump /var/kerberos/krb5kdc/slave_datatrans
```

9. Use the `kprop` command to transmit its contents to the secondary KDC.

```
# kprop slavekdc.example.com
```

10. Using `kinit`, verify that the client system is able to correctly obtain the initial credentials from the KDC. The `/etc/krb5.conf` for the client should list only the secondary KDC in its list of KDCs.
11. Create a script which dumps the realm database and runs the `kprop` command to transmit the database to each secondary KDC in turn, and configure the `cron` service to run the script periodically.

3.4. Configuring a Kerberos 5 Client

All that is required to set up a Kerberos 5 client is to install the client packages and provide each client with a valid `krb5.conf` configuration file. While `ssh` and `slogin` are the preferred methods of remotely logging in to client systems, Kerberized versions of `rsh` and `rlogin` are still available, with additional configuration changes.

1. Be sure that time synchronization is in place between the Kerberos client and the KDC and that DNS is working properly on the Kerberos client.
2. Install the `krb5-libs` and `krb5-workstation` packages on all of the client machines.
3. Supply a valid `/etc/krb5.conf` file for each client (usually this can be the same `krb5.conf` file used by the KDC).
4. To use kerberized `rsh` and `rlogin` services, install the `rsh` package.
5. Before a workstation can use Kerberos to authenticate users who connect using `ssh`, `rsh`, or `rlogin`, it must have its own host principal in the Kerberos database. The `sshd`, `kshd`, and `klogind` server programs all need access to the keys for the host service's principal.

- a. Using **kadmin**, add a host principal for the workstation on the KDC. The instance in this case is the hostname of the workstation. Use the **-randkey** option for the **kadmin's addprinc** command to create the principal and assign it a random key:

```
addprinc -randkey host/server.example.com
```

- b. The keys can be extracted for the workstation by running **kadmin** on the workstation itself and using the **ktadd** command.

```
ktadd -k /etc/krb5.keytab host/server.example.com
```

6. To use other kerberized network services, install the *krb5-server* package and start the services. The kerberized services are listed in [Table 3.3, "Common Kerberized Services"](#).

Table 3.3. Common Kerberized Services

Service Name	Usage Information
ssh	OpenSSH uses GSS-API to authenticate users to servers if the client's and server's configuration both have GSSAPIAuthentication enabled. If the client also has GSSAPIDelegateCredentials enabled, the user's credentials are made available on the remote system.
rsh and rlogin	Enable klogin , eklogin , and kshell .
Telnet	Enable krb5-telnet .
FTP	Create and extract a key for the principal with a root of ftp . Be certain to set the instance to the fully qualified hostname of the FTP server, then enable gssftp .
IMAP	The cyrus-imap package uses Kerberos 5 if it also has the cyrus-sasl-gssapi package installed. The cyrus-sasl-gssapi package contains the Cyrus SASL plugins which support GSS-API authentication. Cyrus IMAP functions properly with Kerberos as long as the cyrus user is able to find the proper key in /etc/krb5.keytab , and the root for the principal is set to imap (created with kadmin). An alternative to cyrus-imap can be found in the dovecot package, which is also included in Red Hat Enterprise Linux. This package contains an IMAP server but does not, to date, support GSS-API and Kerberos.
CVS	gserver uses a principal with a root of cvs and is otherwise identical to the CVS pserver .

3.5. Domain-to-Realm Mapping

When a client attempts to access a service running on a particular server, it knows the name of the service (*host*) and the name of the server (*foo.example.com*), but because more than one realm can be deployed on your network, it must guess at the name of the realm in which the service resides.

By default, the name of the realm is taken to be the DNS domain name of the server in all capital letters.

```
foo.example.org → EXAMPLE.ORG
foo.example.com → EXAMPLE.COM
foo.hq.example.com → HQ.EXAMPLE.COM
```

In some configurations, this will be sufficient, but in others, the realm name which is derived will be the name of a non-existent realm. In these cases, the mapping from the server's DNS domain name to the name of its realm must be specified in the *domain_realm* section of the client system's **krb5.conf**. For example:

```
[domain_realm]
.example.com = EXAMPLE.COM
example.com = EXAMPLE.COM
```

The configuration specifies two mappings. The first mapping specifies that any system in the example.com DNS domain belongs to the *EXAMPLE.COM* realm. The second specifies that a system with the exact name example.com is also in the realm. The distinction between a domain and a specific host is marked by the presence or lack of an initial period character. The mapping can also be stored directly in DNS.

3.6. Setting up Cross Realm Authentication

Allowing clients (typically users) of one realm to use Kerberos to authenticate to services (typically server processes running on a particular server system) which belong to another realm requires *cross-realm authentication*.

3.6.1. Setting up Basic Trust Relationships

For the simplest case, for a client of realm **A.EXAMPLE.COM** to access a service in the **B.EXAMPLE.COM** realm, both realms must share a key for a principal named **krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM**, and both keys must have the same key version number associated with them.

To accomplish this, select a very strong password or passphrase, and create an entry for the principal in both realms using **kadmin**.

```
# kadmin -r A.EXAMPLE.COM
kadmin: add_principal krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM
Enter password for principal "krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM":
Re-enter password for principal "krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM":
Principal "krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM" created.
quit

# kadmin -r B.EXAMPLE.COM
kadmin: add_principal krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM
Enter password for principal "krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM":
Re-enter password for principal "krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM":
Principal "krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM" created.
quit
```

Use the `get_principal` command to verify that both entries have matching key version numbers (`kvno` values) and encryption types.



IMPORTANT

A common, but incorrect, situation is for administrators to try to use the `add_principal` command's `-randkey` option to assign a random key instead of a password, dump the new entry from the database of the first realm, and import it into the second. This will not work unless the master keys for the realm databases are identical, as the keys contained in a database dump are themselves encrypted using the master key.

Clients in the `A.EXAMPLE.COM` realm are now able to authenticate to services in the `B.EXAMPLE.COM` realm. Put another way, the `B.EXAMPLE.COM` realm now *trusts* the `A.EXAMPLE.COM` realm.

This brings us to an important point: **cross-realm trust is unidirectional** by default. The KDC for the `B.EXAMPLE.COM` realm can trust clients from the `A.EXAMPLE.COM` to authenticate to services in the `B.EXAMPLE.COM` realm. However, this trust is not automatically reciprocated so that the `B.EXAMPLE.COM` realm are trusted to authenticate to services in the `A.EXAMPLE.COM` realm. To establish trust in the other direction, both realms would need to share keys for the `krbtgt/A.EXAMPLE.COM@B.EXAMPLE.COM` service — an entry with a reverse mapping from the previous example.

3.6.2. Setting up Complex Trust Relationships

If direct trust relationships were the only method for providing trust between realms, networks which contain multiple realms would be very difficult to set up. Luckily, cross-realm trust is transitive. If clients from `A.EXAMPLE.COM` can authenticate to services in `B.EXAMPLE.COM`, and clients from `B.EXAMPLE.COM` can authenticate to services in `C.EXAMPLE.COM`, then clients in `A.EXAMPLE.COM` can also authenticate to services in `C.EXAMPLE.COM`, *even if C.EXAMPLE.COM does not directly trust A.EXAMPLE.COM*. This means that, on a network with multiple realms which all need to trust each other, making good choices about which trust relationships to set up can greatly reduce the amount of effort required.

The client's system must be configured so that it can properly deduce the realm to which a particular service belongs, and it must be able to determine how to obtain credentials for services in that realm.

Taking first things first, the principal name for a service provided from a specific server system in a given realm typically looks like this:

```
service/server.example.com@EXAMPLE.COM
```

`service` is typically either the name of the protocol in use (other common values include LDAP, IMAP, CVS, and HTTP) or `host`. `server.example.com` is the fully-qualified domain name of the system which runs the service. `EXAMPLE.COM` is the name of the realm.

To deduce the realm to which the service belongs, clients will most often consult DNS or the `domain_realm` section of `/etc/krb5.conf` to map either a hostname (`server.example.com`) or a DNS domain name (`.example.com`) to the name of a realm (`EXAMPLE.COM`).

After determining the realm to which a service belongs, a client then has to determine the set of realms which it needs to contact, and in which order it must contact them, to obtain credentials for use in authenticating to the service.

This can be done in one of two ways. The simplest is to use a shared hierarchy to name realms. The second uses explicit configuration in the `krb5.conf` file.

3.6.2.1. Configuring a Shared Hierarchy of Names

The default method, which requires no explicit configuration, is to give the realms names within a shared hierarchy. For an example, assume realms named `A.EXAMPLE.COM`, `B.EXAMPLE.COM`, and `EXAMPLE.COM`. When a client in the `A.EXAMPLE.COM` realm attempts to authenticate to a service in `B.EXAMPLE.COM`, it will, by default, first attempt to get credentials for the `EXAMPLE.COM` realm, and then to use those credentials to obtain credentials for use in the `B.EXAMPLE.COM` realm.

The client in this scenario treats the realm name as one might treat a DNS name. It repeatedly strips off the components of its own realm's name to generate the names of realms which are "above" it in the hierarchy until it reaches a point which is also "above" the service's realm. At that point it begins prepending components of the service's realm name until it reaches the service's realm. Each realm which is involved in the process is another "hop".

For example, using credentials in `A.EXAMPLE.COM`, authenticating to a service in `B.EXAMPLE.COM` has three hops: `A.EXAMPLE.COM` → `EXAMPLE.COM` → `B.EXAMPLE.COM` .

- `A.EXAMPLE.COM` and `EXAMPLE.COM` share a key for `krbtgt/EXAMPLE.COM@A.EXAMPLE.COM`
- `EXAMPLE.COM` and `B.EXAMPLE.COM` share a key for `krbtgt/B.EXAMPLE.COM@EXAMPLE.COM`

Another example, using credentials in `SITE1.SALES.EXAMPLE.COM`, authenticating to a service in `EVERYWHERE.EXAMPLE.COM` can have several series of hops:

```
SITE1.SALES.EXAMPLE.COM →
SALES.EXAMPLE.COM →
EXAMPLE.COM →
EVERYWHERE.EXAMPLE.COM
```

- `SITE1.SALES.EXAMPLE.COM` and `SALES.EXAMPLE.COM` share a key for `krbtgt/SALES.EXAMPLE.COM@SITE1.SALES.EXAMPLE.COM`
- `SALES.EXAMPLE.COM` and `EXAMPLE.COM` share a key for `krbtgt/EXAMPLE.COM@SALES.EXAMPLE.COM`
- `EXAMPLE.COM` and `EVERYWHERE.EXAMPLE.COM` share a key for `krbtgt/EVERYWHERE.EXAMPLE.COM@EXAMPLE.COM`

There can even be hops between realm names whose names share no common suffix, such as `DEVEL.EXAMPLE.COM` and `PROD.EXAMPLE.ORG`.

```
DEVEL.EXAMPLE.COM →
EXAMPLE.COM →
COM →
ORG →
EXAMPLE.ORG →
PROD.EXAMPLE.ORG
```

- `DEVEL.EXAMPLE.COM` and `EXAMPLE.COM` share a key for `krbtgt/EXAMPLE.COM@DEVEL.EXAMPLE.COM`
- `EXAMPLE.COM` and `COM` share a key for `krbtgt/COM@EXAMPLE.COM`
- `COM` and `ORG` share a key for `krbtgt/ORG@COM`
- `ORG` and `EXAMPLE.ORG` share a key for `krbtgt/EXAMPLE.ORG@ORG`

- **EXAMPLE.ORG** and **PROD.EXAMPLE.ORG** share a key for **krbtgt/PROD.EXAMPLE.ORG@EXAMPLE.ORG**

3.6.2.2. Configuring Paths in `krb5.conf`

The more complicated, but also more flexible, method involves configuring the **capaths** section of `/etc/krb5.conf`, so that clients which have credentials for one realm will be able to look up which realm is next in the chain which will eventually lead to the being able to authenticate to servers.

The format of the **capaths** section is relatively straightforward: each entry in the section is named after a realm in which a client might exist. Inside of that subsection, the set of intermediate realms from which the client must obtain credentials is listed as values of the key which corresponds to the realm in which a service might reside. If there are no intermediate realms, the value "." is used.

For example:

```
[capaths]
A.EXAMPLE.COM = {
B.EXAMPLE.COM = .
C.EXAMPLE.COM = B.EXAMPLE.COM
D.EXAMPLE.COM = B.EXAMPLE.COM
D.EXAMPLE.COM = C.EXAMPLE.COM
}
```

Clients in the **A.EXAMPLE.COM** realm can obtain cross-realm credentials for **B.EXAMPLE.COM** directly from the **A.EXAMPLE.COM** KDC.

If those clients wish to contact a service in the **C.EXAMPLE.COM** realm, they will first need to obtain necessary credentials from the **B.EXAMPLE.COM** realm (this requires that **krbtgt/B.EXAMPLE.COM@A.EXAMPLE.COM** exist), and then use **those** credentials to obtain credentials for use in the **C.EXAMPLE.COM** realm (using **krbtgt/C.EXAMPLE.COM@B.EXAMPLE.COM**).

If those clients wish to contact a service in the **D.EXAMPLE.COM** realm, they will first need to obtain necessary credentials from the **B.EXAMPLE.COM** realm, and then credentials from the **C.EXAMPLE.COM** realm, before finally obtaining credentials for use with the **D.EXAMPLE.COM** realm.



NOTE

Without a `capath` entry indicating otherwise, Kerberos assumes that cross-realm trust relationships form a hierarchy.

Clients in the **A.EXAMPLE.COM** realm can obtain cross-realm credentials from **B.EXAMPLE.COM** realm directly. Without the "." indicating this, the client would instead attempt to use a hierarchical path, in this case:

```
A.EXAMPLE.COM → EXAMPLE.COM → B.EXAMPLE.COM
```

Setting up Enterprise Security Client

The following sections contain basic instructions on using the Enterprise Security Client for token enrollment, formatting, and password reset operations.

4.1. Installing the Smart Card Package Group

Packages used to manage smart cards, such as **esc**, should already be installed on the Red Hat Enterprise Linux system. If the packages are not installed or need to be updated, all of the smart card-related packages can be pulled in by installing the **Smart card support** package group. For example:

```
yum groupinstall "Smart card support"
```

4.2. Launching the Smart Card Manager UI

There are two aspects to launching the Enterprise Security Client UI. The Enterprise Security Client process must be started and it runs silently, waiting to detect any inserted smart card or token. The Smart Card Manager UI for the Enterprise Security Client opens automatically when smart cards are inserted or can be opened manually.

Initiate the Enterprise Security Client daemon (**escd**) from the command line:

```
esc
```

This daemon listens silently for smart cards and opens the GUI as soon as a smart card is inserted.

To open the Smart Card Manager GUI manually, click **Applications**, **System Tools**, and then **Smart Card Manager**.

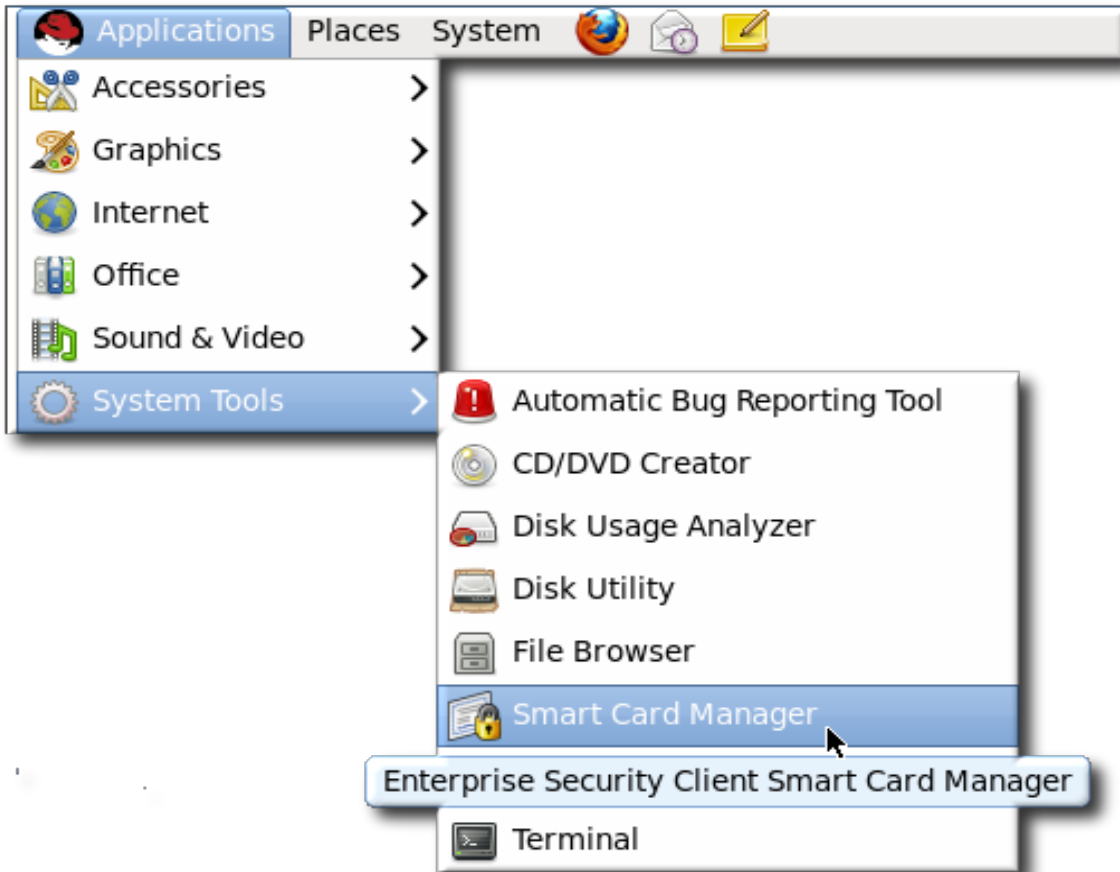


Figure 4.1. Selecting the Smart Card Manager Item in the Menu

4.3. Overview of Enterprise Security Client Configuration

The Enterprise Security Client is an intermediary frontend that provides connections between users (and their tokens), the Token Processing System, and certificate authority. The Enterprise Security Client provides two slightly different interfaces:

- A local interface, based on XUL and JavaScript
- A web-hosted interface which can be used for remote access, based on CGIs, HTML, and JavaScript

The primary Enterprise Security Client user interface, which is accessed from the local server, incorporates Mozilla XULRunner technology. XULRunner is a runtime package which hosts standalone applications based on XUL, an XML markup language with a rich feature set for user interfaces and offers several advantages over HTML for applications:

- A wide UI widget set and greater control over the presentation.
- Local markup to the client machine, so it has a greater privilege level than HTML.
- JavaScript as the scripting language for convenient program logic scripting and the ability to leverage XPCOM technology.

All of the files for the web-hosted interface can be customized and edited to change the behavior or appearance of the Enterprise Security Client, within reason.

The Enterprise Security Client, in conjunction with the Token Processing System, supports different *user profiles* so that different types of users have different token enrollment paths. Both the Enterprise Security Client and TPS also support different *token profiles*, so that the certificate settings can be custom-defined for different types of tokens. Both of these configurations are set in the TPS, and are described in the *Certificate System Administrator's Guide*.

4.3.1. Enterprise Security Client File Locations

This reference shows the different directories and file locations for the different client machines.

On Red Hat Enterprise Linux 32-bit, the Enterprise Security Client is installed by its binary RPM to the default location, `/usr/lib/esc-1.1.0/esc`. On Red Hat Enterprise Linux 64-bit systems, the installation directory is `/usr/lib64/esc-1.1.0/esc`.



NOTE

The Enterprise Security Client uses some specific XUL configuration files, but, overall, the Enterprise Security Client uses the system XULRunner packages on Red Hat Enterprise Linux.

Table 4.1. Enterprise Security Client File and Directory Locations

File or Directory	Purpose
application.ini	XULRunner application configuration file.
components/	XPCOM components.
chrome/	Directory for Chrome components and additional application files for Enterprise Security Client XUL and JavaScript.
defaults/	Enterprise Security Client default preferences.
esc	The script which launches the Enterprise Security Client.

4.3.2. About the Preferences Configuration Files

The Enterprise Security Client is configured similarly to Mozilla applications, using preferences files. The primary configuration file is `esc-prefs.js`, which is installed with Enterprise Security Client. The second one is `prefs.js` in the Mozilla profiles directory, which is created when the Enterprise Security Client is first launched.

The Enterprise Security Client uses the Mozilla configuration preferences for each of the supported platforms. The default configuration file on Red Hat Enterprise Linux 32-bit is in `/usr/lib/esc-1.1.0/defaults/preferences/esc-prefs.js`. On Red Hat Enterprise Linux 64-bit, this is in `/usr/lib64/esc-1.1.0/defaults/preferences/esc-prefs.js`.

The `esc-prefs.js` file specifies the default configuration to use when the Enterprise Security Client is first launched. This includes parameters to connect to the TPS subsystem, set the password prompt, and configure Phone Home information. Each setting is prefaced by the word **pref**, then the parameter and value are enclosed in parentheses. For example:

```
pref(parameter, value);
```

The `esc-prefs.js` file parameters are listed in [Table 4.2, “esc-prefs.js Parameters”](#). The default `esc-prefs.js` file is shown in [Example 4.1, “Default esc-prefs.js File”](#).

Table 4.2. esc-prefs.js Parameters

Parameter	Description	Notes and Defaults
<code>toolkit.defaultChromeURI</code>	Defines the URL for the Enterprise Security Client to use to contact the XUL Chrome page.	("toolkit.defaultChromeURI", "chrome://esc/content/settings.xul")
<code>esc.tps.message.timeout</code>	Sets a timeout period, in seconds, for connecting to the TPS.	("esc.tps.message.timeout", "90");
<code>esc.disable.password.prompt</code>	Enables the password prompt, which means that a password is required to read the certificate information off the smart card. The password prompt is disabled by default, so anyone can use the Enterprise Security Client. However, in security contexts, like when a company uses security officers to manage token operations, then enable the password prompt to restrict access to the Enterprise Security Client.	("esc.disable.password.prompt", "yes");
<code>esc.global.phone.home.url</code>	Sets the URL to use to contact the TPS server. Normally, the Phone Home information is set on the token already through its applet. If a token does not have Phone Home information, meaning it has no way to contact the TPS server, then the Enterprise Security Client checks for a global default Phone Home URL. This setting is only checked if it is explicitly set. This setting also applies to every token formatted through the client, so setting this parameter forces all tokens to point to the same TPS. Only use this parameter if that specific behavior is desired.	("esc.global.phone.home.url", "http://server.example.com:7888/cgi-bin/home/index.cgi");

Parameter	Description	Notes and Defaults
esc.global.alt.nss.db	<p>Points to a directory that contains a common security database that is used by all Enterprise Security Client users on the server.</p> <p>Phone Home URL.</p> <p>This setting is only checked if it is explicitly set. If this is not set, then each user accesses only each individual profile security database, rather than a shared database.</p>	<pre>prefs("esc.global.alt.nss.db", "C:/Documents and Settings/All Users/shared-db");</pre>

Example 4.1. Default esc-prefs.js File

The comments in this file are not included in the example.

```
#pref("toolkit.defaultChromeURI", "chrome://esc/content/settings.xul");
pref("signed.applets.codebase_principal_support",true); for internal use only

pref("capability.principal.codebase.p0.granted", "UniversalXPConnect"); for internal use
only
pref("capability.principal.codebase.p0.id", "file://"); for internal use only

pref("esc.tps.message.timeout","90");

#Do we populate CAPI certs on windows?
pref("esc.windows.do.capi","yes");

#Sample Security Officer Enrollment UI
#pref("esc.security.url","http://test.host.com:7888/cgi-bin/so/enroll.cgi");

#Sample Security Officer Workstation UI
#pref("esc.security.url","https://dhcp-170.sjc.redhat.com:7889/cgi-bin/sow/welcome.cgi");

#Hide the format button or not.
pref("esc.hide.format","no");

#Use this if you absolutely want a global phone home url for all tokens
#Not recommended!
#pref("esc.global.phone.home.url","http://test.host.com:7888/cgi-bin/home/index.cgi");
```

When the Enterprise Security Client is launched, it creates a separate, unique profile directory for each user on the system. These profiles are stored in `~/ .redhat/esc/alphanumeric_string.default/prefs.js` in Red Hat Enterprise Linux 6.



NOTE

When the Enterprise Security Client requires any changes to a user's configuration values, the updated values are written to the user's profile area, not to the default JavaScript file.

Table 4.3, “*prefs.js Parameters*” lists the most relevant parameters for the **prefs.js** file. Editing this file is tricky. The **prefs.js** file is generated and edited dynamically by the Enterprise Security Client, and manual changes to this file are overwritten when the Enterprise Security Client exits.

Table 4.3. *prefs.js Parameters*

Parameter	Description	Notes and Defaults
esc.tps.url	Sets a URL for the Enterprise Security Client to use to connect to the TPS. This is not set by default.	
esc.key.token_ID.tps.url	Sets the hostname and port to use to contact a TPS. If this Phone Home information was not burned into the card at the factory, it can be manually added to the card by adding the TPS URL, an enrollment page URL, the issuer's name, and Phone Home URL.	("esc.key.token_ID.tps.url" = "http://server.example.com:7888/nk_service");
esc.key.token_ID.tps.enrollment-ui.url	Gives the URL to contact the enrollment page for enroll certificates on the token. If this Phone Home information was not burned into the card at the factory, it can be manually added to the card by adding the TPS URL, an enrollment page URL, the issuer's name, and Phone Home URL.	("esc.key.token_ID.tps.enrollment-ui.url" = "http://server.example.com:7888/cgi_bin/esc.cgi?");
esc.key.token_ID.issuer.name	Gives the name of the organization enrolling the token.	("esc.key.token_ID.issuer.name" = "Example Corp");
esc.key.token_ID.phone.home.url	Gives the URL to use to contact the Phone Home functionality for the TPS. The global Phone Home parameter sets a default to use with any token enrollment, if the token does not specify the Phone Home information. By setting this parameter to a specific token ID number, the specified Phone Home parameter applies only to that token.	("esc.key.token_ID.phone.home.url" = "http://server.example.com:7888/cgi-bin/home/index.cgi?");
esc.security.url	Points to the URL to use for security officer mode. If this is pointed to the security officer enrollment form, then	("esc.security.url", "https://server.example.com:7888/cgi-bin/so/enroll.cgi");

Parameter	Description	Notes and Defaults
	the Enterprise Security Client opens the forms to enroll security officer tokens. If this is pointed to the security officer workstation URL, then it opens the workstation to enroll regular users with security officer approval.	

4.3.3. About the XUL and JavaScript Files in the Enterprise Security Client

Smart Card Manager stores the XUL markup and JavaScript functionality in `/usr/lib[64]/esc-1.1.0/chrome/content/esc/`.

The primary Enterprise Security Client XUL files are listed in [Table 4.4, “Main XUL Files”](#).

Table 4.4. Main XUL Files

Filename	Purpose
settings.xul	Contains the code for the Settings page.
esc.xul	Contains the code for the Enrollment page.
config.xul	Contains the code for the configuration UI.

The primary **Smart Card Manager** JavaScript files are listed in the following table.

Table 4.5. Main JavaScript Files

Filename	Purpose
ESC.js	Contains most of the Smart Card Manager JavaScript functionality.
TRAY.js	Contains the tray icon functionality.
AdvancedInfo.js	Contains the code for the Diagnostics feature.
GenericAuth.js	Contains the code for the authentication prompt. This prompt is configurable from the TPS server, which requires dynamic processing by the Smart Card Manager .

4.4. Configuring Phone Home

The *Phone Home* feature in the Enterprise Security Client associates information within each smart card with information that points to distinct TPS servers and Smart Card Manager UI pages. Whenever the Enterprise Security Client accesses a new smart card, it can connect to the TPS instance and retrieve the Phone Home information.

Phone Home retrieves and then caches this information; because the information is cached locally, the TPS subsystem does not have to be contacted each time a formatted smart card is inserted.

The information can be different for every key or token, which means that different TPS servers and enrollment URLs can be configured for different corporate or customer groups. Phone Home makes it possible to configure different TPS servers for different issuers or company units, without having to configure the Enterprise Security Client manually to locate the correct server and URL.



NOTE

In order for the TPS subsystem to utilize the Phone Home feature, Phone Home must be enabled in the TPS configuration file, as follows:

```
op.format.userKey.issuerinfo.enable=true
op.format.userKey.issuerinfo.value=http://server.example.com
```

4.4.1. About Phone Home Profiles

The Enterprise Security Client is based on Mozilla XULRunner. Consequently, each user has a profile similar to the user profiles used by Mozilla Firefox and Thunderbird. The Enterprise Security Client accesses the configuration preferences file. When the Enterprise Security Client caches information for each token, the information is stored in the user's configuration file. The next time the Enterprise Security Client is launched, it retrieves the information from the configuration file instead of contacting the server again.

When a smart card is inserted and Phone Home is launched, the Enterprise Security Client first checks the token for the Phone Home information. If no information is on the token, then the client checks the `esc-prefs.js` file for the `esc.global.phone.home.url` parameter.

If no Phone Home information is stored on the token and there is no global Phone Home parameter, the user is prompted for the Phone Home URL when a smart card is inserted, as shown in [Figure 4.2, "Prompt for Phone Home Information"](#). The other information is supplied and stored when the token is formatted. In this case, the company supplies the specific Phone Home URL for the user. After the user submits the URL, the format process adds the rest of the information to the Phone Home profile. The format process is not any different for the user.

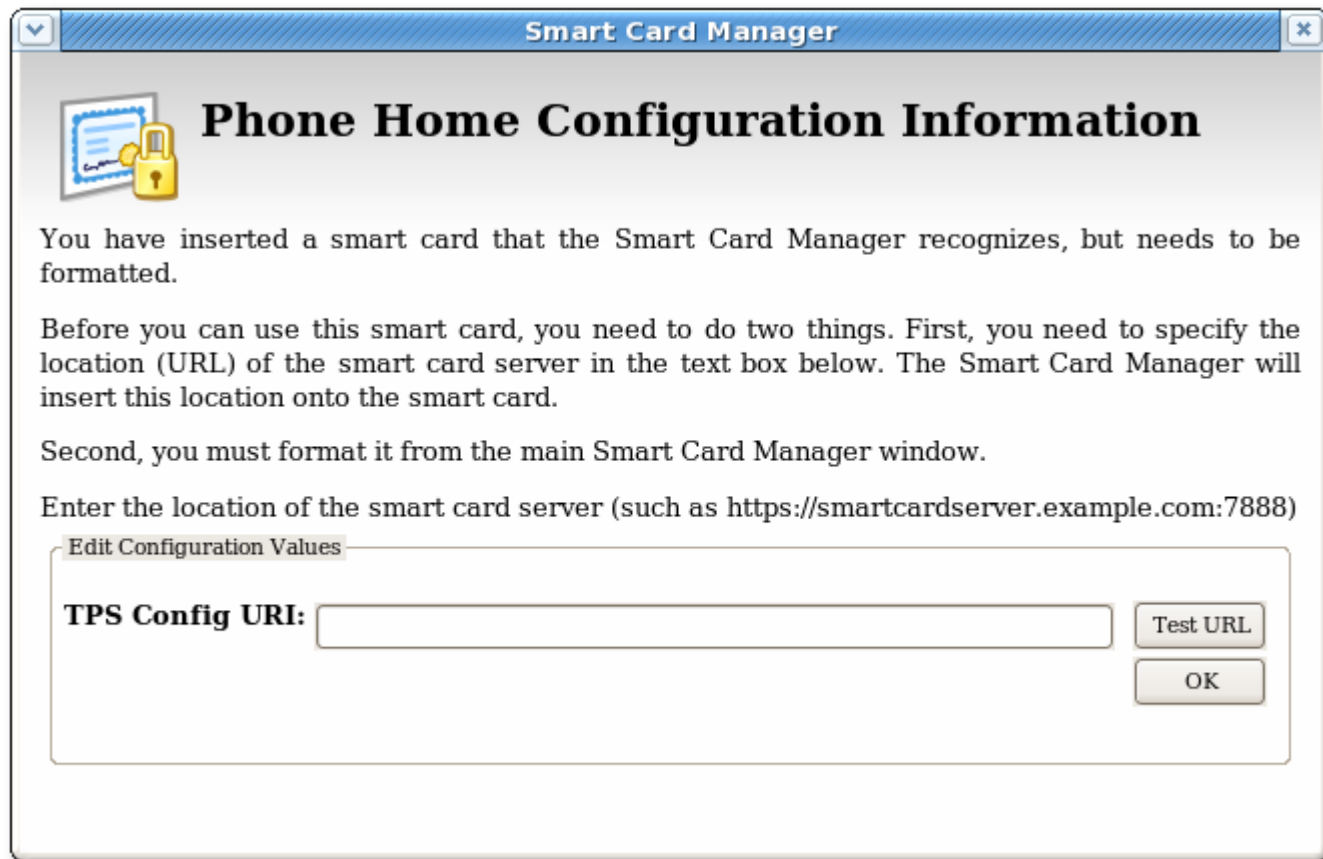


Figure 4.2. Prompt for Phone Home Information

4.4.2. Setting Global Phone Home Information

Phone Home is triggered automatically when a security token is inserted into a machine. The system immediately attempts to read the Phone Home URL from the token and to contact the TPS server. For new tokens or for previously formatted tokens, the Phone Home information may not be available to the card.

The Enterprise Security Client configuration file, **esc-prefs.js**, has a parameter which allows a global Phone Home URL default to be set. This parameter is *esc.global.phone.home.url* and is not in the file by default.

To define the global Phone Home URL:

1. Remove any existing Enterprise Security Client user profile directory. Profile directories are created automatically when a smart card is inserted. By default, the profile directory is `~/.redhat/esc`.
2. Open the **esc-prefs.js** file.

On Red Hat Enterprise Linux 6, the profile directory is `/usr/lib/esc-1.1.0/defaults/preferences`. On 64-bit systems, this is `/usr/lib64/esc-1.1.0/defaults/preferences`.

3. Add the global Phone Home parameter line to the **esc-prefs.js** file. For example:

```
pref("esc.global.phone.home.url", "http://server.example.com:7888/cgi-bin/home/index.cgi");
```

The URL can reference a machine name, a fully-qualified domain name, or an IPv4 or IPv6 address, depending on the DNS and network configuration.

4.4.3. Adding Phone Home Information to a Token Manually

The Phone Home information can be manually put on a token in one of two ways:

- The preferred method is that the information is burned onto the token at the factory. When the tokens are ordered from the manufacturer, the company supplies detailed information on how the tokens should be configured when shipped.
- If tokens are blank, the company IT department can supply the information when formatting small groups of tokens.

The following information is used by the Phone Home feature for each smart card in the `~/ .redhat/esc/alphanumeric_string.default/prefs.js` file:

- The TPS server and port. For example:

```
"esc.key.token_ID.tps.url" = "http://server.example.com:7888/nk_service"
```

- The TPS enrollment interface URL. For example:

```
"esc.key.token_ID.tps.enrollment-ui.url" = "http://server.example.com:7888/cgi_bin/esc.cgi?"
```

- The issuing company name or ID. For example:

```
"esc.key.token_ID.issuer.name" = "Example Corp"
```

- The Phone Home URL. For example:

```
"esc.key.token_ID.phone.home.url" = "http://server.example.com:7888/cgi-bin/home/index.cgi?"
```

- Optionally, a default browser URL to access when an enrolled smart card is inserted.

```
"esc.key.token_ID.EnrolledTokenBrowserURL" = "http://www.test.example.com"
```

More of the parameters used by the `prefs.js` file are listed in [Table 4.3, “prefs.js Parameters”](#).



NOTE

The URLs for these parameters can reference a machine name, a fully-qualified domain name, or an IPv4 or IPv6 address, depending on the DNS and network configuration.

4.4.4. Configuring the TPS to Use Phone Home

The Phone Home feature and the different type of information used by it only work when the TPS has been properly configured to use Phone Home. If the TPS is not configured for Phone Home, then this

feature is ignored. Phone Home is configured in the `index.cgi` in the `/var/lib/pki-tps/cgi-bin/home` directory; this prints the Phone Home information to XML.

Example 4.2, “TPS Phone Home Configuration File” shows an example XML file used by the TPS subsystem to configure the Phone Home feature.

Example 4.2. TPS Phone Home Configuration File

```
<ServiceInfo><IssuerName>Example Corp</IssuerName>
  <Services>
    <Operation>http://server.example.com:7888/nk_service ## TPS server URL
    </Operation>
    <UI>http://server.example.com:7888/cgi_bin/esc.cgi ## Optional
  Enrollment UI
  </UI>
    <EnrolledTokenBrowserURL>http://www.test.url.com ## Optional
  enrolled token url
  </EnrolledTokenBrowserURL>
  </Services>
</ServiceInfo>
```

The TPS configuration URI is the URL of the TPS server which returns the rest of the Phone Home information to the Enterprise Security Client. An example of this URL is `http://server.example.com:7888/cgi-bin/home/index.cgi`; the URL can reference the machine name, fully-qualified domain name, or an IPv4 or IPv6 address, as appropriate. When the TPS configuration URI is accessed, the TPS server is prompted to return all of the Phone Home information to the Enterprise Security Client.

To test the URL of the Smart Card server, enter the address in the **TPS Config URI** field, and click **Test URL**.

If the server is successfully contacted, a message box indicates success. If the test connection fails, an error dialog appears.

4.5. Using Security Officer Mode

The Enterprise Security Client, together with the TPS subsystem, supports a special *security officer* mode of operation. This mode allows a supervisory individual, a security officer, the ability to oversee the face to face enrollment of regular users in a given organization.

Security officer mode provides the ability to enroll individuals under the supervision of a security officer, a designated user-type who can manage other user's smart cards in face-to-face and very secure operations. Security officer mode overlaps with some regular user operations, with additional security features:

- The ability to search for an individual within an organization.
- An interface that displays a photo and other pertinent information about an individual.
- The ability to enroll approved individuals.
- Formatting or resetting a user's card.
- Formatting or resetting a security officer's card.
- Enrolling a temporary card for a user that has misplaced their primary card.

- Storing TPS server information on a card. This Phone Home information is used by the Enterprise Security Client to contact a given TPS server installation.

Working in the security officer mode falls into two distinct areas:

- Creating and managing security officers.
- Managing regular users by security officers.

When security officer mode is enabled, the Enterprise Security Client uses an external user interface provided by the server. This interface takes control of smart card operations in place of the local XUL code that the Enterprise Security Client normally uses.

The external interface maintains control until security officer mode is disabled.



TIP

It is a good idea to run security officer clients over SSL, so make sure that the TPS is configured to run in SSL, and then point the Enterprise Security Client to the TPS's SSL agent port.

4.5.1. Enabling Security Officer Mode

There are two areas where the security officer mode must be configured, both in the TPS and in the Enterprise Security Client's `esc-prefs.js` file.

In the TPS:

1. Add the security officer user entry to the TPS database as a member of the TUS Officers group. This group is created by default in the TPS LDAP database and is the expected location for all security officer user entries.



TIP

It can be simpler to add and copy user entries in the LDAP database using the Red Hat Directory Server Console. Using the Directory Server Console is described in the *Red Hat Directory Server Administrators Guide* in [section 3.1.2, "Creating Directory Entries"](#)¹.

There are two subtrees associated with the TPS, each associated with a different database. (Commonly, both databases can be on the same server, but that is not required.)

- The first suffix, within the *authentication database*, is for external users; the TPS checks their user credentials against the directory to authenticate any user attempting to enroll a smart card. This has a distinguished name (DN) like `dc=server, dc=example, dc=com`.
- The other database is used for internal TPS instance entries, including TPS agents, administrators, and security officers. This subtree is within the *internal database* for the TPS, which includes the *token database*. This subtree has a DN based on the TPS server, like `dc=server.example.com-pki-tps`. The TUS Officers group entry is under the `dc=server.example.com-pki-tps` suffix.

The LDAP directory and the suffix are defined in the token profile in the TPS **CS.cfg** file in the *authId* and *baseDN* parameters for the security officer's auth instance. For example:

```
auth.instance.1.authId=ldap2
auth.instance.1.baseDN=dc=sec_officers,dc=server.example.com-pki-tps
```

Any security officer entry has to be a child entry of the TUS Officers group entry. This means that the group entry is the main entry, and the user entry is directly beneath it in the directory tree.

The TUS Officers group entry is **cn=TUS Officers,ou=Groups,dc=server.example.com-pki-tps**.

For example, to add the security officer entry using **ldapmodify**:

```
/usr/lib/mozldap/ldapmodify -a -D "cn=Directory Manager" -w secret -p 389 -h
server.example.com

dn: uid=jsmith,cn=TUS Officers,ou=Groups,dc=server.example.com-pki-tps
objectclass: inetorgperson
objectclass: organizationalPerson
objectclass: person
objectclass: top
sn: smith
uid: jsmith
cn: John Smith
mail: jsmith@example.com
userPassword: secret
```

Press the **Enter** key twice to send the entry, or use **Ctrl+D**.

Then, configure the Enterprise Security Client.

1. First, trust the CA certificate chain.



NOTE

This step is only required if the certificate is not yet trusted in the Enterprise Security Client database.

If you want to point the Enterprise Security Client to a database which already contains the required certificates, use the *esc.global.alt.nss.db* in the **esc-prefs.js** file to point to another database.

- a. Open the CA's end-entities page.

```
https://server.example.com:9444/ca/ee/ca/
```

- b. Click the **Retrieval** tab, and download the CA certificate chain.
- c. Open the Enterprise Security Client.

```
esc
```

- d. Click the **View Certificates** button.
 - e. Click the **Authorities** tab.
 - f. Click the **Import** button, and import the CA certificate chain.
 - g. Set the trust settings for the CA certificate chain.
2. Then, format and enroll the security officer's token. This token is used to access the security officer Smart Card Manager UI.
- a. Insert a blank token.
 - b. When the prompt for the Phone Home information opens, enter the security officer URL.

```
/var/lib/pki-tps/cgi-bin/so/index.cgi
```

- c. Click the **Format** button to format the security officer's token.
- d. Close the interface and stop the Enterprise Security Client.
- e. Add two parameters in the **esc-prefs.js** file. The first, **esc.disable.password.prompt**, sets security officer mode. The second, **esc.security.url**, points to the security officer enrollment page. Just the presence of the **esc.security.url** parameter instructs the Enterprise Security Client to open in security officer mode next time it opens.

```
pref("esc.disable.password.prompt", "no");  
pref("esc.security.url", "https://server.example.com:7888/cgi-bin/so/enroll.cgi");
```

- f. Start the Enterprise Security Client again, and open the UI.

```
esc
```

- g. The Enterprise Security Client is configured to connect to the security officer enrollment form in order to enroll the new security officer's token. Enroll the token as described in [Section 4.5.2, "Enrolling a New Security Officer"](#).
- h. Close the interface and stop the Enterprise Security Client.
- i. Edit the **esc-prefs.js** file again, and this time change the **esc.security.url** parameter to point to the security officer workstation page.

```
pref("esc.security.url", "https://server.example.com:7889/cgi-bin/sow/welcome.cgi");
```

- j. Restart the Enterprise Security Client again. The UI now points to the security officer workstation to allow security officers to enroll tokens for regular users.

To disable security officer mode, close the Smart Card Manager GUI, stop the **escd** process, and comment out the **esc.security.url** and **esc.disable.password.prompt** lines in the **esc-prefs.js** file. When the **esc** process is restarted, it starts in normal mode.

4.5.2. Enrolling a New Security Officer

Security officers are set up using a separate, unique interface rather than the one for regular enrollments or the one used for security officer-managed enrollments.

1. Make sure the **esc** process is running.

```
esc
```

With security officer mode enabled in the **esc-pref.js** file ([Section 4.5.1, "Enabling Security Officer Mode"](#)), the security officer enrollment page opens.

2. In the **Security Officer Enrollment** window, enter the LDAP user name and password of the new security officer and a password that will be used with the security officer's smart card.



**NOTE**

If the password is stored using the SSHA hash, then any exclamation point (!) and dollar sign (\$) characters in the password must be properly escaped for a user to bind successfully to the Enterprise Security Client on Windows XP and Vista systems.

- For the dollar sign (\$) character, escape the dollar sign *when the password is created*:

```
\$
```

Then, enter only the dollar sign (\$) character when logging into the Enterprise Security Client.

- For the exclamation point (!) character, escape the character when the password is created *and* when the password is entered to log into the Enterprise Security Client.

```
\!
```

3. Click **Enroll My Smartcard**.

This produces a smart card which contains the certificates needed by the security officer to access the Enterprise Security Client security officer, so that regular users can be enrolled and managed within the system.

4.5.3. Using Security Officers to Manage Users

The security officer Station page manages regular users through operations such as enrolling new or temporary cards, formatting cards, and setting the Phone Home URL.

4.5.3.1. Enrolling a New User

There is one significant difference between enrolling a user's smart card in security officer mode and the process in [Section 5.3, "Enrolling a Smart Card Automatically"](#) and [Section 5.4.6, "Enrolling Smart Cards"](#). All processes require logging into an LDAP database to verify the user's identity, but the security officer mode has an extra step to compare some credentials presented by the user against some information in the database (such as a photograph).

1. Make sure the **esc** process is running. If necessary, start the process.

```
esc
```

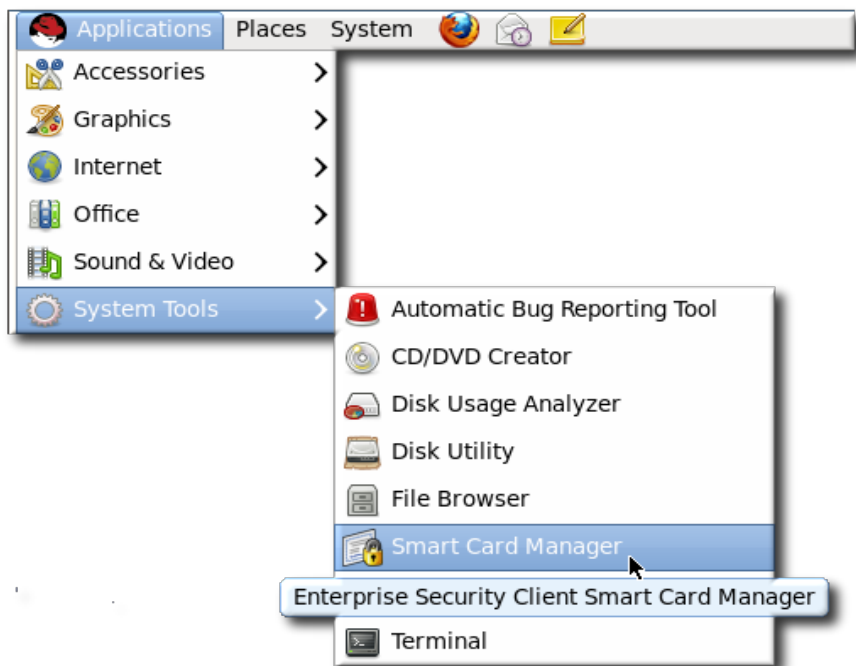
Also, make sure that security officer mode is enabled, as described in [Section 4.5.1, "Enabling Security Officer Mode"](#).

2. Then open the Smart Card Manager UI.

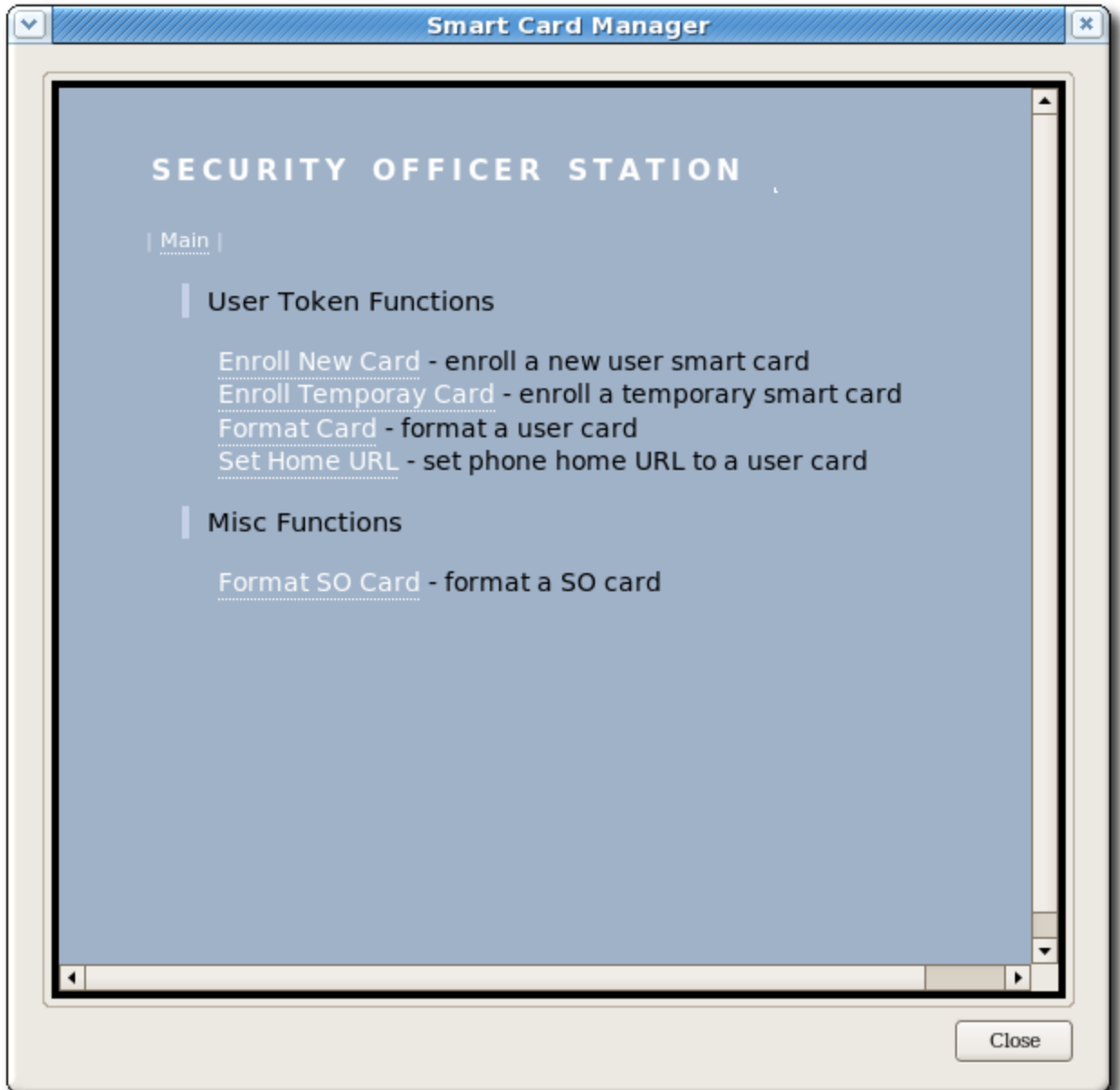


NOTE

Ensure that there is a valid and enrolled security officer card plugged into the computer. A security officer's credentials are required to access the following pages.



3. Click **Continue** to display the security officer Station page. The client prompts for the password for the security officer's card (which is required for SSL client authentication) or to select the security officer's signing certificate from the drop-down menu.
4. Click the **Enroll New Card** link to display the **Security Officer Select User** page.



5. Enter the LDAP name of the user who is to receive a new smart card.
6. Click **Continue**. If the user exists, the **Security Officer Confirm User** page opens.
7. Compare the information returned in the Smart Card Manager UI to the person or credentials that are present.
8. If all the details are correct, click **Continue** to display the **Security Officer Enroll User** page. This page prompts the officer to insert a new smart card into the computer.
9. If the smart card is properly recognized, enter the new password for this card and click **Start Enrollment**.

A successful enrollment produces a smart card that a user can use to access the secured network and services for which the smart card was made.

4.5.3.2. Performing Other Security Officer Tasks

All of the other operations that can be performed for regular users by a security officer — issuing temporary tokens, re-enrolling tokens, or setting a Phone Home URL — are performed as described in [Chapter 4, Setting up Enterprise Security Client](#), after opening the security officer UI.

1. Make sure the **esc** process is running. If necessary, start the process.

```
esc
```

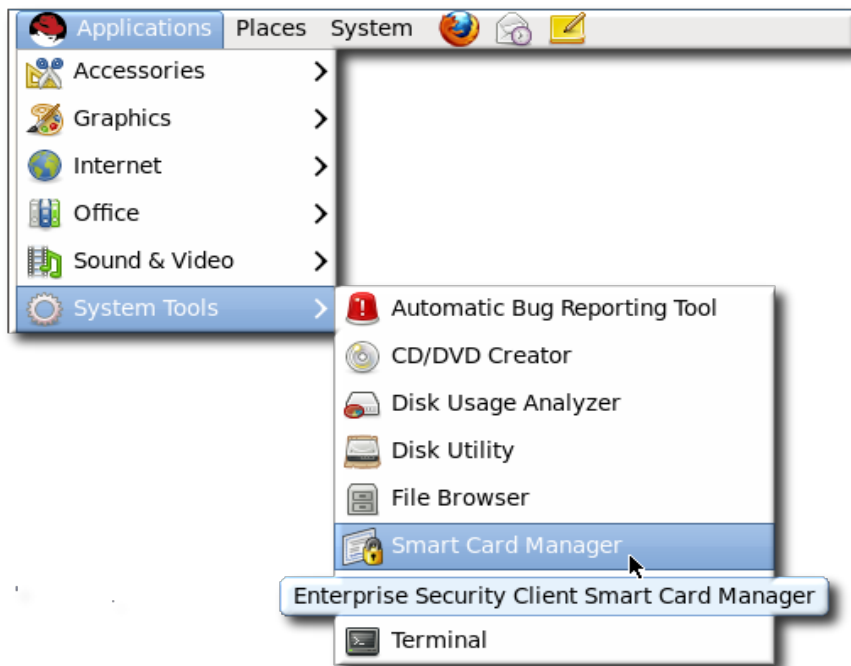
Also, make sure that security officer mode is enabled, as described in [Section 4.5.1, “Enabling Security Officer Mode”](#).

2. Then open the Smart Card Manager UI.

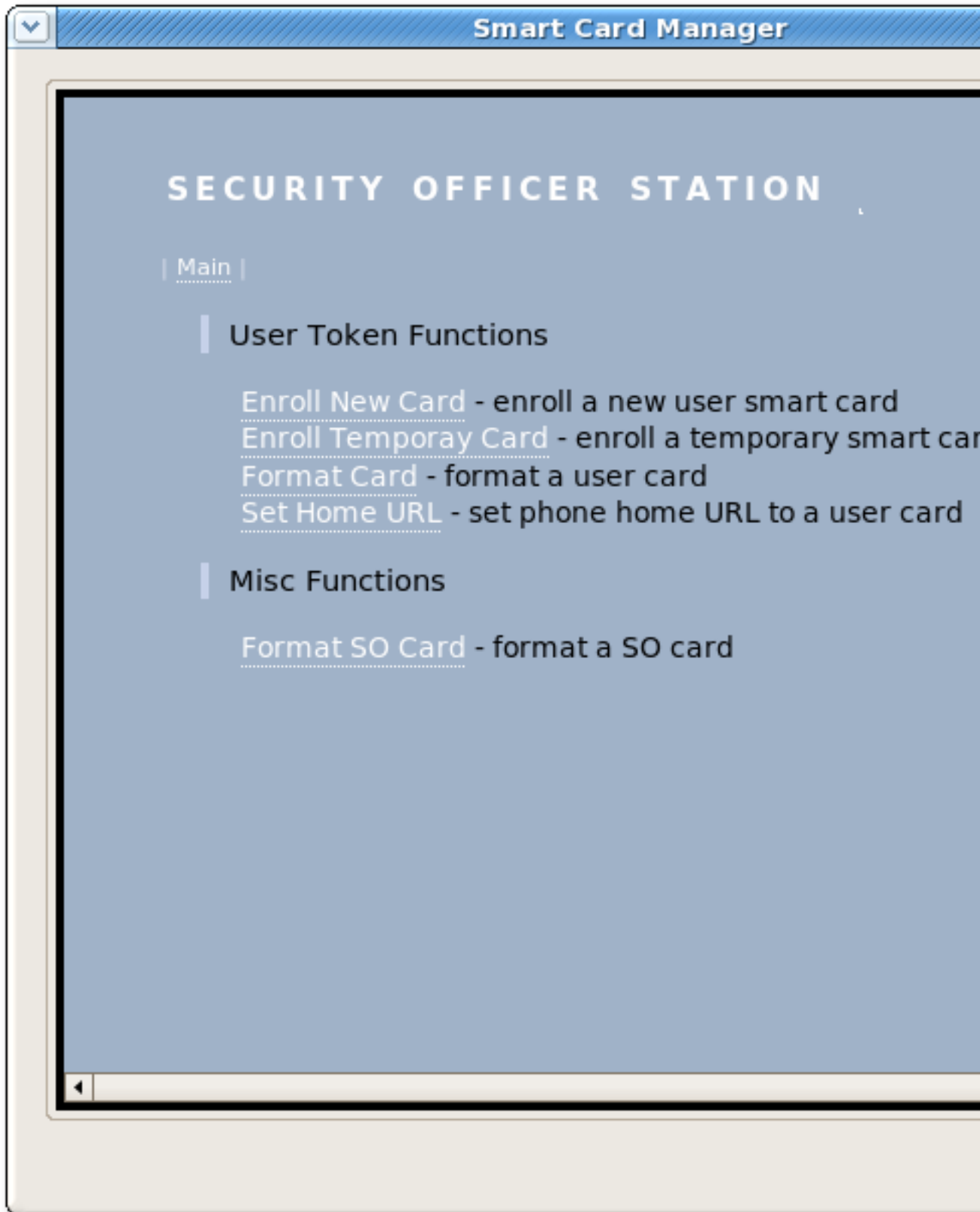


NOTE

Ensure that there is a valid and enrolled security officer card plugged into the computer. A security officer's credentials are required to access the following pages.



3. Click **Continue** to display the security officer Station page. If prompted, enter the password for the security officer's card. This is required for SSL client authentication.
4. Select the operation from the menu (enrolling a temporary token, formatting the card, or setting the Phone Home URL).



5. Continue the operation as described in [Chapter 4, Setting up Enterprise Security Client](#).

4.5.3.3. Formatting an Existing Security Officer Smart Card



IMPORTANT

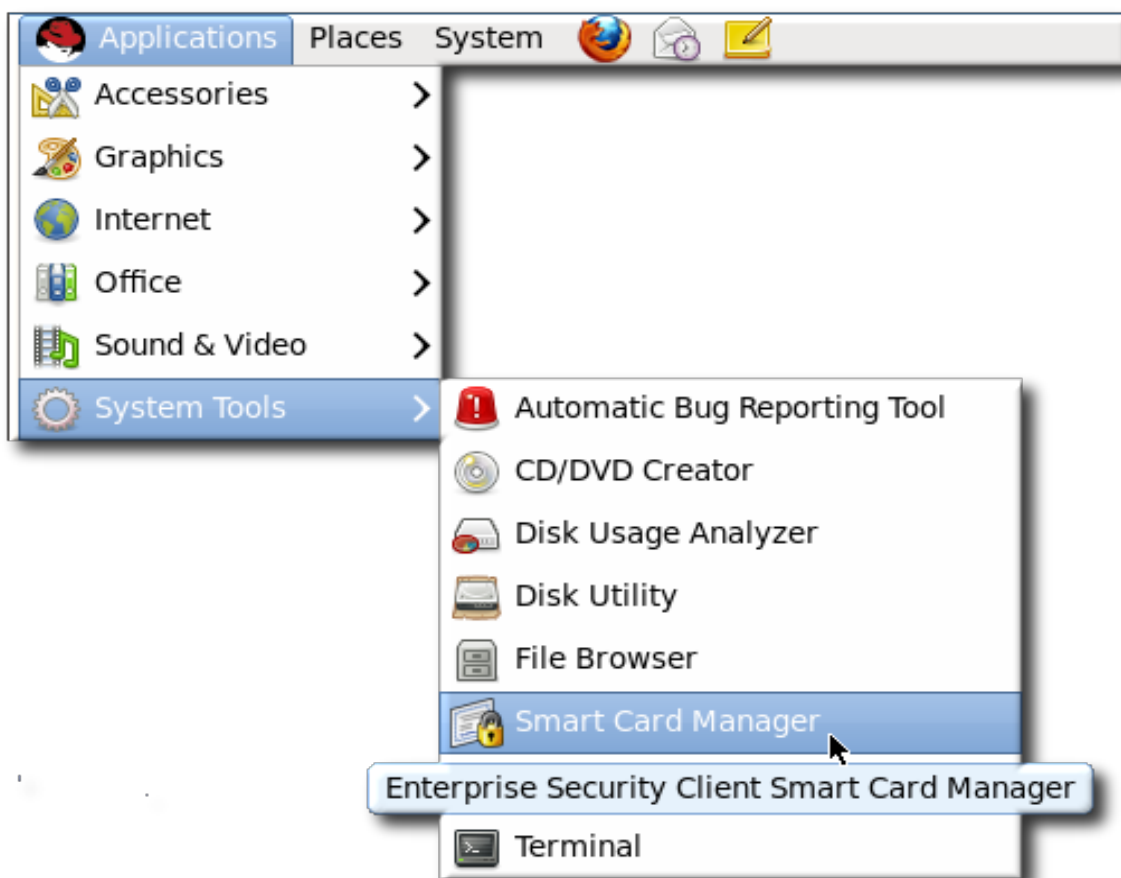
Reformatting a token is a destructive operation to the security officer's token and should only be done if absolutely needed.

1. Make sure that security officer mode is enabled, as described in [Section 4.5.1, "Enabling Security Officer Mode"](#).
2. Open the Smart Card Manager UI.



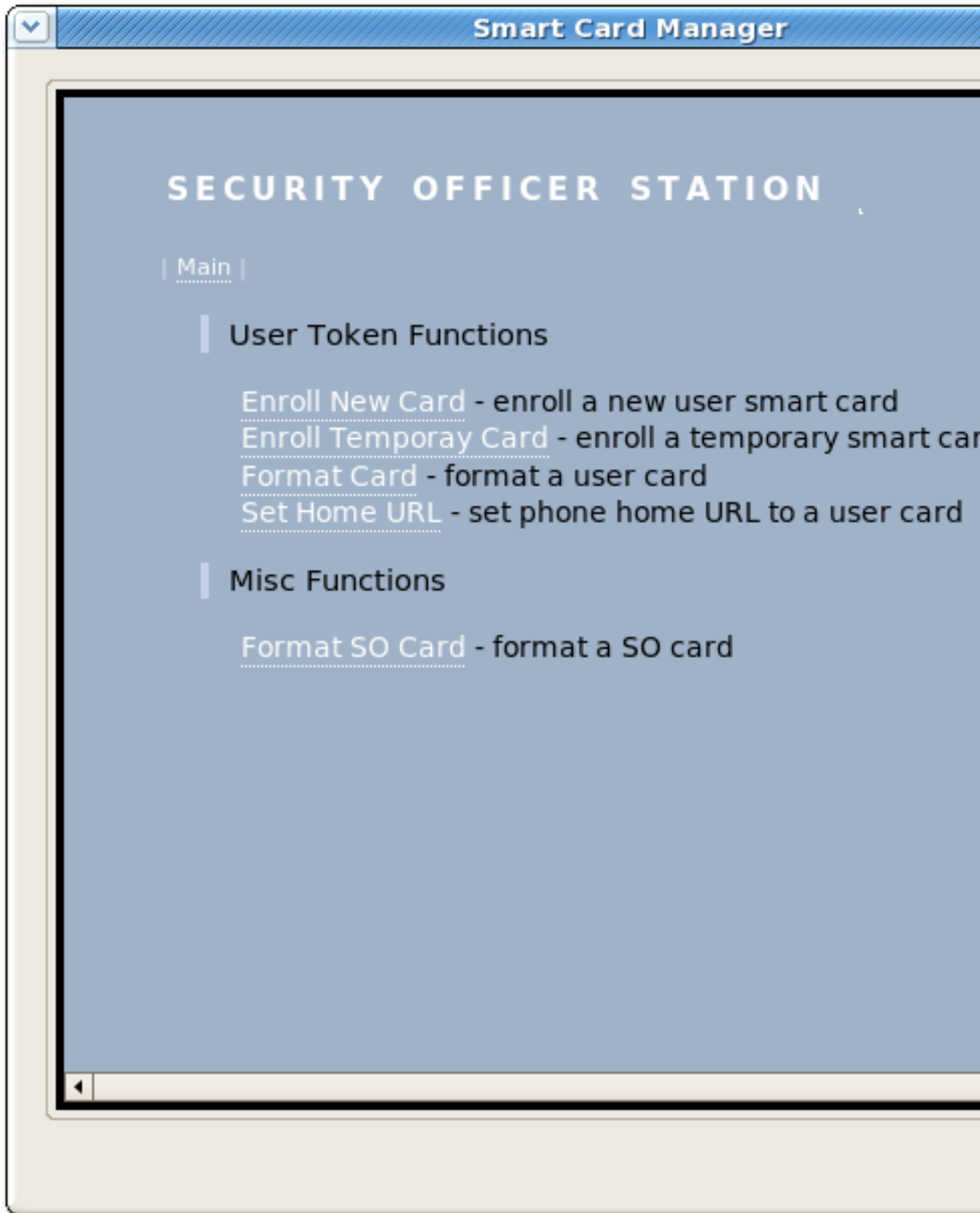
NOTE

Ensure that there is a valid and enrolled security officer card plugged into the computer. A security officer's credentials are required to access the following pages.



3. Click **Continue** to display the security officer Station page. If prompted, enter the password for the security officer's card. This is required for SSL client authentication.

4. Select the operation from the menu (enrolling a temporary token, formatting the card, or setting the Phone Home URL).



5. Click **Format SO Card**. Because the security officer card is already inserted, the following screen displays:



6. Click **Format** to begin the operation.

When the card is successfully formatted, the security officer's card values are reset. Another security officer's card must be used to enter security officer mode and perform any further operations.

4.6. Configuring SSL Connections with the TPS

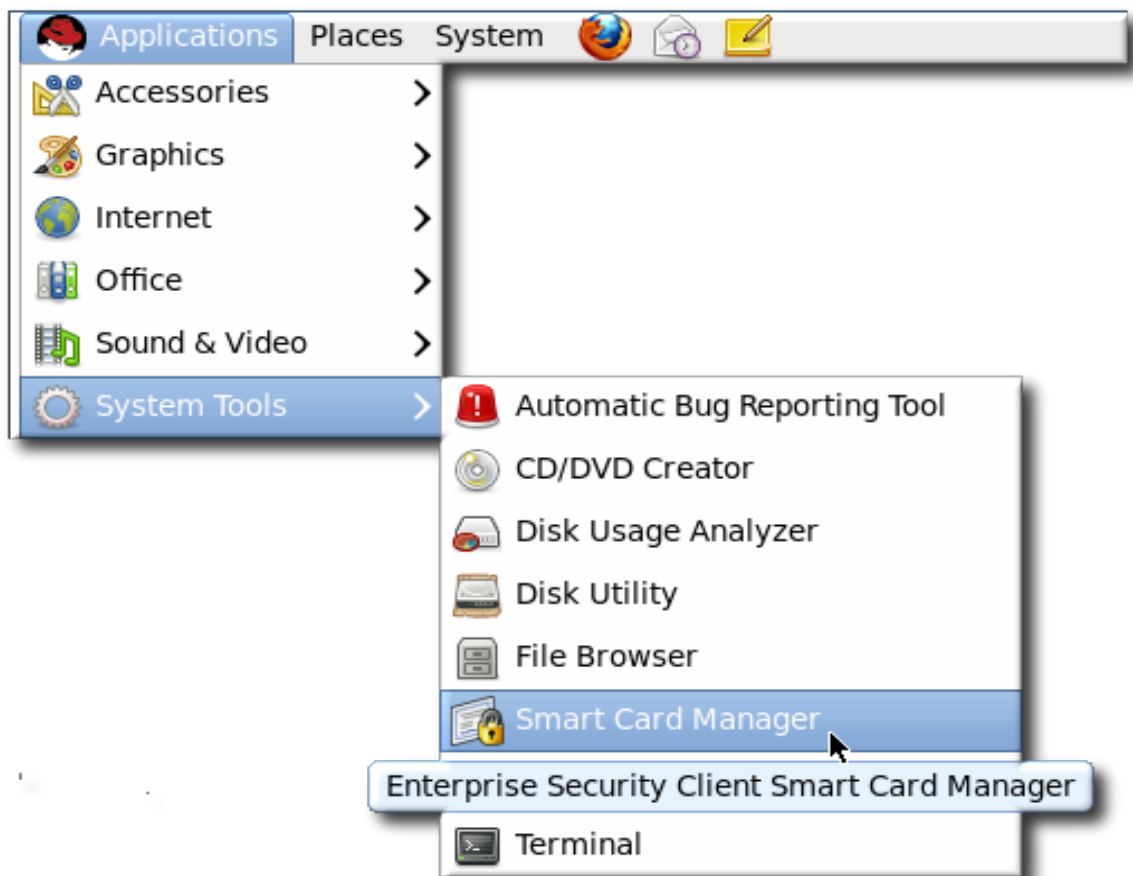
By default, the TPS communicates with the Enterprise Security Client over standard HTTP. It is also possible, and in many situations desirable, to secure the TPS-client communications by using HTTP over SSL (HTTPS).

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. From there, the Enterprise Security Client can be configured to connect to the TPS's SSL certificate.

1. Download the CA certificate used by the TPS.
 - a. Open the CA's end user pages in a web browser.

```
https://server.example.com:9444/ca/ee/ca/
```

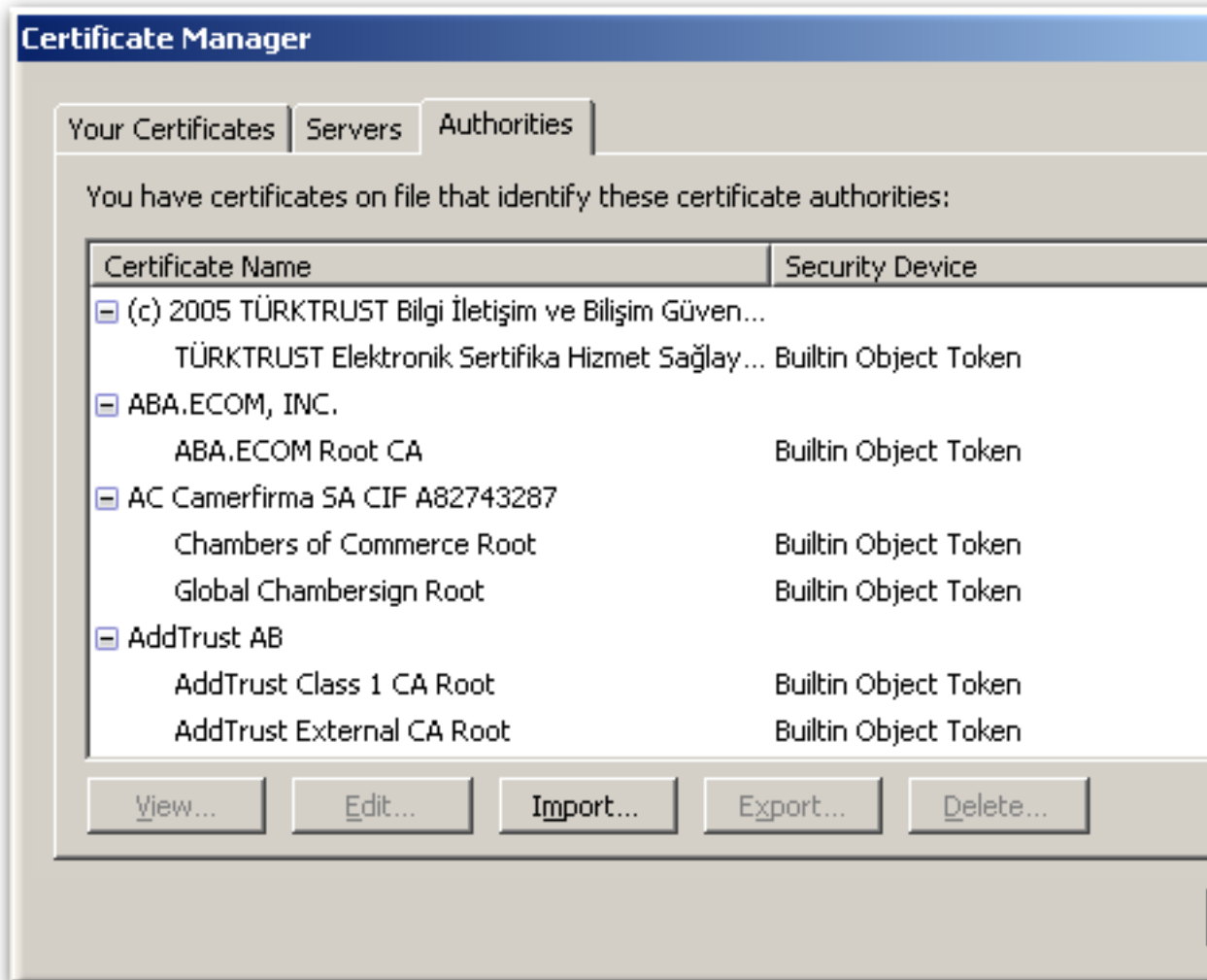
- b. Click the **Retrieval** tab at the top.
 - c. In the left menu, click the **Import CA Certificate Chain** link.
 - d. Choose the radio button to download the chain as a file, and remember the location and name of the downloaded file.
2. Open the Enterprise Security Client.
 - a. Click the **Smart Card Manager** icon in the System Tools menu.



3. Import the CA certificate.
 - a. Click the **View Certificates** button.



- b. Click the **Authorities** tab.
- c. Click **Import**.



- d. Browse to the CA certificate chain file, and select it.
 - e. When prompted, confirm that you want to trust the CA.
4. 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.
 5. 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 (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.

6. Fill in the new TPS URL with the SSL port information. For example:

```
https://server.example.com:7890/cgi-bin/home/index.cgi
```

7. Click the **Test** button to send a message to the TPS.

If the request is successful, the client opens a dialog box saying that the Phone Home URL was successfully obtained.

4.7. Customizing the Smart Card Enrollment User Interface

The TPS subsystem displays a generically-formatted smart card enrollment screen which is opened automatically when an uninitialized smart card is inserted. This is actually comprised of three pages, depending on the mode in which the client is running:

- `/var/lib/pki-tps/cgi-bin/home/Enroll.html` for regular enrollments
- `/var/lib/pki-tps/cgi-bin/so/Enroll.html` for security officer enrollments
- `/var/lib/pki-tps/cgi-bin/sow/Enroll.html` for security officer workstation enrollments (users enrolled through the security officer UI)



NOTE

The security officer workstation directory contains other HTML files for other token operations, such as formats and PIN resets.

There can be even more enrollment pages if there are custom user profiles.

These enrollment pages are basic HTML and JavaScript, which allows them to be easily customized for both their appearance and functionality. The resources, such as images and JavaScript files, referenced by the enrollment file are located in the corresponding `docroot/` directory, such as `/var/lib/pki-tps/docroot/esc/sow` for the security officer enrollment file in `/var/lib/pki-tps/cgi-bin/sow`.

There are several ways that the smart card enrollment pages can be customized. The first, and simplest, is changing the text on the page. The page title, section headings, field names, and descriptions can all be changed by editing the HTML file, as shown in the extracts in [Example 4.3, "Changing Page Text"](#).

Example 4.3. Changing Page Text

```
<!-- Change the title if desired -->
<title>Enrollment</title>
...
<p class="headerText">Smartcard Enrollment</p>
...
<!-- Insert customized descriptive text here. -->
<p class="bodyText">You have plugged in your smart card!
    After answering a few easy questions, you will be able to use your smart card.

</p>
<p class="bodyText">
    Now we would like you to identify yourself.
</p>
...
<table>
  <tr>
    <td><p >LDAP User ID: </p></td>
    <td> </td>
    <td><input type="text" id="snameTF" value=""></td>
  </tr>
</table>
```

The styles of the page can be changed through two files: the **style.css** CSS style sheet and the logo image, **logo.png**.

Example 4.4. Changing Page Styles

```
<link rel=stylesheet href="/esc/home/style.css" type="text/css">
...

<table width="100%" class="logobar">
  <tr>
    <td>

    </td>
    <td>
      <p class="headerText">Smartcard Enrollment</p>
    </td>
  </tr>
</table>
```

The **style.css** file is a standard CSS file, so all of the tags and classes can be defined as follows:

```
body {
background-color: grey;
  font-family: arial;
  font-size: 7p
}
```

More information on CSS is available at <http://www.w3.org/Style/CSS/learning>.

The last way to customize the **Enroll.html** files is through the JavaScript file which sets the page functionality. This file controls features like the progress meter, as well as processing the inputs which are used to authenticate the user to the user directory.

Example 4.5. Changing Page Script

```
<progressmeter id="progress-id" hidden="true" align = "center"/>
...
<table>
  <tr>
    <td><p >LDAP User ID: </p></td>
    <td> </td>
    <td><input type="text" id="sname" value=""></td>
  </tr>
</table>
```



WARNING

Be very cautious about changing the **util.js** file. If this file is improperly edited, it can break the Enterprise Security Client UI and prevent tokens from being enrolled.

The complete `/var/lib/pki-tps/cgi-bin/home/Enroll.html` file is in [Example 4.6](#), “[Complete Enroll.html File](#)”.

Example 4.6. Complete Enroll.html File

```

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8">
<link rel="stylesheet" href="/esc/home/style.css" type="text/css">

<title>Enrollment</title>
</head>
<script type="text/JavaScript" src="/esc/home/util.js">
</script>
<body onload="InitializeBindingTable();" onunload=cleanup()>

<progressmeter id="progress-id" hidden="true" align = "center"/>
<table width="100%" class="logobar">
  <tr>
    <td>

</td>
    <td>
      <p class="headerText">Smartcard Enrollment</p>
    </td>
  </tr>
</table>
  <table id="BindingTable" width="200px" align="center">
    <tr id="HeaderRow">
    </tr>
  </table>
  <p class="bodyText">You have plugged in your smart card! After answering a few easy
questions, you will be able to use your smart card.
</p>
  <p class="bodyText">
    Now we would like you to identify yourself.
  </p>
  <table>
    <tr>
      <td><p >LDAP User ID: </p></td>
      <td> </td>
      <td><input type="text" id="snameTF" value=""></td>
      <td> </td>
      <td><p>LDAP Password: </p></td>
      <td> </td>
      <td><input type="password" id="snamePWD" value=""></td>
    </tr>

  </table>

  <p class="bodyText"> Before you can use your smart card, you will need a password to
protect it.</p>
  <table>
    <tr>
      <td><p >Password:</p></td>
      <td><input type="password" id="pinTF" name="pinTF" value=""></td>

      <td><p >Re-Enter Password:</p></td>
      <td><input type="password" id="reenterpinTF" name="reenterpinTF" value=""></td>
    </table>
  <br>
  <table width="100%">
    <tr>
      <td align="right">
        <input type="button" id="enrollbtn" name="enrollbtn" value="Enroll My Smartcard"
onClick="DoEnrollCOOLKey();">
      </td>
    </tr>
  </table>

```



```
</table>  
</body></html>
```

4.8. Disabling LDAP Authentication for Token Operations

By default, each user who requests a token operation is authenticated against an LDAP directory. If the user has an entry, then the operation is allowed; if the user does not have an entry, then the operation is rejected.

For testing or for certain types of users, then it can be simpler or preferable to disable LDAP authentication. This is not configured in the Enterprise Security Client configuration, but in the Token Processing System configuration, and must be done by a TPS administrator.

1. Stop the TPS subsystem.

```
service pki-tps stop
```

2. Open the TPS configuration file.

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

3. Set the authentication parameters to **false**.

```
op.operation_type.token_type.loginRequest.enable=false  
op.operation_type.token_type.auth.enable=false
```

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, security officers, and the users enrolled by security officers. There can also be custom token types for other kinds of users or certificates.

For example:

```
op.enroll.userKey.loginRequest.enable=false  
op.enroll.userKey.pinReset.enable=false
```

4. Restart the TPS subsystem.

```
service pki-tps start
```

Editing the TPS configuration is covered in the *Certificate System Administrator's Guide*.

Using Smart Cards with the Enterprise Security Client

When a smart card is *enrolled*, it means that user-specific keys and certificates are generated and placed on the card. In Red Hat Enterprise Linux, the interface that works between the user and the system which issues certificates is the *Enterprise Security Client*. The Enterprise Security Client recognizes when a smart card is inserted (or removed) and signals the appropriate subsystem in Red Hat Certificate System. That subsystem then generates the certificate materials and sends them to the Enterprise Security Client, which writes them to the token. That is the enrollment process.

The following sections contain basic instructions on using the Enterprise Security Client for token enrollment, formatting, and password reset operations.

5.1. Supported Smart Cards

The Enterprise Security Client supports smart cards which are JavaCard 2.1 or higher and Global Platform 2.01-compliant and was tested using the following cards:

- Safenet 330J Java smart cards
- Gemalto 64K V2 tokens, both as a smart card and GemPCKey USB form factor key
- Gemalto GCx4 72K and TOPDLGX4 144K common access cards (CAC)
- Oberthur ID One V5.2 common access cards (CAC)
- Personal identity verification (PIV) cards, compliant with FIPS 201



NOTE

Enterprise Security Client does not provision PIV or CAC cards, but it will read them and display information.

Smart card testing was conducted using the SCM SCR331 CCID reader.

The only card manager applet supported with Enterprise Security Client is the CoolKey applet.

5.2. Setting up Users to Be Enrolled

When the Token Processing System is installed, one of its configuration settings is the LDAP directory which contains the users who are allowed to enroll a token. Only users who are stored within this authentication directory are allowed to enroll, format, or have a token. Before attempting to enroll a token or smart card, make sure that the person requesting the operation has an entry in the LDAP directory.

The TPS is configured to look at a specific base DN in the LDAP directory. This is configured in the TPS's **cs.cfg**:

```
auth.instance.0.baseDN=dc=example,dc=com
auth.instance.0.hostport=server.example.com:389
```

For a user to be allowed to enroll a token, the user must be somewhere below the base DN.

If the user does not already have an entry, then the administrator must add the user to the specified LDAP directory in the specified base DN before any tokens can be enrolled for the user.

```
/usr/bin/ldapmodify -a -D "cn=Directory Manager" -w secret -p 389 -h server.example.com

dn: uid=jsmith,ou=People, dc=example,dc=com
objectclass: person
objectclass: inetorgperson
objectclass: top
uid: jsmith
cn: John Smith
email: jsmith@example.com
userPassword: secret
```

5.3. Enrolling a Smart Card Automatically

Because the Enterprise Security Client is configured using the Phone Home feature, enrolling a smart card is extremely easy. Because the information needed to contact the backend TPS server is provided with each smart card, the user is guided quickly and easily through the procedure.

To enroll an uninitialized smart card:



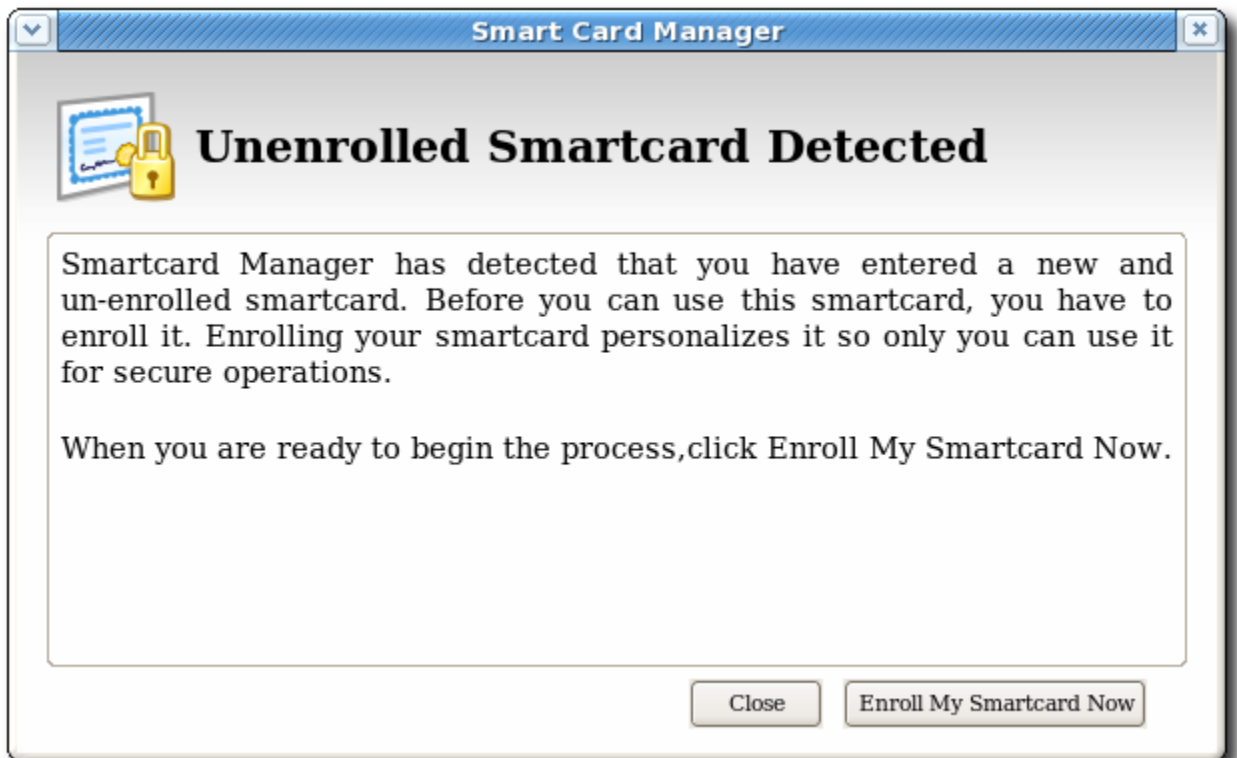
NOTE

This procedure assumes that the smart card is uninitialized and the appropriate Phone Home information has been configured.

1. Ensure that the Enterprise Security Client is running.
2. Insert an uninitialized smart card, pre-formatted with the Phone Home information for the TPS and the enrollment interface URL for the user's organization.

The smart card can be added either by placing a USB form factor smart card into a free USB slot, or by inserting a standard, full-sized smart card into a smart card reader.

When the system recognizes the smart card, it displays a message indicating it has detected an uninitialized smart card.



3. Click **Enroll My Smart Card Now** to display the smart card enrollment form.

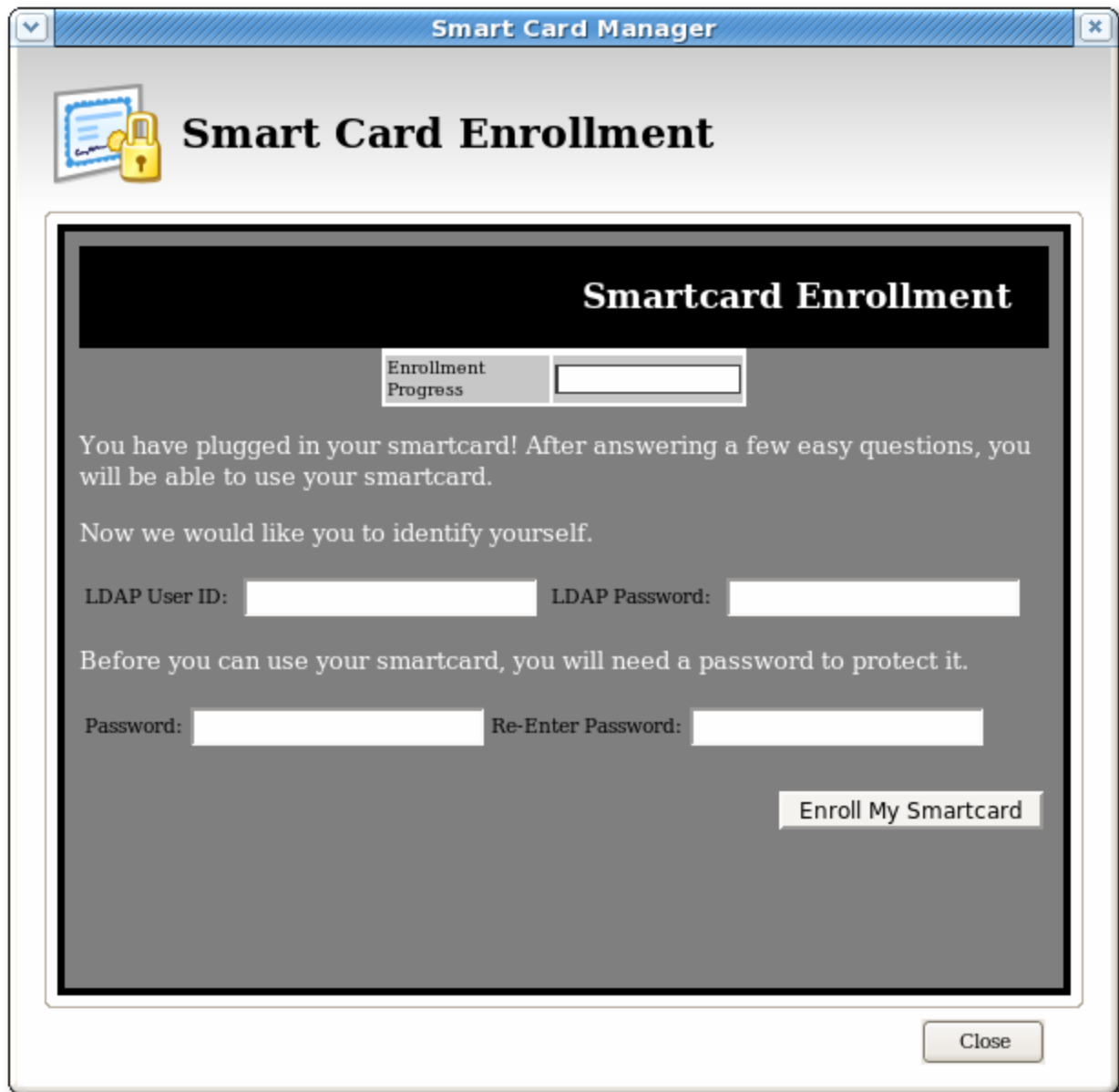


NOTE

If you remove the card at this point, a message displays stating that the smart card can no longer be detected. Reinsert the card to continue with the enrollment process.

The enrollment files are accessed remotely; they reside on the TPS instance. If the network connection is bad or broken, then an error may come up saying *Check the Network Connection and Try Again*. It is also possible that the enrollment window appears to open but the enrollment process does not proceed. The enrollment pages can be cached if the Enterprise Security Client previously connect to them successfully, so the enrollment UI opens even if the network is offline. Try restarting Enterprise Security Client and check the network connection.

4. Because the Smart Card Manager now knows where the enrollment UI is located (it is included in the Phone Home information), the enrollment form is displayed for the user to enter the required information.



This illustration shows the default enrollment UI included with the TPS server. This UI is a standard HTML form, which you can customize to suit your own deployment requirements. This could include adding a company logo or adding and changing field text.

See [Section 4.7, "Customizing the Smart Card Enrollment User Interface"](#) for information on customizing the UI.

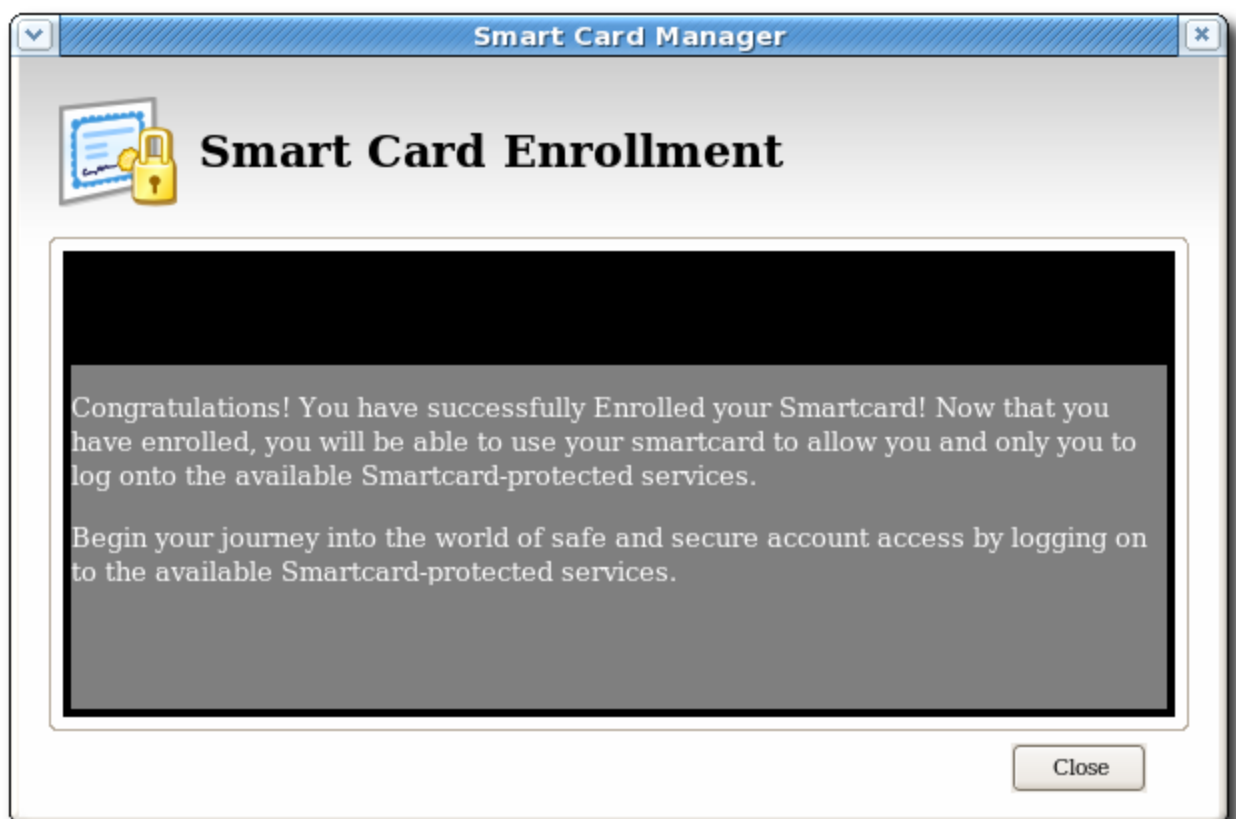
5. The sample enrollment UI requires the following information for the TPS server to process the smart card enrollment operation:
 - *LDAP User ID*. This is the LDAP user ID of the user enrolling the smart card; this can also be a screen name or employee or customer ID number.
 - *LDAP Password*. This is the password corresponding to the user ID entered; this can be a simple password or a customer number.

**NOTE**

The LDAP user ID and password are related to the Directory Server user. The TPS server is usually associated with a Directory Server, which stores user information and through which the TPS authenticates users.

Passwords must conform to the password policy configured in the Directory Server.

- *Password and Re-Enter Password.* These fields set and confirm the smart card's password, used to protect the card information.
6. After you have entered all required information, click **Enroll My Smart Card** to submit the information and enroll the card.
 7. When the enrollment process is complete, a message page opens which shows that the card was successfully enrolled and can offer custom instructions on using the newly-enrolled smart card.



5.4. Managing Smart Cards

You can use the **Manage Smart Cards** page to perform many of the operations that can be applied to one of the cryptographic keys stored on the token.

You can use this page to format the token, set and reset the card's password, and to display card information. Two other operations, enrolling tokens and viewing the diagnostic logs, are also accessed through the **Manage Smart Cards** page. These operations are addressed in other sections.

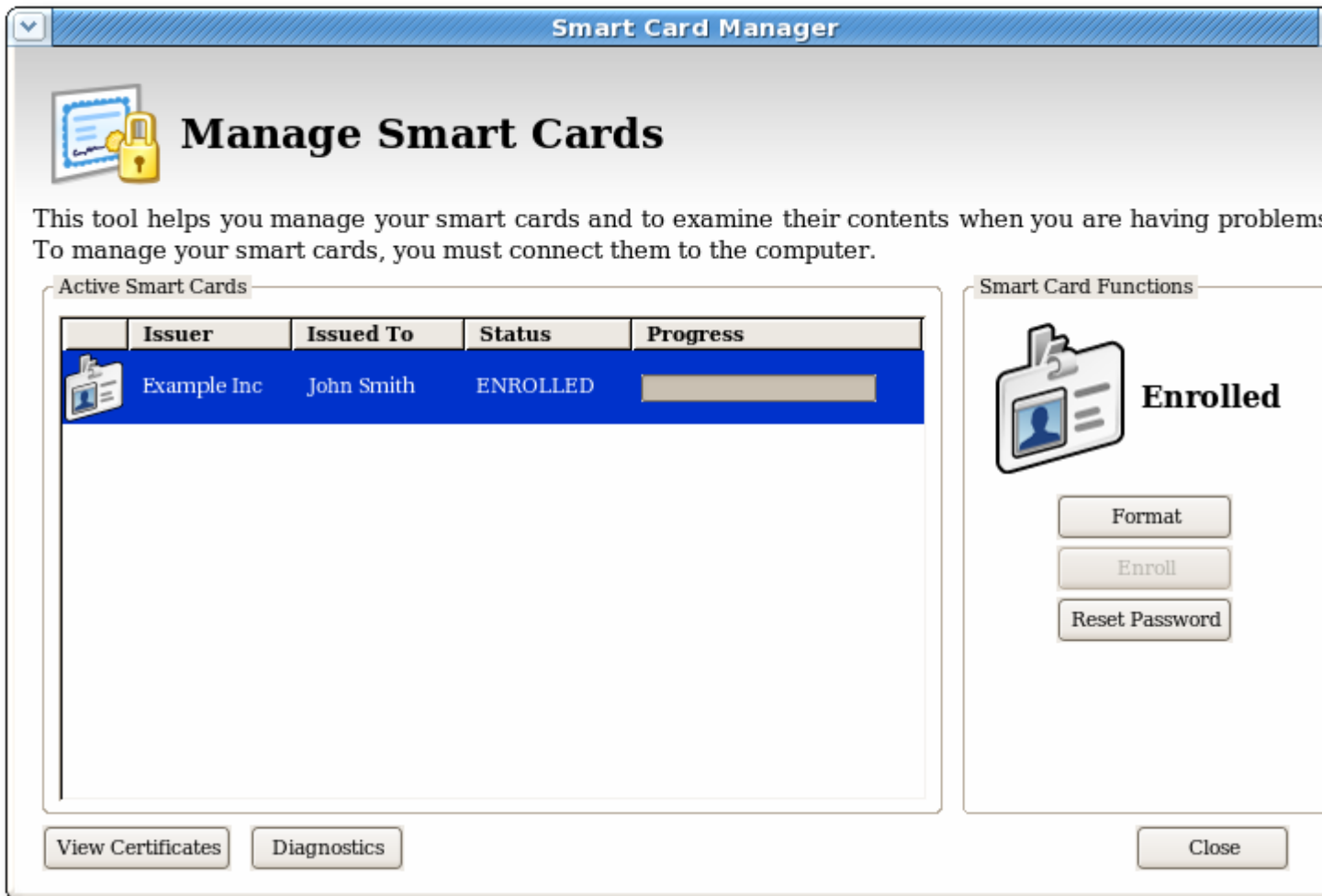


Figure 5.1. Manage Smart Cards Page

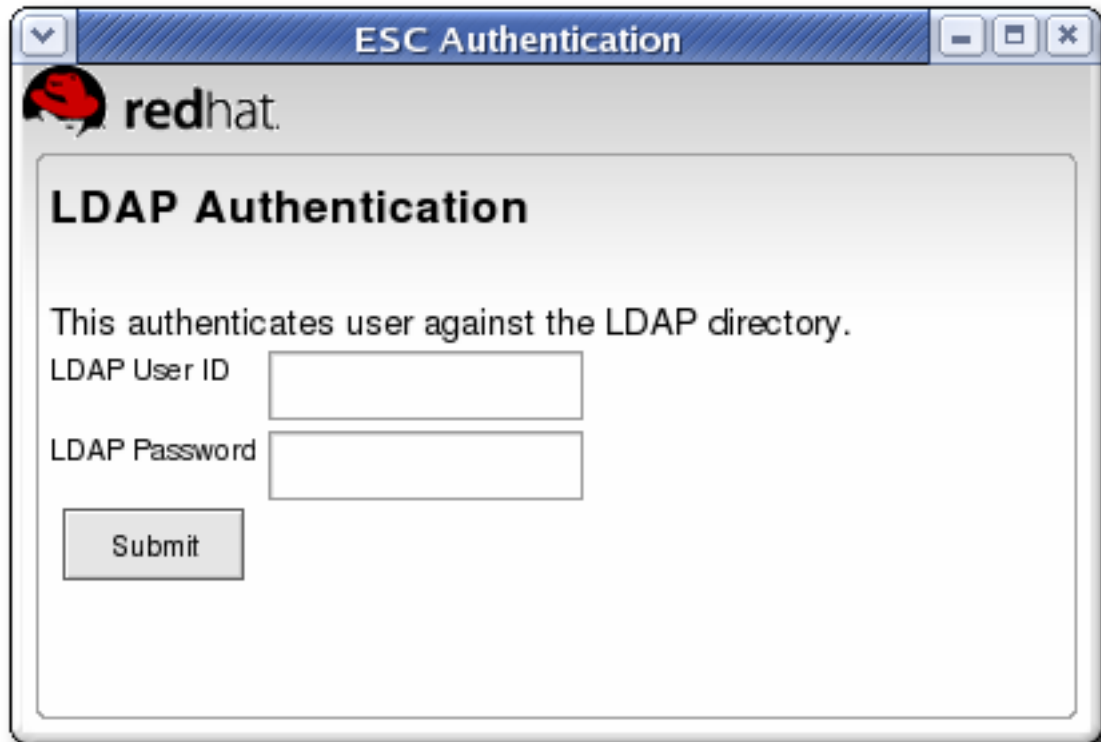
5.4.1. Formatting the Smart Card

When you format a smart card, it is reset to the uninitialized state. This removes all previously generated user key pairs and erases the password set on the smart card during enrollment.

The TPS server can be configured to load newer versions of the applet and symmetric keys onto the card. The TPS supports the CoolKey applet which is shipped with Red Hat Enterprise Linux 6.

To format a smart card:

1. Insert a supported smart card into the computer. Ensure that the card is listed in the **Active Smart Cards** table.
2. In the **Smart Card Functions** section of the **Manage Smart Cards** screen, click **Format**.
3. If the TPS has been configured for user authentication, enter the user credentials in the authentication dialog, and click **Submit**.



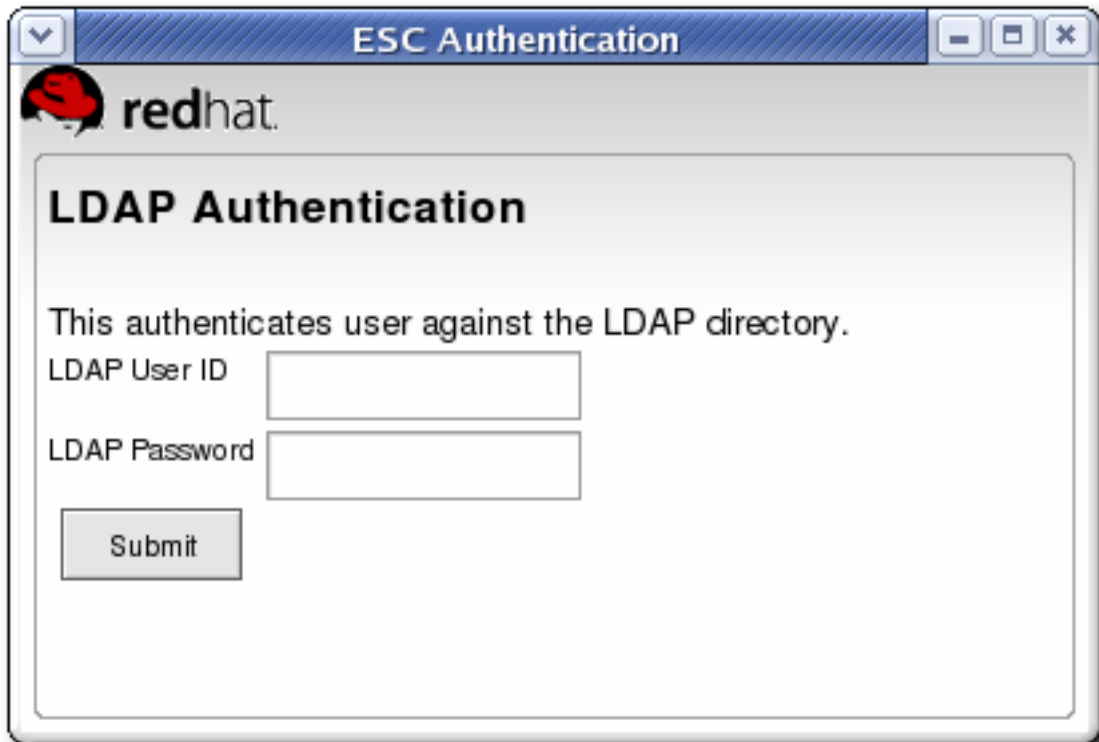
4. During the formatting process, the status of the card changes to BUSY and a progress bar is displayed. A success message is displayed when the formatting process is complete. Click **OK** to close the message box.
5. When the formatting process is complete, the **Active Smart Cards** table shows the card status as UNINITIALIZED.

5.4.2. Resetting a Smart Card Password

1. Insert a supported smart card into the computer. Ensure that the card is listed in the **Active Smart Cards** table.
2. In the **Smart Card Functions** section of the Manage Smart Cards screen, click **Reset Password** to display the **Password** dialog.
3. Enter a new smart card password in the **Enter new password** field.
4. Confirm the new smart card password in the **Re-Enter password** field, and then click **OK**.



5. If the TPS has been configured for user authentication, enter the user credentials in the authentication dialog, and click **Submit**.



ESC Authentication

redhat.

LDAP Authentication

This authenticates user against the LDAP directory.

LDAP User ID

LDAP Password

Submit

6. Wait for the password to finish being reset.

5.4.3. Viewing Certificates

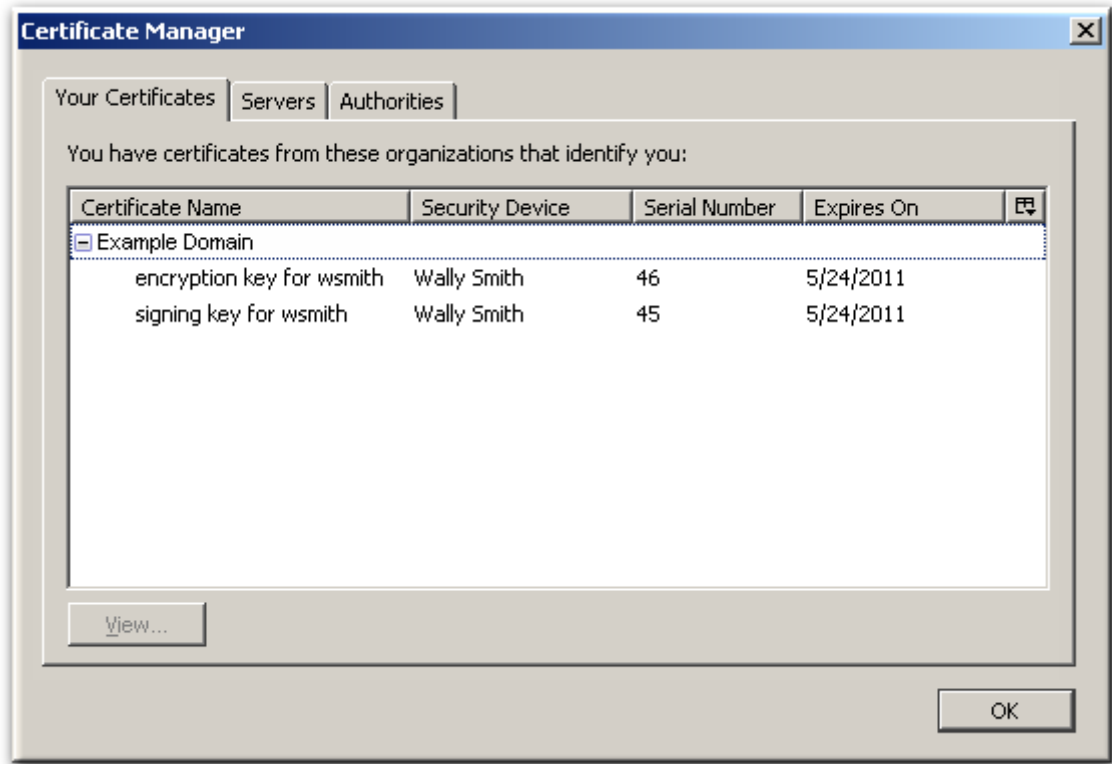
The **Smart Card Manager** can display basic information about a selected smart card, including stored keys and certificates. To view certificate information:

1. Insert a supported smart card into the computer. Ensure that the card is listed in the **Active Smart Cards** table.
2. Select the card from the list, and click **View Certificates**.



This displays basic information about the certificates stored on the card, including the serial number, certificate nickname, and validity dates.

- 3. To view more detailed information about a certificate, select the certificate from the list and click **View**.



5.4.4. Importing CA Certificates

The XULRunner Gecko engine implements stringent controls over which SSL-based URLs can be visited by client like a browser or the Enterprise Security Client. If the Enterprise Security Client (through the XULRunner framework) does not trust a URL, the URL can not be visited.

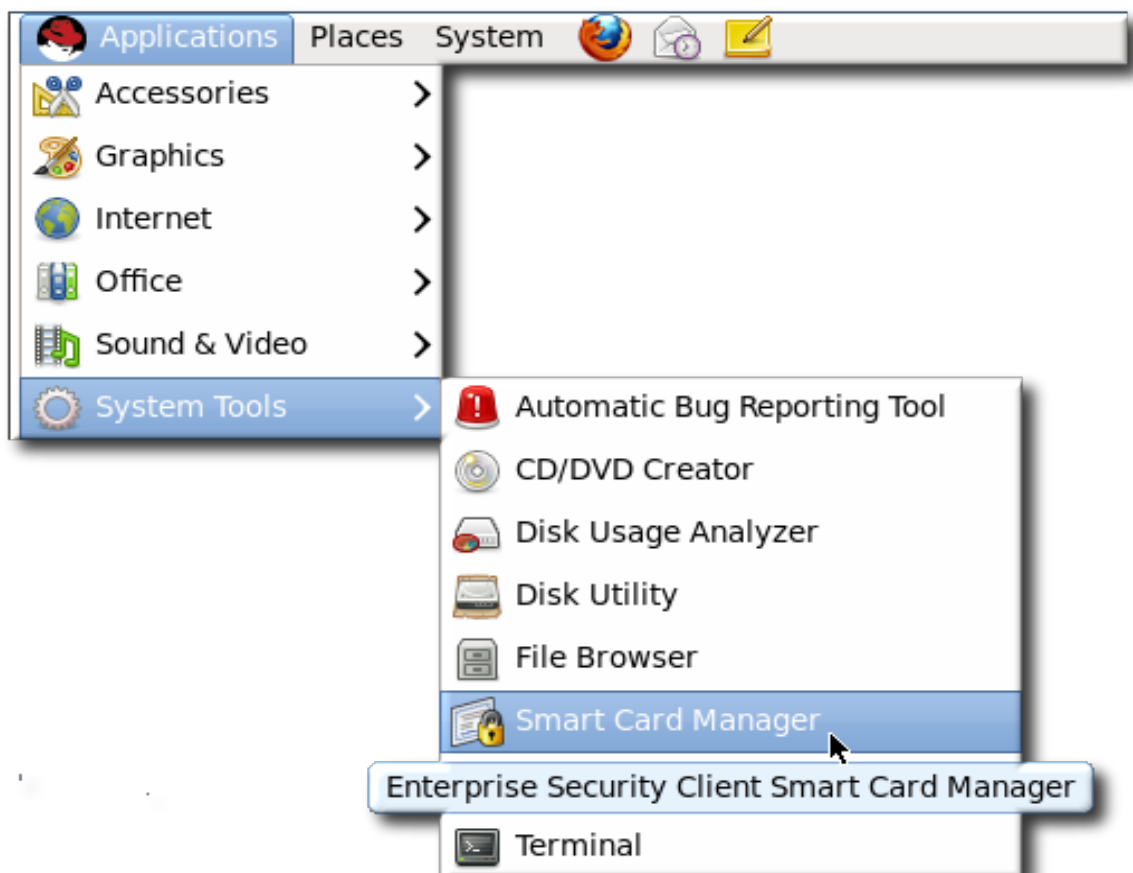
One way to trust an SSL-based URL is to import and trust the CA certificate chain of the CA which issued the certificates for the site. (The other is to create a trust *security exception* for the site, as in [Section 5.4.5, "Adding Exceptions for Servers"](#).)

Any CA which issues certificates for smart cards must be trusted by the Enterprise Security Client application, which means that its CA certificate must be imported into the Enterprise Security Client.

1. Open the CA's end user pages in a web browser.

```
https://server.example.com:9444/ca/ee/ca/
```

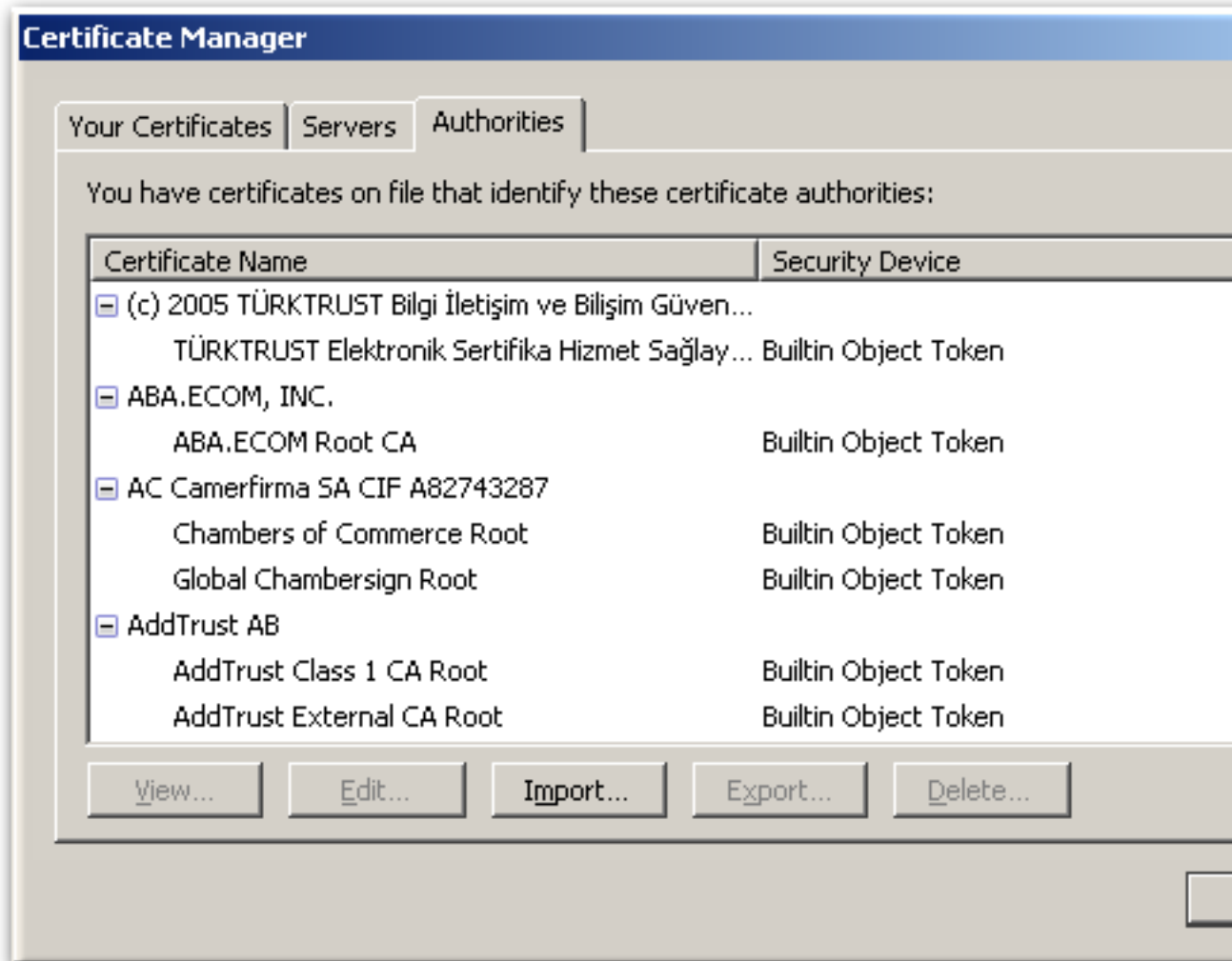
2. Click the **Retrieval** tab at the top.
3. In the left menu, click the **Import CA Certificate Chain** link.
4. Choose the radio button to download the chain as a file, and remember the location and name of the downloaded file.
5. Open the Smart Card Manager GUI.



6. Click the **View Certificates** button.



7. Click the **Authorities** tab.
8. Click **Import**.



9. Browse to the CA certificate chain file, and select it.
10. When prompted, confirm that you want to trust the CA.

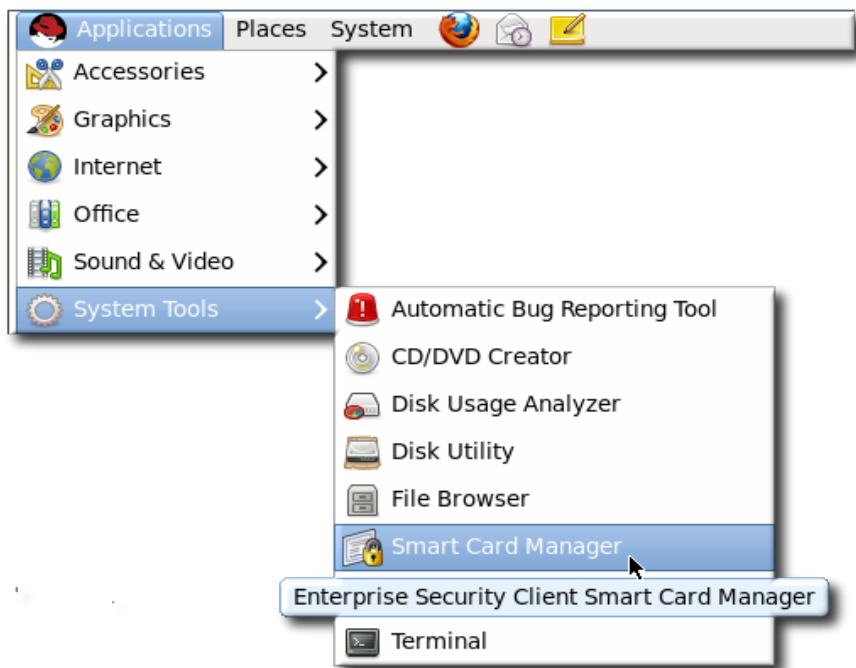
5.4.5. Adding Exceptions for Servers

The XULRunner Gecko engine implements stringent controls over which SSL-based URLs can be visited by client like a browser or the Enterprise Security Client. If the Enterprise Security Client (through the XULRunner framework) does not trust a URL, the URL can not be visited.

One way to trust an SSL-based URL is to create a trust *security exception* for the site, which imports the certificate for the site and forces the Enterprise Security Client to recognize it. (The other option is to import the CA certificate chain for the site and automatically trust it, as in [Section 5.4.4, "Importing CA Certificates"](#).)

The smart card can be used to access services or websites over SSL that require special security exceptions; these exceptions can be configured through the Enterprise Security Client, similar to configuring exceptions for websites in a browser like Mozilla Firefox.

1. Open the Smart Card Manager UI.

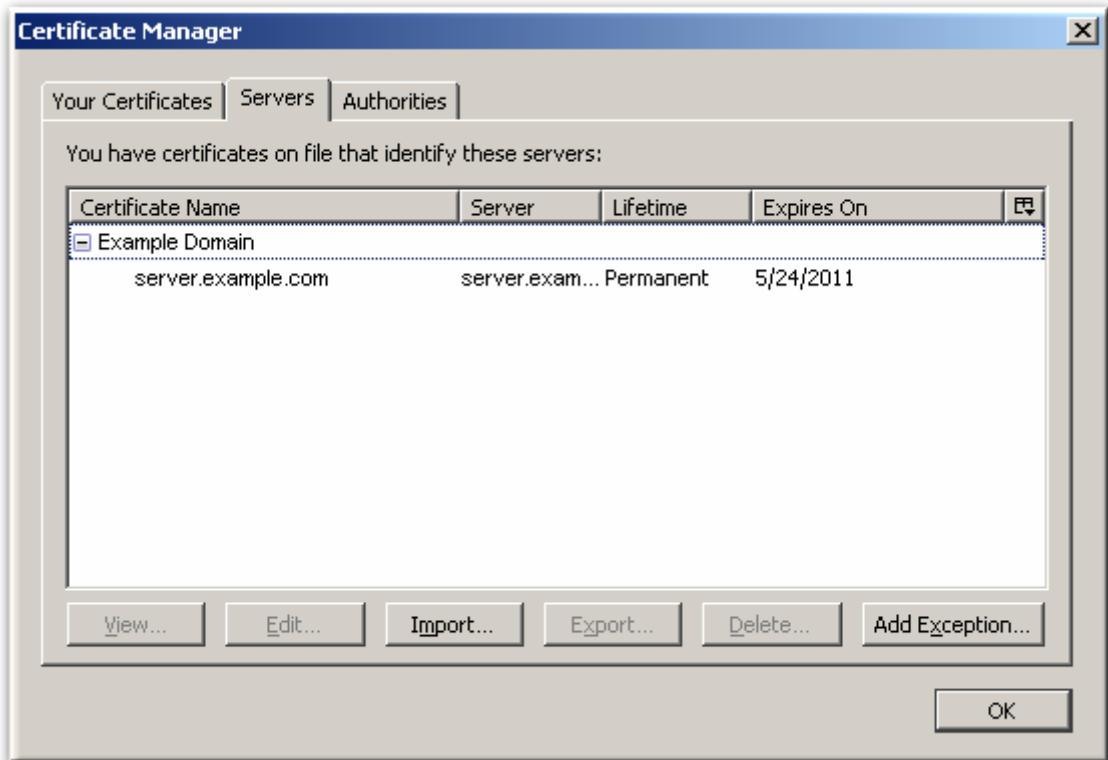


2. Click the **View Certificates** button.

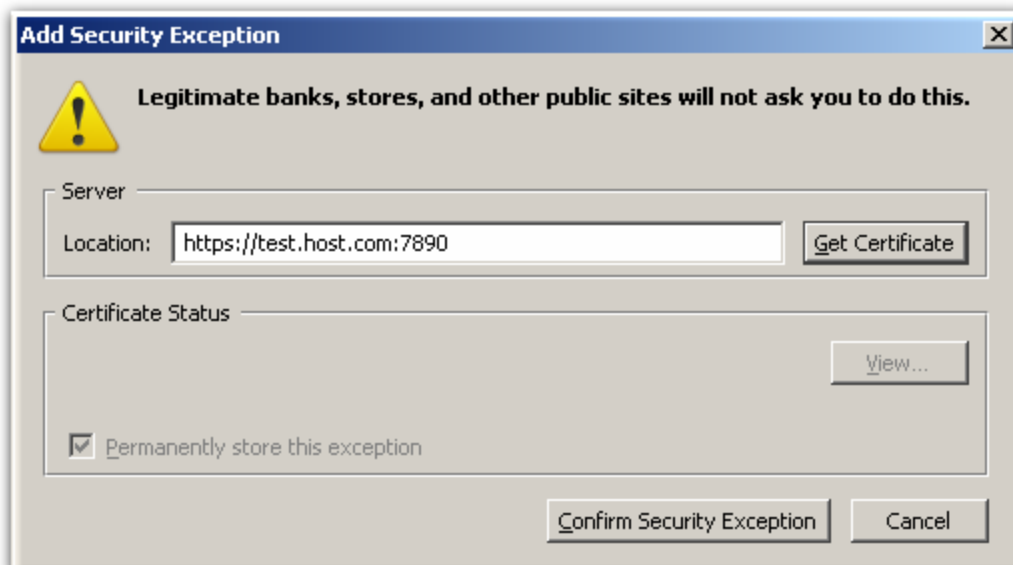


3. Click the **Servers** tab.

4. Click **Add Exception**.



5. Enter the URL, including any port numbers, for the site or service which the smart card will be used to access. Then click the **Get Certificates** button to download the server certificate for the site.



6. Click **Confirm Security Exception** to add the site to the list of allowed sites.

5.4.6. Enrolling Smart Cards

Most smart cards will be automatically enrolled using the automated enrollment procedure, described in [Section 5.3, “Enrolling a Smart Card Automatically”](#). You can also use the **Manage Smart Cards** facility to manually enroll a smart card.

If you enroll a token with the user key pairs, then the token can be used for certificate-based operations such as SSL client authentication and S/MIME.

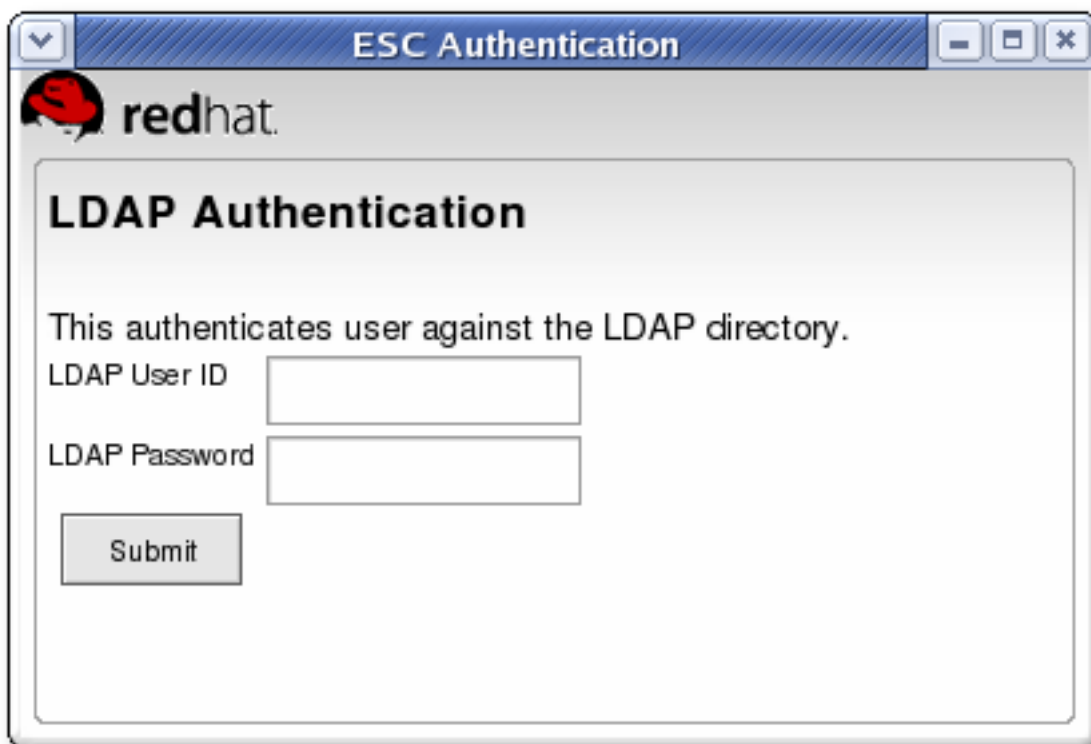


NOTE

The TPS server can be configured to generate the user key pairs on the server and then archived in the DRM subsystem for recovery if the token is lost.

To enroll a smart card manually:

1. Insert a supported, unenrolled smart card into the computer. Ensure that the card is listed in the **Active Smart Cards** table.
2. Click **Enroll** to display the **Password** dialog.
3. Enter a new key password in the **Enter a password** field.
Confirm the new password in the **Re-Enter a password** field.
4. Click **OK** to begin the enrollment.
5. If the TPS has been configured for user authentication, enter the user credentials in the authentication dialog, and click **Submit**.



6. If the TPS has been configured to archive keys to the DRM, the enrollment process will begin generating and archiving keys.

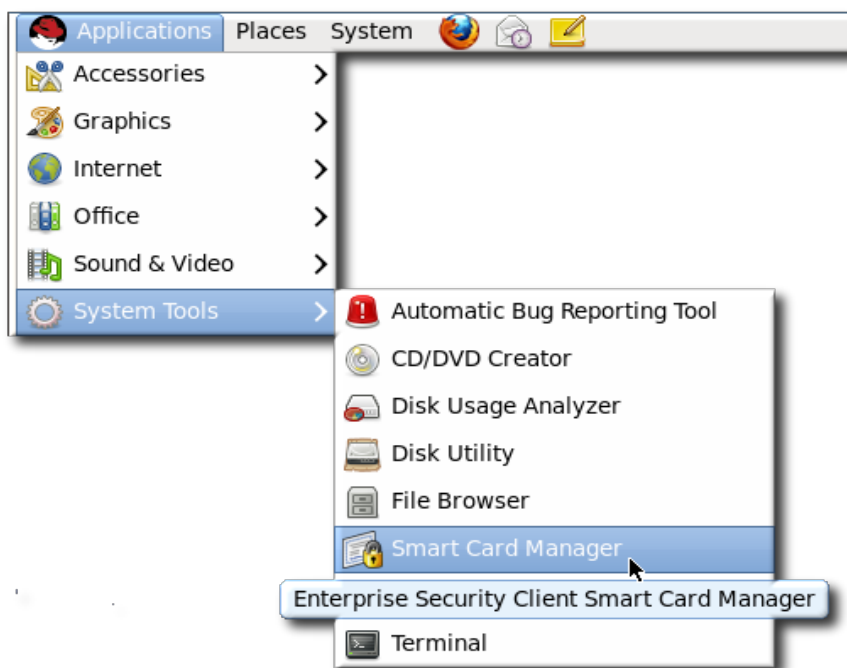
When the enrollment is complete, the status of the smart card is displayed as ENROLLED.

5.5. Diagnosing Problems

The Enterprise Security Client includes basic diagnostic tools and a simple interface to log errors and common events, such as inserting and removing a smart card or changing the card's password. The diagnostic tools can identify and notify users about problems with the Enterprise Security Client, smart cards, and TPS connections.

To open the **Diagnostics Information** window:

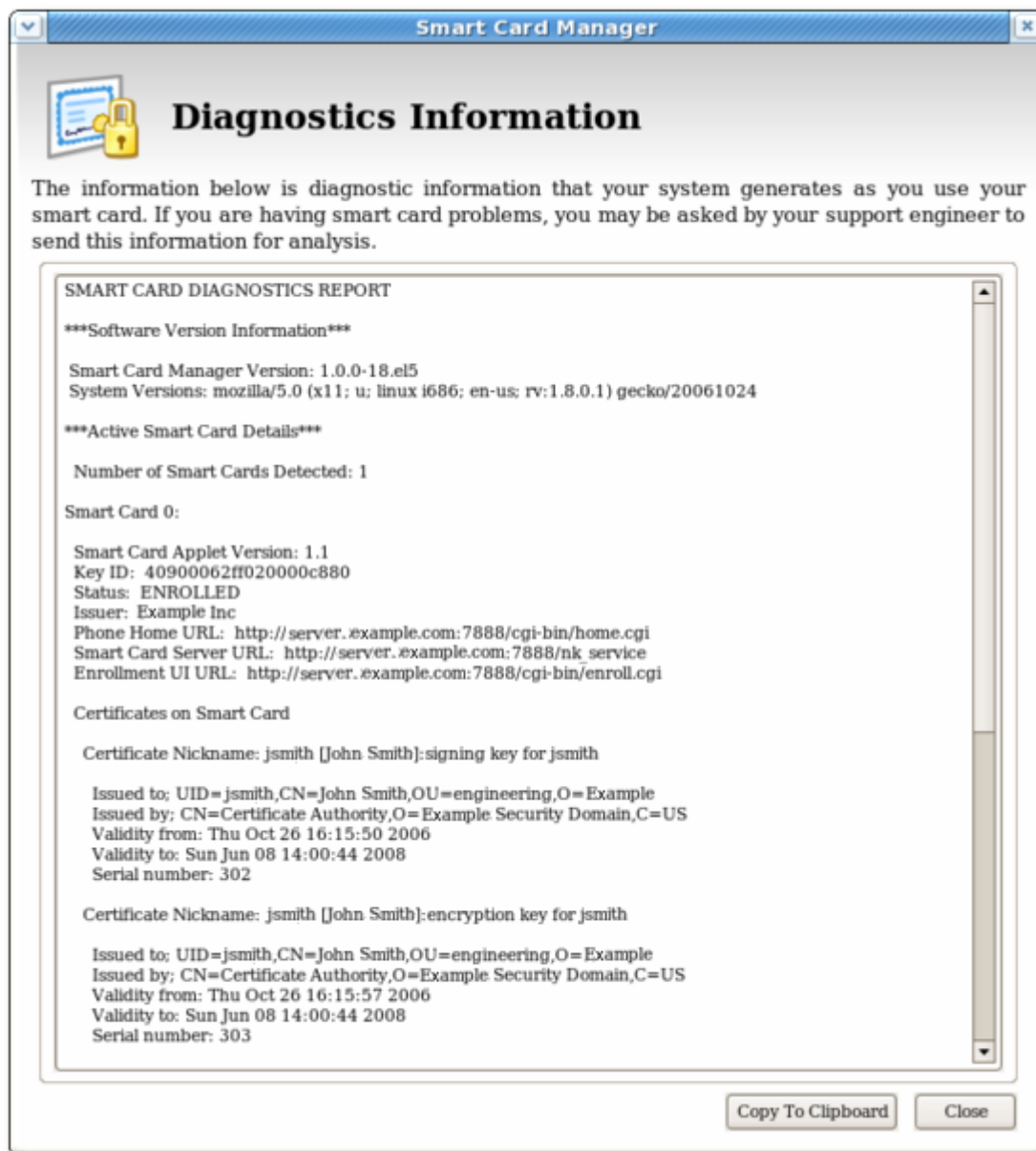
1. Open the Smart Card Manager UI.



2. Select the smart card to check from the list.
3. Click the **Diagnostics** button.



4. This opens the **Diagnostic Information** window for the selected smart card.



The **Diagnostics Information** screen displays the following information:

- The Enterprise Security Client version number (listed as the Smart Card Manager version).
- The version information for the XULRunner framework upon which the client is running.
- The number of cards detected by the Enterprise Security Client.

For each card detected, the following information is displayed:

- The version of the applet running on the smart card.
- The alpha-numeric ID of the smart card.
- The card's status, which can be any of the three things:
 - *NO_APPLET* No key was detected.

- *UNINITIALIZED*. The key was detected, but no certificates have been enrolled.
- *ENROLLED*. The detected card has been enrolled with certificate and card information.
- The card's Phone Home URL. This is the URL from which all Phone Home information is obtained.
- The card issuer name, such as **Example Corp.**
- The card's answer-to-reset (ATR) string. This is a unique value that can be used to identify different classes of smart cards. For example:

```
3BEC00FF8131FE45A000000056333304A330600A1
```

- The TPS Phone Home URL.
- The TPS server URL. This is retrieved through Phone Home.
- The TPS enrollment form URL. This is retrieved through Phone Home.
- Detailed information about each certificate contained on the card.
- A running log of the most recent Enterprise Security Client errors and common events.

The Enterprise Security Client records two types of diagnostic information. It records *errors* that are returned by the smart card, and it records *events* that have occurred through the Enterprise Security Client. It also returns basic information about the smart card configuration.

5.5.1. Errors

- The Enterprise Security Client does not recognize a card.
- Problems occur during a smart card operation, such as a certificate enrollment, password reset, or format operation.
- The Enterprise Security Client loses the connection to the smart card. This can happen when problems occur communicating with the **PCSC** daemon.
- The connection between the Enterprise Security Client and TPS is lost.

Smart cards can report certain error codes to the TPS; these are recorded in the TPS's **tps-debug.log** or **tps-error.log** files, depending on the cause for the message.

Table 5.1. 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

Return Code	Description
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

5.5.2. Events

- Simple events such as card insertions and removals, successfully completed operations, card operations that result in an error, and similar events.
- Errors are reported from the TPS to the Enterprise Security Client.
- The NSS crypto library is initialized.
- Other low-level smart card events are detected.

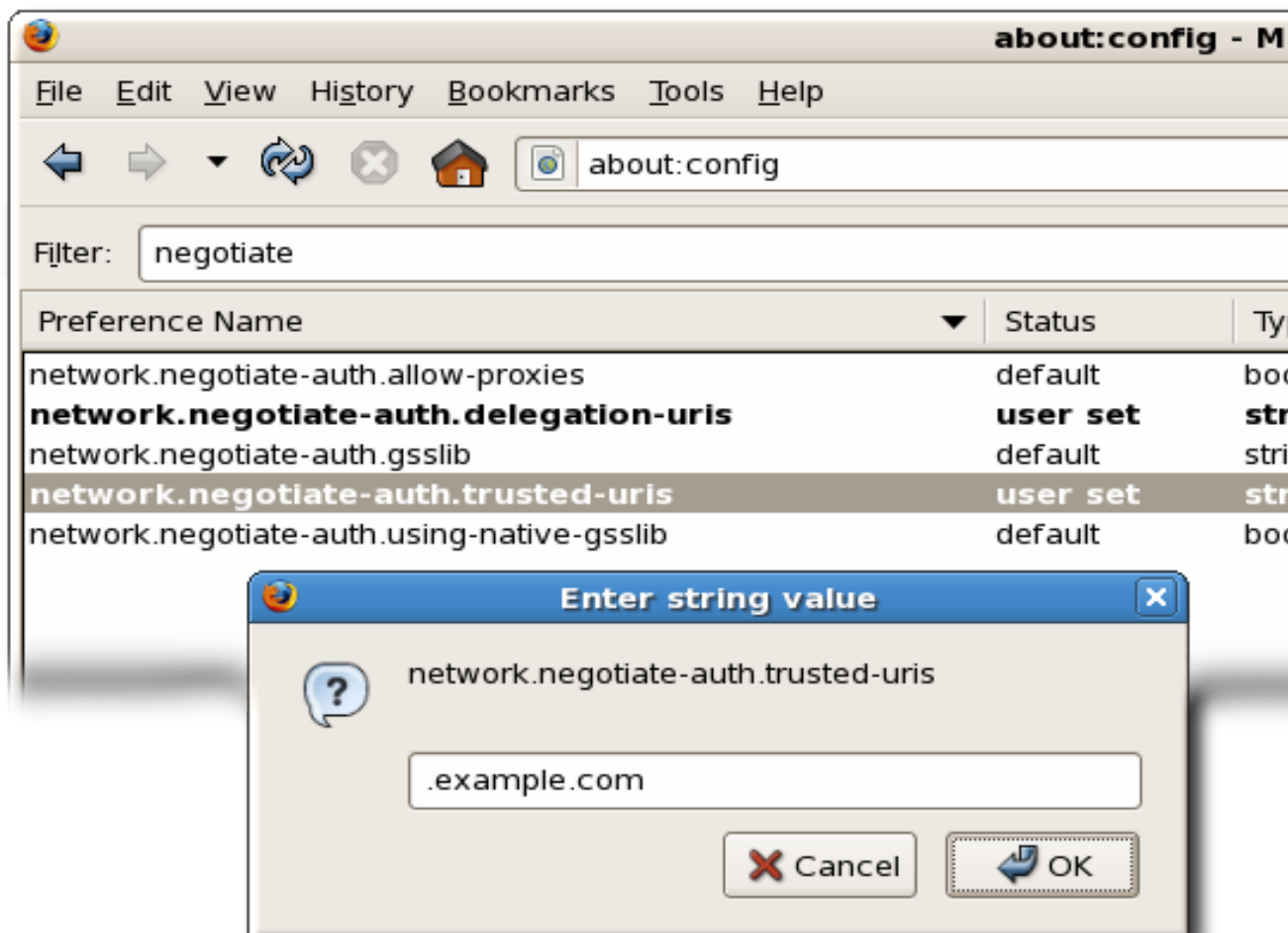
Configuring Applications for Single Sign-On

After a smart card is enrolled, the smart card can be used for SSL client authentication and S/MIME email applications. The PKCS #11 module used by these applications, by default, is located in `/usr/lib/libcoolkeypk11.so`.

6.1. Configuring Firefox to Use Kerberos for Single Sign-On

Firefox can use Kerberos for single sign-on to intranet sites and other protected websites. For Firefox to use Kerberos, it first has to be configured to send Kerberos credentials to the appropriate KDC.

1. In the address bar of Firefox, type **about:config** to display the list of current configuration options.
2. In the **Filter** field, type **negotiate** to restrict the list of options.
3. Double-click the **network.negotiate-auth.trusted-uris** entry.
4. Enter the name of the domain against which to authenticate.



5. Next, configure the **network.negotiate-auth.delegation-uris** entry, using the same domain as for **network.negotiate-auth.trusted-uris**.



NOTE

Even after Firefox is configured to pass Kerberos credentials, it still requires a valid Kerberos ticket to use. To generate a Kerberos ticket, use the **kinit** command and supply the user password for the user on the KDC.

```
[jsmith@host ~] $ kinit
Password for jsmith@EXAMPLE.COM:
```

If Kerberos authentication is not working, turn on verbose logging for the authentication process.

1. Close all instances of Firefox.
2. In a command prompt, export values for the `NSPR_LOG_*` variables:

```
export NSPR_LOG_MODULES=negotiateauth:5
export NSPR_LOG_FILE=/tmp/moz.log
```

3. Restart Firefox *from that shell*, and visit the website where Kerberos authentication is failing.
4. Check the `/tmp/moz.log` file for error messages with `nsNegotiateAuth` in the message.

There are several common errors that occur with Kerberos authentication.

- The first error says that no credentials have been found.

```
-1208550944[90039d0]: entering nsNegotiateAuth::GetNextToken()
-1208550944[90039d0]: gss_init_sec_context() failed: Miscellaneous failure
No credentials cache found
```

This means that there are no Kerberos tickets (meaning that they expired or were not generated). To fix this, run **kinit** to generate the Kerberos ticket and then open the website again.

- The second potential error is if the browser is unable to contact the KDC, with the message *Server not found in Kerberos database*.

```
-1208994096[8d683d8]: entering nsAuthGSSAPI::GetNextToken()
-1208994096[8d683d8]: gss_init_sec_context() failed: Miscellaneous failure
Server not found in Kerberos database
```

This is usually a Kerberos configuration problem. The correct entries must be in the **[domain_realm]** section of the `/etc/krb5.conf` file to identify the domain. For example:

```
.example.com = EXAMPLE.COM
example.com = EXAMPLE.COM
```

- If there are no errors in the log, then the problem could be that an HTTP proxy server is stripping off the HTTP headers required for Kerberos authentication. Try to connect to the site using HTTPS, which allows the request to pass through unmodified.

6.2. Enabling Smart Card Login

Smart card login for Red Hat Enterprise Linux servers and workstations is not enabled by default and must be enabled in the system settings.



NOTE

Using single sign-on when logging into Red Hat Enterprise Linux requires these packages:

- nss-tools
- esc
- pam_pkcs11
- coolkey
- ccid
- gdm
- authconfig
- authconfig-gtk
- krb5-libs
- krb5-workstation
- krb5-auth-dialog
- krb5-pkinit-openssl

1. Log into the system as root.
2. Download the root CA certificates for the network in base 64 format, and install them on the server. The certificates are installed in the appropriate system database using the **certutil** command. For example:

```
# certutil -A -d /etc/pki/nssdb -n "root CA cert" -t "CT,C,C" -i /tmp/ca_cert.crt
```

3. In the top menu, select the **System** menu, select **Administration**, and then click **Authentication**.
4. Open the **Advanced Options** tab.
5. Click the **Enable Smart Card Support** checkbox.
6. When the button is active, click **Configure smart card ...**.

There are two behaviors that can be configured for smart cards:

- The **Require smart card for login** checkbox requires smart cards and essentially disables Kerberos password authentication for logging into the system. Do not select this until *after* you have successfully logged in using a smart card.

- The **Card removal action** menu sets the response that the system takes if the smart card is removed during an active session. **Ignore** means that the system continues functioning as normal if the smart card is removed, while **Lock** immediately locks the screen.
7. By default, the mechanisms to check whether a certificate has been revoked (Online Certificate Status Protocol, or OCSP, responses) are disabled. To validate whether a certificate has been revoked before its expiration period, enable OCSP checking by adding the **ocsp_on** option to the *cert_policy* directive.
 - a. Open the **pam_pkcs11.conf** file.

```
vim /etc/pam_pkcs11/pam_pkcs11.conf
```

- b. Change every *cert_policy* line so that it contains the **ocsp_on** option.

```
cert_policy =ca, ocsp_on, signature;
```



NOTE

Because of the way the file is parsed, there *must* be a space between **cert_policy** and the equals sign. Otherwise, parsing the parameter fails.

8. If the smart card has not yet been enrolled (set up with personal certificates and keys), enroll the smart card, as described in [Section 5.3, “Enrolling a Smart Card Automatically”](#).
9. If the smart card is a CAC card, the PAM modules used for smart card login must be configured to recognize the specific CAC card.
 - a. As root, create a file called **/etc/pam_pkcs11/cn_map**.
 - b. Add the following entry to the **cn_map** file:

```
MY.CAC_CN.123454 -> login
```

MY.CAC_CN.123454 is the common name on the CAC card and *login* is the Red Hat Enterprise Linux login ID.

**TIP**

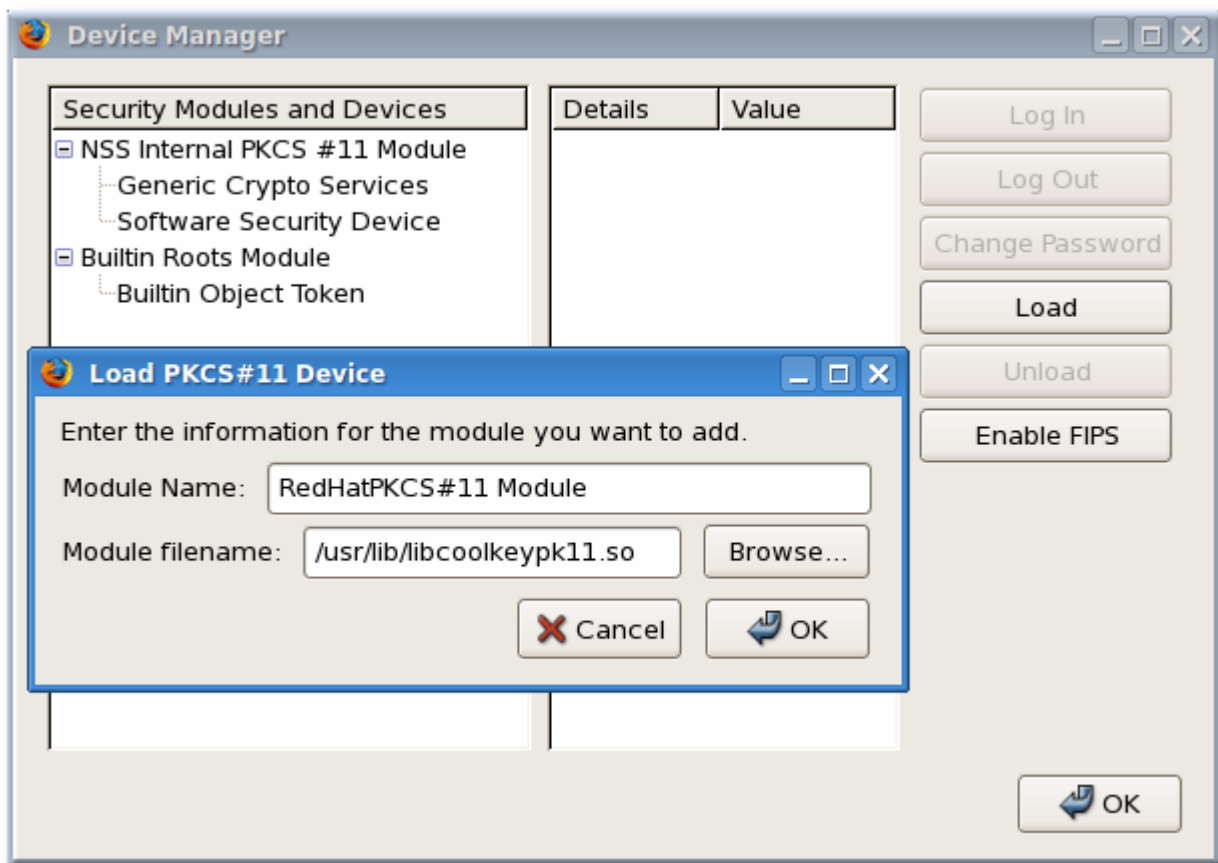
When a smart card is inserted, the **pklogin_finder** tool (in debug mode) first maps the login ID to the certificates on the card and then attempts to output information about the validity of certificates.

```
pklogin_finder debug
```

This is useful for diagnosing any problems with using the smart card to log into the system.

6.3. Setting up Browsers to Support SSL for Tokens

1. In Mozilla Firefox, open the **Edit** menu, choose **Preferences**, and then click **Advanced**.
2. Open the **Encryption** tab.
3. Add a PKCS #11 driver.
 - a. Click **Security Devices** to open the **Device Manager** window, and then click the **Load** button.
 - b. Enter a module name, such as **token key pk11 driver**.
 - c. Click **Browse**, find the Enterprise Security Client PKCS #11 driver, and click **OK**. The PKCS #11 module used by these applications, by default, is located in **/usr/lib/libcoolkeypk11.so**.



4. If the CA is not yet trusted, download and import the CA certificate.

a. Open the **SSL End Entity** page on the CA. For example:

```
https://server.example.com:9444/ca/ee/ca/
```

- b. Click the **Retrieval** tab, and then click **Import CA Certificate Chain**.
- c. Click **Download the CA certificate chain in binary form** and then click **Submit**.
- d. Choose a suitable directory to save the certificate chain, and then click **OK**.
- e. Click **Edit > Preferences**, and select the **Advanced** tab.
- f. Click the **View Certificates** button.
- g. Click **Authorities**, and import the CA certificate.

5. Set the certificate trust relationships.

- a. Click **Edit > Preferences**, and select the **Advanced** tab.
- b. Click the **View Certificates** button.
- c. Click **Edit**, and set the trust for websites.

The certificates can be used for SSL.

6.4. Using the Certificates on Tokens for Mail Clients

1. In Mozilla Thunderbird, open the **Edit** menu, choose **Preferences**, and then click **Advanced**.
2. Open the **Certificate** tab.
3. Add a PKCS #11 driver.

- a. Click **Security Devices** to open the **Device Manager** window.
- b. Click the **Load** button.
- c. Enter the module name, such as **token keypk11 driver**.
- d. Click **Browse**, find the Enterprise Security Client PKCS #11 driver, and click **OK**. The PKCS #11 module used by these applications, by default, is located in **/usr/lib/libcoolkeypk11.so**.

4. If the CA is not yet trusted, download and import the CA certificate.

- a. Open the **SSL End Entity** page on the CA. For example:

```
https://server.example.com:9444/ca/ee/ca/
```

- b. Click the **Retrieval** tab, and then click **Import CA Certificate Chain**.
 - c. Click **Download the CA certificate chain in binary form** and then click **Submit**.
 - d. Choose a suitable directory to save the certificate chain, and then click **OK**.
 - e. In Mozilla Thunderbird, open the **Edit** menu, choose **Preferences**, and then click **Advanced**.
 - f. Open the **Certificate** tab, and click the **View Certificates** button.
 - g. Click the **Authorities** tab, and import the CA certificate.
5. Set up the certificate trust relationships.
 - a. In Mozilla Thunderbird, open the **Edit** menu, choose **Preferences**, and then click **Advanced**.
 - b. Open the **Certificate** tab, and click the **View Certificates** button.
 - c. In the **Authorities** tab, select the CA, and click the **Edit** button.
 - d. Set the trust settings for identifying websites and mail users.
 - e. In the **Digital Signing** section of the **Security** panel, click **Select** to choose a certificate to use for signing messages.
 6. In the **Encryption** of the **Security** panel, click **Select** to choose the certificate to encrypt and decrypt messages.

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 , Data Recovery Manager agent .
agent services	<ol style="list-style-type: none">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	<i>Application protocol data unit</i> . 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 <i>attribute = value</i> , where <i>attribute</i> is a tag, such as o (organization) or uid (user ID), and <i>value</i> 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.

Glossary

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

	<p><i>infrastructure (PKI)</i>, a certificate must be issued and signed by a CA that is trusted by other entities enrolled in the PKI.</p>
certificate authority (CA)	<p>A trusted entity that issues a <i>certificate</i> 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.</p>
certificate chain	<p>A hierarchical series of certificates signed by successive certificate authorities. A CA certificate identifies a <i>certificate authority (CA)</i> 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 <i>root CA</i>. Certificate System allows any end entity to retrieve all the certificates in a certificate chain.</p>
certificate extensions	<p>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.</p>
certificate fingerprint	<p>A <i>one-way hash</i> 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.</p>
Certificate Management Message Formats (CMMF)	<p>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, <i>Certificate Management Messages over Cryptographic Message Syntax (CMC)</i>. For detailed information, see http://www.ietf.org/internet-drafts/draft-ietf-pkix-cmmf-02.txt.</p>
Certificate Management Messages over Cryptographic Message Syntax (CMC)	<p>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.</p>
Certificate Manager	<p>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 <i>certificate authority (CA)</i>.</p>
Certificate Manager agent	<p>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.</p>

Glossary

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, Data Recovery Manager , 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

Data Recovery Manager	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 Data Recovery Manager before issuing new certificates. The Data Recovery Manager 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.
Data Recovery Manager agent	A user who belongs to a group authorized to manage agent services for a Data Recovery Manager, including managing the request queue and authorizing recovery operation using HTML-based administration pages.
Data Recovery Manager recovery agent	One of the m of n people who own portions of the storage key for the Data Recovery Manager .
Data Recovery Manager storage key	Special key used by the Data Recovery Manager to encrypt the end entity's encryption key after it has been decrypted with the Data Recovery Manager's private transport key. The storage key never leaves the Data Recovery Manager.
Data Recovery Manager transport certificate	Certifies the public key used by an end entity to encrypt the entity's encryption key for transport to the Data Recovery Manager. The Data Recovery Manager uses the private key corresponding to the certified

	public key to decrypt the end entity's key before encrypting it with the storage key.
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 .
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](#).

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.

Glossary

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, DRM, OCSP, and RA) 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 that's 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](#).

Glossary

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 <i>cryptographic module</i> or <i>cryptographic service provider</i> , 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 Data Recovery Manager transport key that contains information about an archived end-entity key, including key serial number, name of the Data Recovery Manager, subject name of the corresponding certificate, and date of archival. The signed proof-of-archival data are the response returned by the Data Recovery Manager to the Certificate Manager after a successful key archival operation. See also Data Recovery Manager 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, Data Recovery Manager , 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 communication 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 .

Glossary

signing certificate	A certificate that's public key corresponds to a private key used to create digital signatures. For example, a Certificate Manager must have a signing certificate that's 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	<ol style="list-style-type: none">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 <code>jdoe@example.com</code> , or a computer can identify itself as a site called <code>www.redhat.com</code> 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 that's 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.
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token	A hardware or software device that is associated with a <i>slot</i> in a <i>PKCS #11 module</i> . 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 DRM — 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 <i>public-key infrastructure (PKI)</i> , trust refers to the relationship between the user of a certificate and the <i>certificate authority (CA)</i> 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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