

# Certificate Management

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## DESCRIPTION

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# 1 Understanding Certificate Management

## 1.1 Key Certificate Management Concepts

Certificate Management provides a management interface for certificate information, which is stored on the Managed Element (ME) and used for authentication and encryption purposes.

A certificate file is a proof of ownership of a public key for a subject. The subject can be a person, company, or other entity such as an ME. A certificate can be used in various ways, for example, for authentication. Certificate Authority (CA) is an entity that issues certificates.

The Certificate Management managed area is represented in the *CertM* Managed Object Class (MOC) within the Managed Object Model (MOM). For general information about the MOM, MOCs, cardinality, and related concepts, refer to *Managed Object Model User Guide*.

It is assumed that the reader is familiar with the following:

- Basics of the terms and concepts of ITU-T X.509 certificates
- Basics of the Certificate Management Protocol (CMP) for online enrollment

Certificate Management handles the following two major certificate categories:

- Node Credential consists of a (node) certificate and associated private key.

The node certificate is used as a proof of identity of the ME to other network elements. The private key is known by the ME only, and can be used by the secured services in the ME for various cryptographic actions. An ME can have several Node Credentials that can be used for different purposes, for example, one for O&M and another for IP Security (IPsec).

- Trusted certificate is a certificate of a CA that the operator trusts. The ME uses the CA certificate to verify the CA signature on the peer certificate, to ensure that the peer certificate is valid, before using the peer certificate to establish a secure connection.

For example, the CA trusted by the operator issues the certificate to a Lightweight Directory Access Protocol (LDAP) server. The certificate of this trusted CA is configured in the ME as a trusted certificate, and the ME verifies the LDAP server identity against the trusted certificate. A node credential containing valid node certificate must be configured in the ME to allow the LDAP server to accept LDAP/TLS connection from the ME.

Node certificates can be enrolled in the following ways:

- Certificate Signing Request (CSR) based offline enrollment



- PKCS#12 container-based offline enrollment
- CMP version 2 (CMPv2) based online enrollment

Trusted certificates are not subject to an enrollment operation triggered by the ME and are installed directly on the ME.

## 1.2 Chain Certificates

The certificate chain is a sequence of certificates that ensures the authenticity of the certificates from a trusted root certificate to the end certificate of ME identify as shown in Figure 1. The chain certificates in the node credential simplify the peers configuration because the peer does not have to contain all chain certificates of all MEs connecting to it.

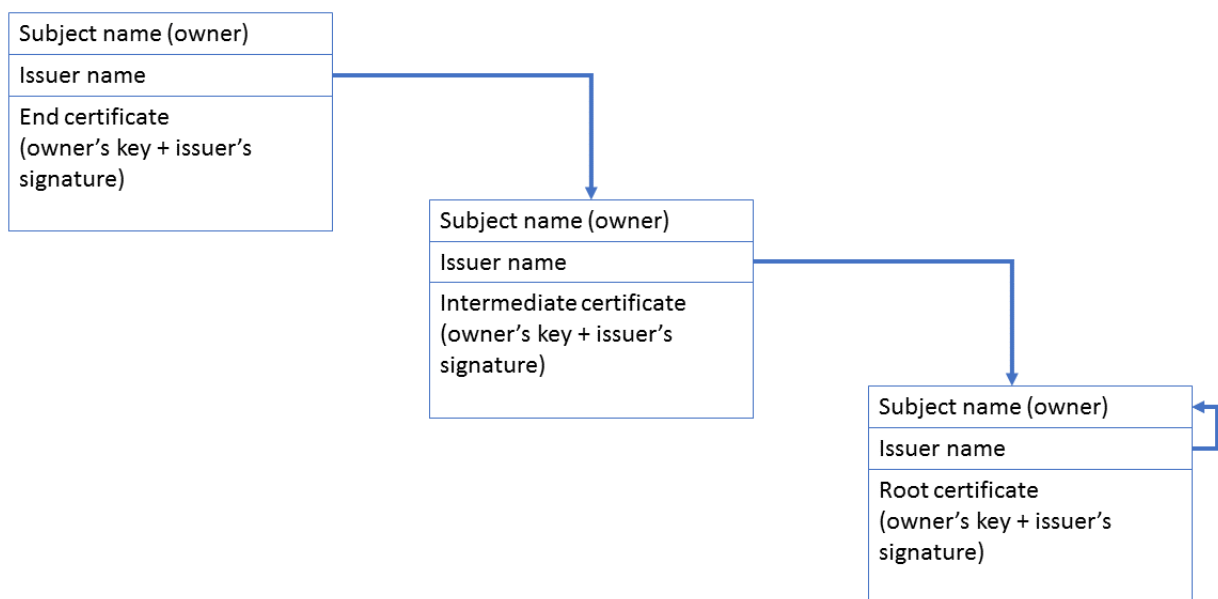


Figure 1 Chain of Trust

Chain certificates are automatically created in the certificate enrollment of the node credential, if the received enrollment data contains the chain of trust. The chain certificate-managed objects are created automatically under the node credential-managed object.



## 1.3 CSR-Based Offline Enrollment

The user can perform offline enrollment of a node certificate based on a CSR. The CSR is a PKCS#10 container file, prepared in the ME, and taken to a CA to enroll into a certificate that can be installed on the ME.

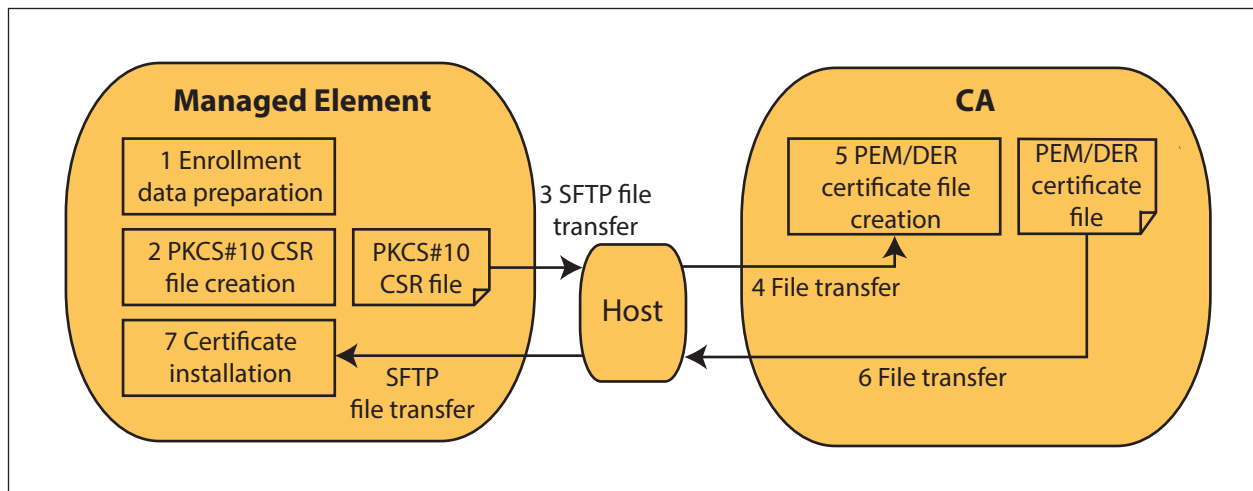


Figure 2 CSR-Based Offline Enrollment

The installation or renewal of a node credential by CSR consists of the following main phases:

- 1 In the ME, the user enters the data needed for the certificate generation.
- 2 The ME generates a private and public key pair for the certificate. The public key is written in the CSR file. The private key remains secret and stored in the ME.
- 3 The user downloads the CSR file from the ME to an external host with the SSH File Transfer Protocol (SFTP).
- 4 The user submits the CSR file further from the external host to the CA and requests the CA to generate a certificate from the file.
- 5 The CA generates the certificate file from the CSR file. The certificate is signed with the public key of the CA and written to a Privacy Enhanced Mail (PEM) or Distinguished Encoding Rules (DER) file. Installation of chain certificates requires the PEM format.
- 6 The user receives the certificate file on the external host from the CA. With this file, the user receives information of the correct fingerprint calculated from the file.
- 7 The user installs the certificate file in the ME. During this phase, the ME downloads the file with the SFTP and calculates the fingerprint from the file. The ME compares the result with the fingerprint value that the user entered. If the fingerprint values are equal, the certificate file is installed on the ME. Otherwise the file is discarded as invalid or corrupt for the

node certificate in question. The successful installation results in a Node Credential, which associates the installed node certificate and the private key generated in Page 3.

- 8 Enrollment action automatically creates chain certificates if they exist in the received enrollment data.

For further details on how to perform this operation, refer to *Install or Renew Node Credential by CSR*.

**Note:** The fingerprint, also known as digest, is used to control that a certificate file has not been compromised. The fingerprint value is an optional input parameter for certificate file installation. For further details on how to perform this operation, refer to *Generate Fingerprint for File*.

## 1.4 PKCS#12 Container-Based Offline Enrollment

The user can perform offline enrollment of a node certificate by installing a PKCS#12 container file. The file is issued by a CA and consists of a private key and a certificate. This enrollment is essentially a one-step offline enrollment.

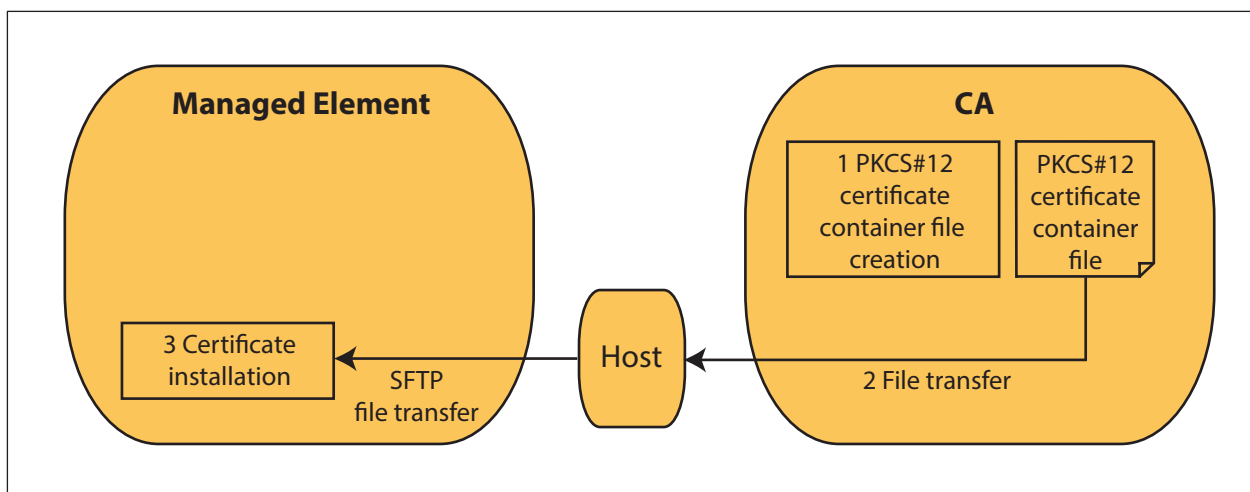


Figure 3 Installation or Renewal of a Node Credential by PKCS#12

The installation or renewal of a node credential by PKCS#12 consists of the following main phases:

- 1 The user requests a PKCS#12 certificate container file from the CA. The CA generates a private and public key pair for the certificate and writes both keys in the PKCS#12 file.
- 2 The user receives the PKCS#12 file from the CA into an external host. With the file, the user receives the password needed for decrypting the file and information of the correct fingerprint calculated from the file.
- 3 The user installs the PKCS#12 file in the ME. During this phase, the ME downloads the file from the external host with the SFTP. The ME decrypts





the downloaded file with an encryption password, provided by the user. The ME also calculates the fingerprint from the downloaded file. The ME compares the calculated fingerprint with the fingerprint value provided by the user. If the fingerprint values are equal, the PKCS#12 file is installed on the ME. Otherwise the file is discarded as invalid or corrupt for the node certificate in question. The successful installation results in a Node Credential, which associates the installed node certificate and the private key generated in Page 4.

- 4 Enrollment action automatically creates chain certificates if they exist in the received enrollment data.

**Note:** In addition to the public key, the PKCS#12 certificate container file also contains the private key for the node certificate. Thus, the PKCS#12 file received from the CA is protected with encryption. The user must specify the decryption key (parameter `credentialPassword`) when installing the file. This enables the ME to decrypt the file.

For further details on how to perform this operation, refer to *Install or Renew Node Credential by PKCS 12*.

**Note:** The fingerprint value is an optional input parameter for certificate file installation. For further details on how to perform this operation, refer to *Generate Fingerprint for File*.

## 1.5 CMPv2-Based Online Enrollment

The CMPv2 protocol is used to provide online certificate enrollment and automatic certificate renewal. It is an alternative to offline enrollment methods and the main advantages are to reduce operating expenses and remove the risk of undesired certificate expiration.

For further details on how to perform these operations, refer to *Install Node Credential Online* and *Renew Node Credential Online*.

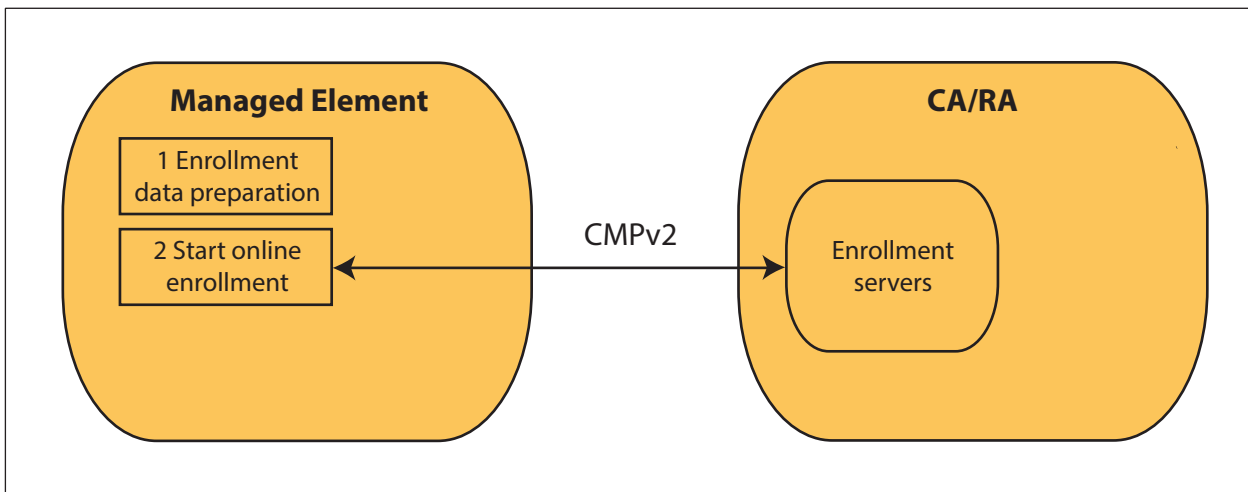


Figure 4 Installation of a Node Credential Online

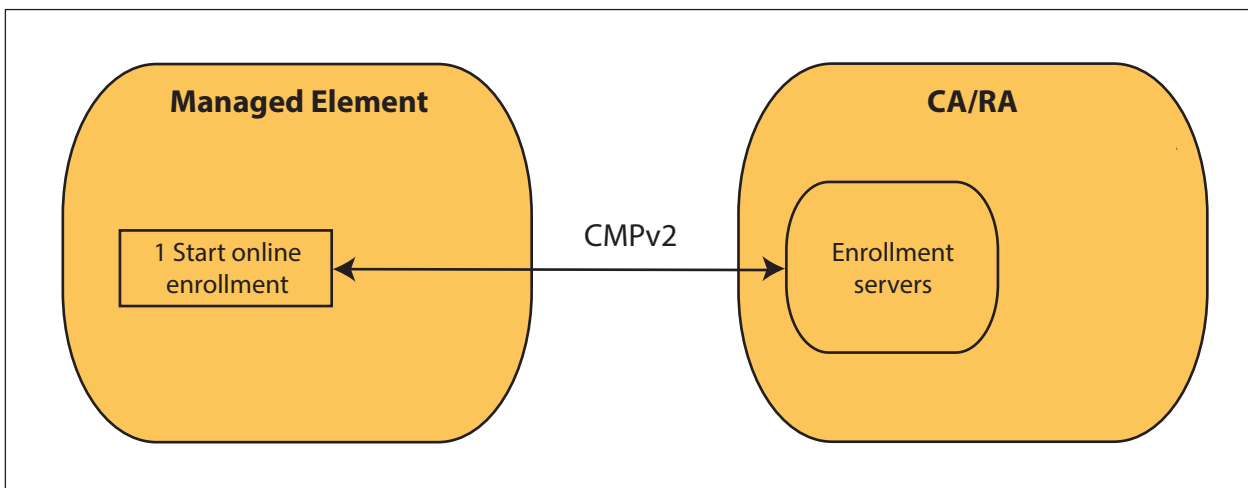


Figure 5 Renewal of a Node Credential Online

For online enrollments, an enrollment authority and an enrollment server must be preconfigured. An enrollment server is the front end to a CA or a Registration Authority (RA). To perform load balancing, servers can be grouped into server groups. Inside the server groups, an algorithm local to the ME can select any server to initiate the enrollment request. For further details on how to perform these operations, refer to *Configure Enrollment Authority*, *Configure Enrollment Server Group Together with Enrollment Servers*, and *Change Enrollment Server*.

The ME and the CA/RA provide a CMPv2 client and a CMPv2 server, respectively. The ME information, including enrollment password, must have been configured to a CA before starting initial online enrollment. Details vary depending on the CA solution used and are not described in this document. Enrollment actions automatically create chain certificates if they exist in the received enrollment data.



**Note:** If automatic renewal is used, the ME automatically updates the certificate when it is about to expire.

## 1.6 Trusted Certificate Installation

The user can install trusted certificates on the ME. The certificates are used to authenticate the communication peers. The user can organize trusted certificates into trust categories.

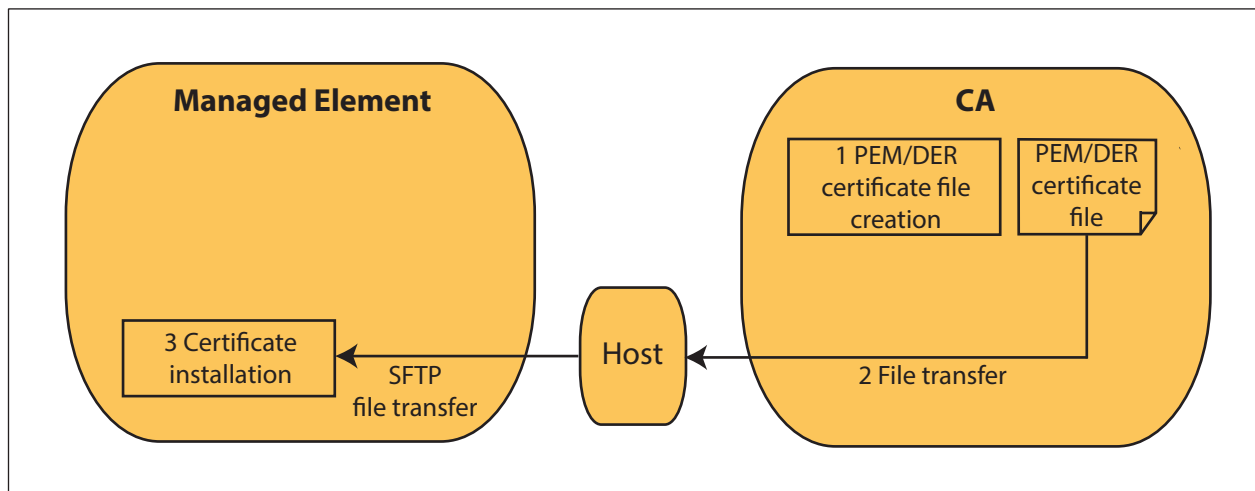


Figure 6 Overview of Installation of a Trusted Certificate

Trust categories can be referred by ME functions that intend to trust and use the corresponding certificates. Such ME functions play a credential user role.

The installation of a trusted certificate consists of the following main phases:

- 1 The CA prepares a PEM or DER certificate file for a trusted peer.
- 2 The user receives the CA certificate file in an external host. With the file, the user receives information of the fingerprint calculated from the file.
- 3 The user installs the certificate file on the ME as trusted certificate. During this phase, the ME downloads the file from the external host with the SFTP and calculates the fingerprint from the downloaded file. The ME compares the result with the fingerprint value provided by the user. If the fingerprint values are equal, the certificate file is installed on the ME. Otherwise the file is discarded as invalid or corrupt for the trusted certificate in question.

For further details on how to perform this operation, refer to *Install Trusted Certificate*.

For details on how to manage trusted certificates, refer to *Create Trust Category*, *Change Trust Category*, *Enable Trusted Certificate*, and *Disable Trusted Certificate*.



**Note:** The fingerprint value is an optional input parameter for certificate file installation. For further details on how to perform this operation, refer to *Generate Fingerprint for File*.

## 2 Basic Certificate Management Procedures

Certificate Management is accessed using NETCONF or the Ericsson Command-Line Interface (ECLI) to manipulate the Management Information Base (MIB).

The following operations can be performed by the user and are described in Operating Instructions using the ECLI:

### **Manage Node Credentials Offline**

- *Install or Renew Node Credential by CSR*
- *Cancel Offline Enrollment*
- *Install or Renew Node Credential by PKCS 12*
- *Generate Fingerprint for File*

### **Manage Node Credentials Online**

- *Configure Enrollment Authority*
- *Configure Enrollment Server Group Together with Enrollment Servers*
- *Change Enrollment Server*
- *Install Node Credential Online*
- *Renew Node Credential Online*
- *Configure Renewal Mode of Node Credential*
- *Delete Enrollment Server*
- *Delete Enrollment Authority*
- *Delete Enrollment Server Group*

### **Delete Node Credentials Offline or Online**

- *Delete Node Credential*



### Manage Trusted Certificates

- *Install Trusted Certificate*
- *Create Trust Category*
- *Change Trust Category*
- *Delete Trust Category*
- *Disable Trusted Certificate*
- *Enable Trusted Certificate*
- *Delete Trusted Certificate*

## 3 Certificate Management-Related Alarms

Table 1 Certificate Management-Related Alarms

Alarm	Description
<i>Certificate Management, a Valid Certificate is not Available</i>	Issued when the certificate is expired, revoked, or unavailable, which can result in failure of a secure service using this certificate.
<i>Certificate Management, Automatic Enrollment Failed</i>	Issued when automatic enrollment or renewal failed to execute because of local misconfiguration or remote enrollment service denial.
<i>Certificate Management, the Certificate is to Expire</i>	Issued when the threshold before certificate expiration has been crossed, and the certificate is to be renewed to prevent a secure service failure.



## 4 Security Management

The System Security Administrator role is required for the operations described in this document.

With the System Administrator role, certificate-related information can only be read.

For details about this role, refer to *User Management*.