INSYS icom

Industrial Data Communication

VPN with INSYS routers

Creating X509.v3 Certificates for VPNs with XCA

Configuration Guide

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1 Introduction

General

The present publication refers to a combination of selected hardware and software components of INSYS icom GmbH as well as other manufacturers. All components have been combined with the target to realize certain results and effects for certain applications in the field of professional data transfer.

All components have been prepared, configured and used as described in this publication. Thus, the desired results and effects have been achieved.

The exact descriptions of all used components, to which this publication refers, are described in the tables *Hardware, Accessories* and *Software* at the end of this publication.

The symbols and formattings used in this publication are explained in the correspondent section at the end of this publication.

Some configurations or preparations, which are precondition in this publication, are described in other publications. Therefore, always refer to the related device manuals. INSYS devices with web interface provide you with helpful information about the configuration possibilities, if you click on "display help text" in the header.0

Target of this Publication

An appropriate certificate structure is required for setting up a VPN network with certificate-based authentication.

You'll learn from this publication how to generate the key and certificate files for Certification Authority (CA), Server, and Clients as well as an optional Certificate Revocation List (CRL) required for this.

These files are necessary to set up an OpenVPN network. Refer to http://www.openvpn.eu for further information about OpenVPN.

Only the CA certificate and key and the certificates of the respective clients are required for setting up a VPN network with IPsec. The certificates for an IPsec participant are identical with those for the OpenVPN client. We refrain from a separate description of the creation of certificates and keys for an IPsec participant here.

The following figures show the distribution of the different keys and certificates across the different participants in the respective VPN networks. A Diffie Hellman parameter set exists by default on the INSYS router, but can also be replaced manually.

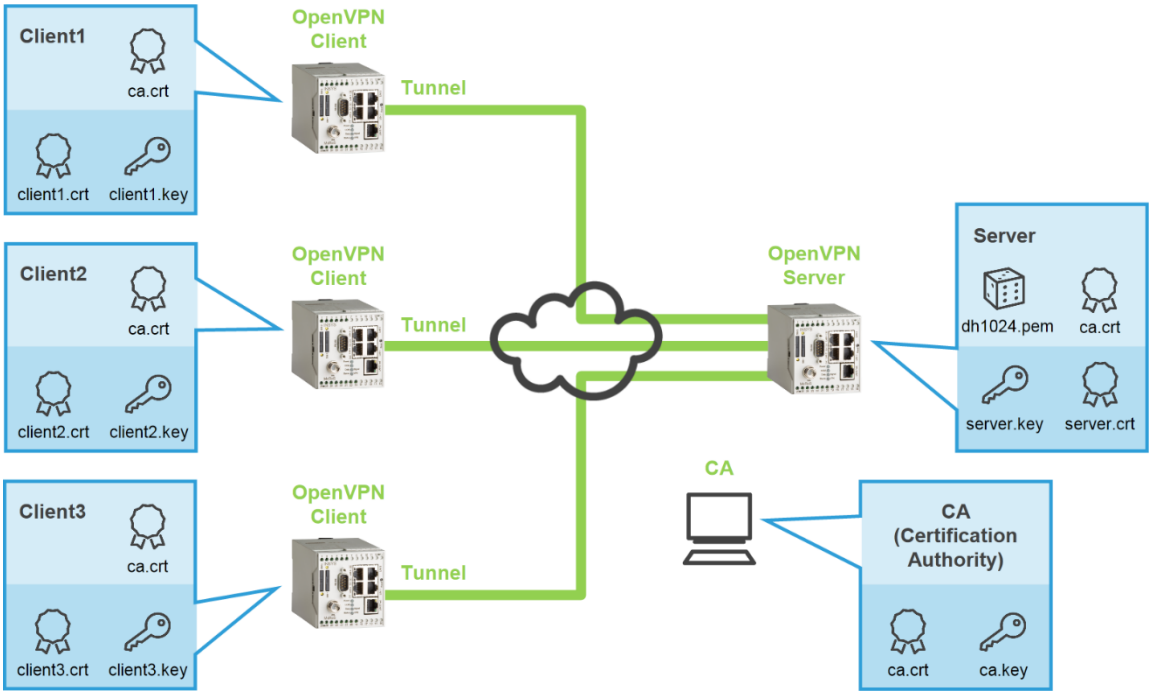


Figure 1: CA certificate structure for OpenVPN server and client with certificate-based authentication, here MoRoS as server and clients

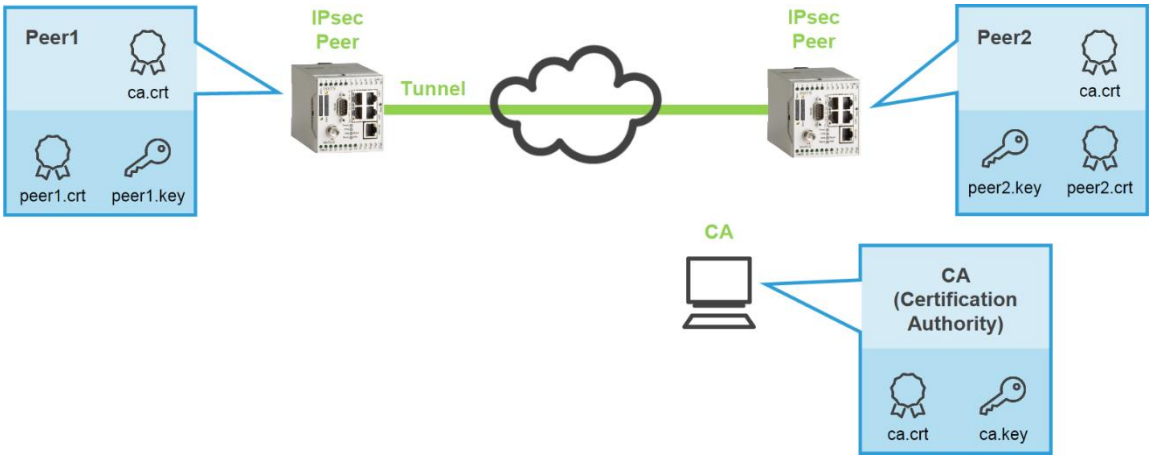


Figure 2: CA certificate structure for IPsec participant with certificate-based authentication, here MoRoS as participant

2 Configuration

2.1 Provisions and Presettings

Provisions

Please prepare the following items before starting the configuration:

- Downloading XCA
- Installing XCA on Windows PC

- **Downloading XCA**

  How to download the XCA software.

→ PC with approx. 30 MB free disk space
→ Web browser
→ Internet connection

1. Open http://sourceforge.net/projects/xca/ to download the software
2. Click on Download.

ⓘ *If a more recent version is available, download this.*

3. Save the file on your PC.

   ✓ You have downloaded the XCA software with this.

- **Installing XCA on Windows PC**

  How to install the XCA software for creating the certificates and keys on your PC successfully.

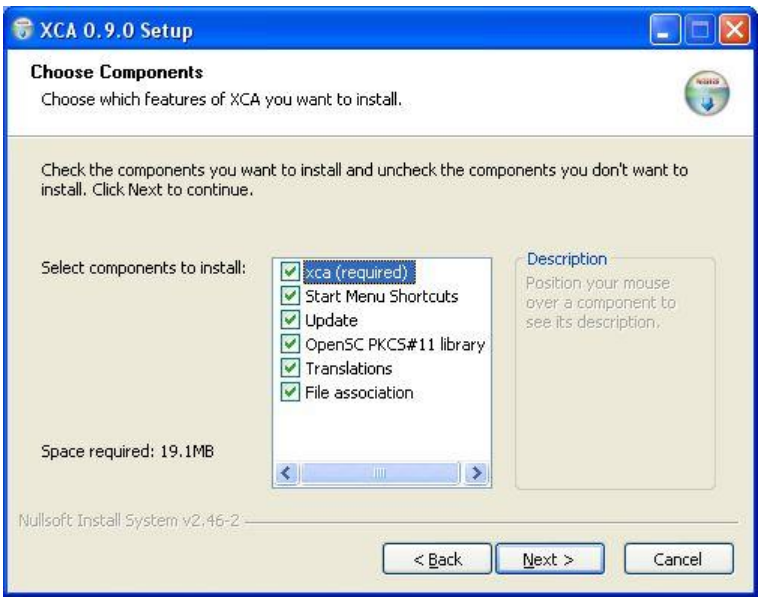
→ You have downloaded the XCA setup file (version 0.9.1 or higher).

1. Execute the installation file (e.g.“setup_xca-0.9.1.exe“)

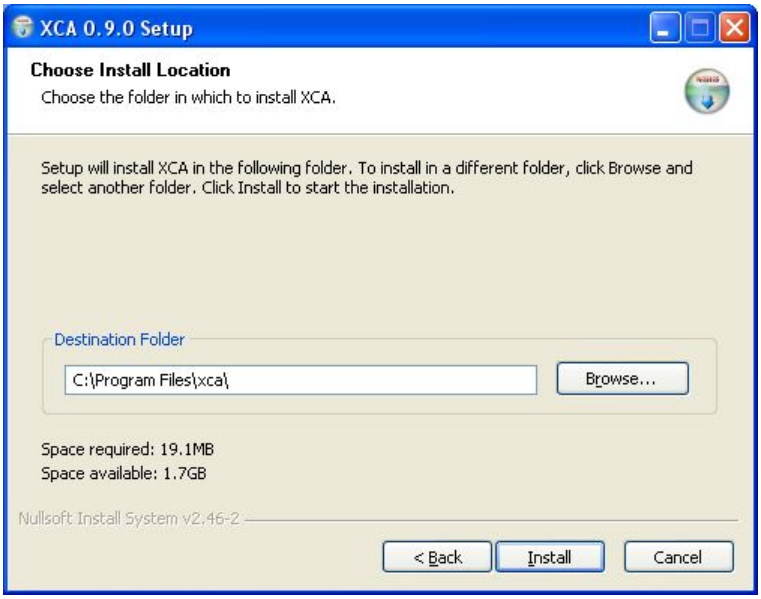
   ⓘ *Execute the installation file under Windows 7 by opening the context menu with a right-click and selecting "Run as administrator".*

   ✓ If a security warning is displayed, acknowledge it.

2. Select "English" as installation language and click on OK.
3. Accept the licence agreement with I Agree.
   ✓ The component selection window appears:



4. Accept the selection of all components and click on Next.
   ✓ The target directory selection window appears:



5. Specify the target directory and click on Install.
6. Complete the installation with Finish.
   ✓ You have successfully installed the XCA software on your PC and completed the provisions with this.

Presettings in XCA

You have to create a project database before you can generate a certificate structure with XCA. All keys and certificates of this CA project are stored in this database.

It is helpful to create templates for CA, server and client certificates for a quick and accurate creation of key and certificate files.

Perform the following presettings for this:

- **Starting XCA and Creating a Database**
- **Creating a CA Template**
- **Creating a Server Template**
- **Creating a Client Template**

■ Starting XCA and Creating a Database

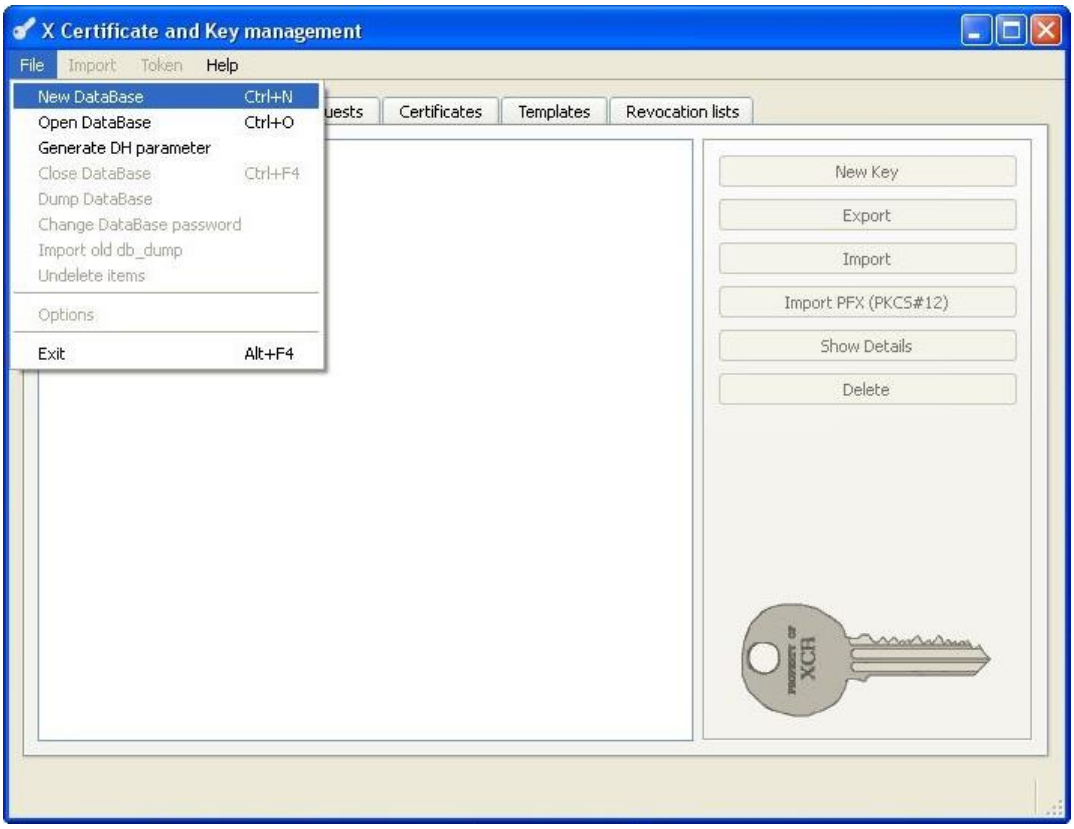
How to start the XCA software and create a new database for the CA project.

→ You have successfully installed the XCA software on your PC.

1. Select in the start menu Program Files → xca → xca

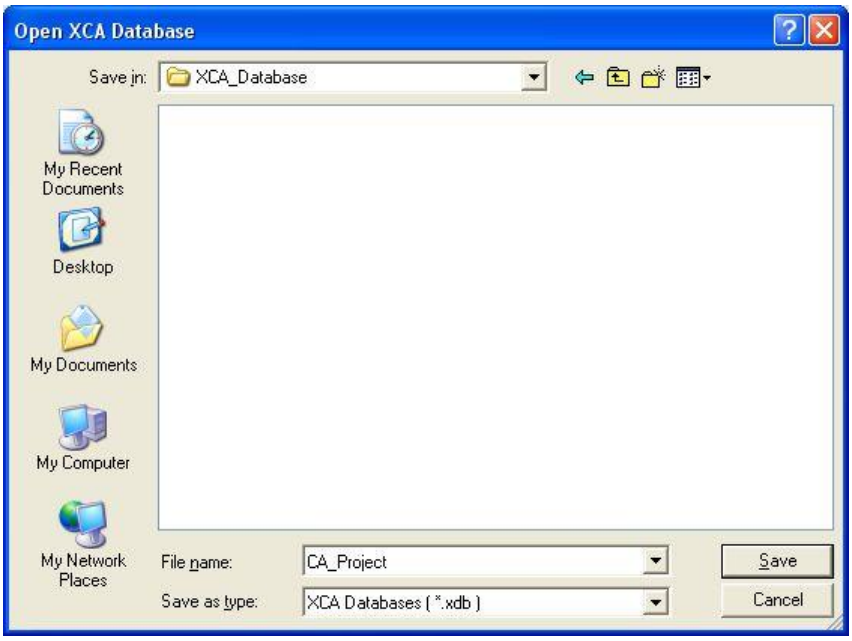
   ⓘ *Execute the program under Windows 7 by opening the context menu with a right-click on "xca" and selecting "Run as administrator".*

   ✓ The XCA window appears:



2. Select in the "File" menu the option "New DataBase".

✓ The database selection window appears:



3. Specify path and file name and click on Save.

✓ The password definition window appears:

4. Specify a password and click on Install.

ⓘ *We strongly recommend to specify a password. Keep this password in mind. You'll need it every time you want to open the database of this CA project.*

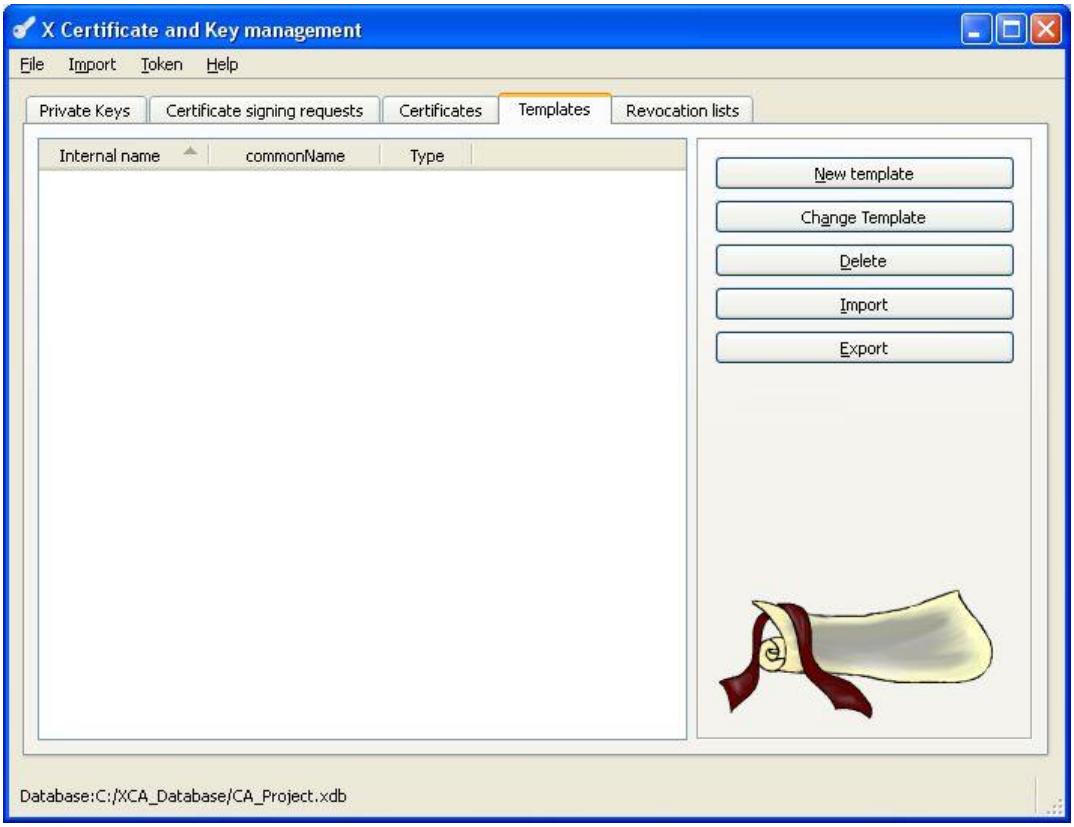
✓ You have created a new database for the CA project with this.

Creating a CA Template

How to create a template for CA certificates.

→ The XCA software is started and the project database is opened.

1. Change to the "Templates" tab.

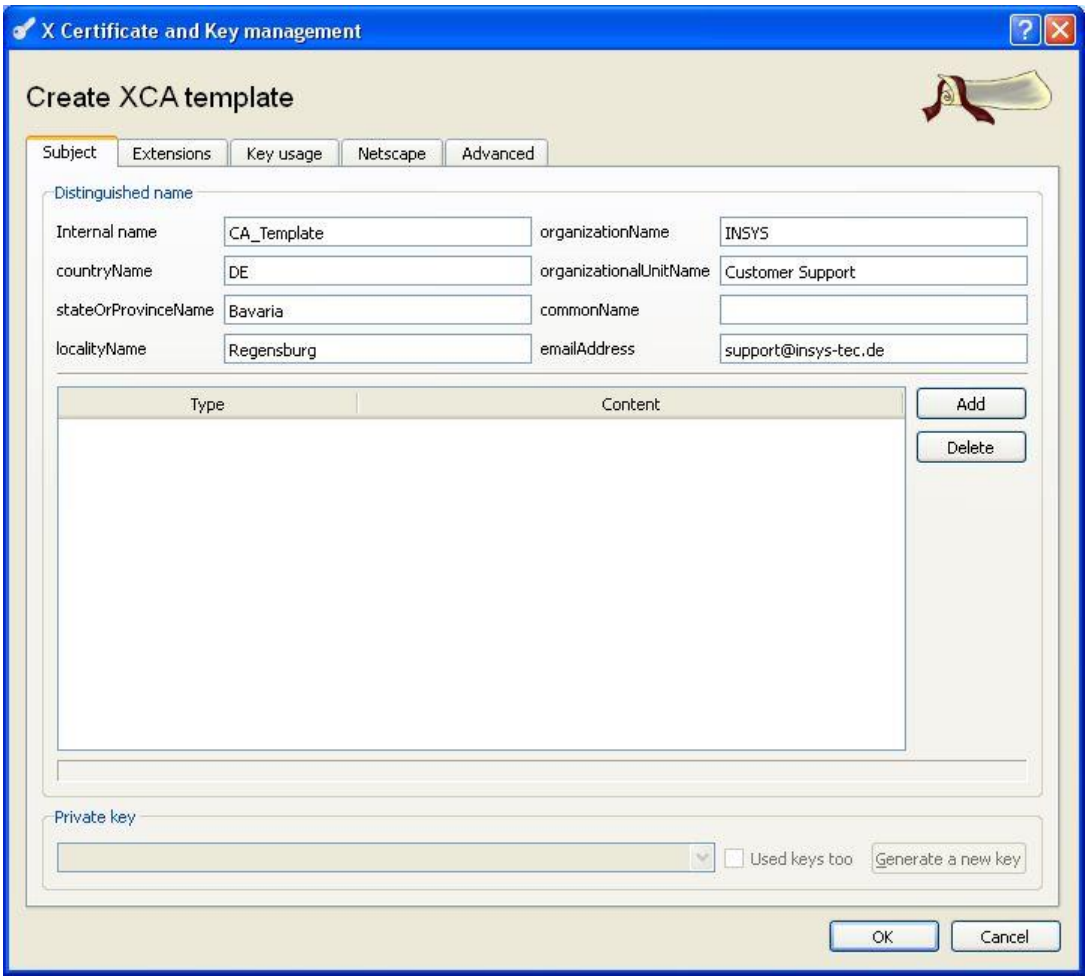


2. Select New Template.

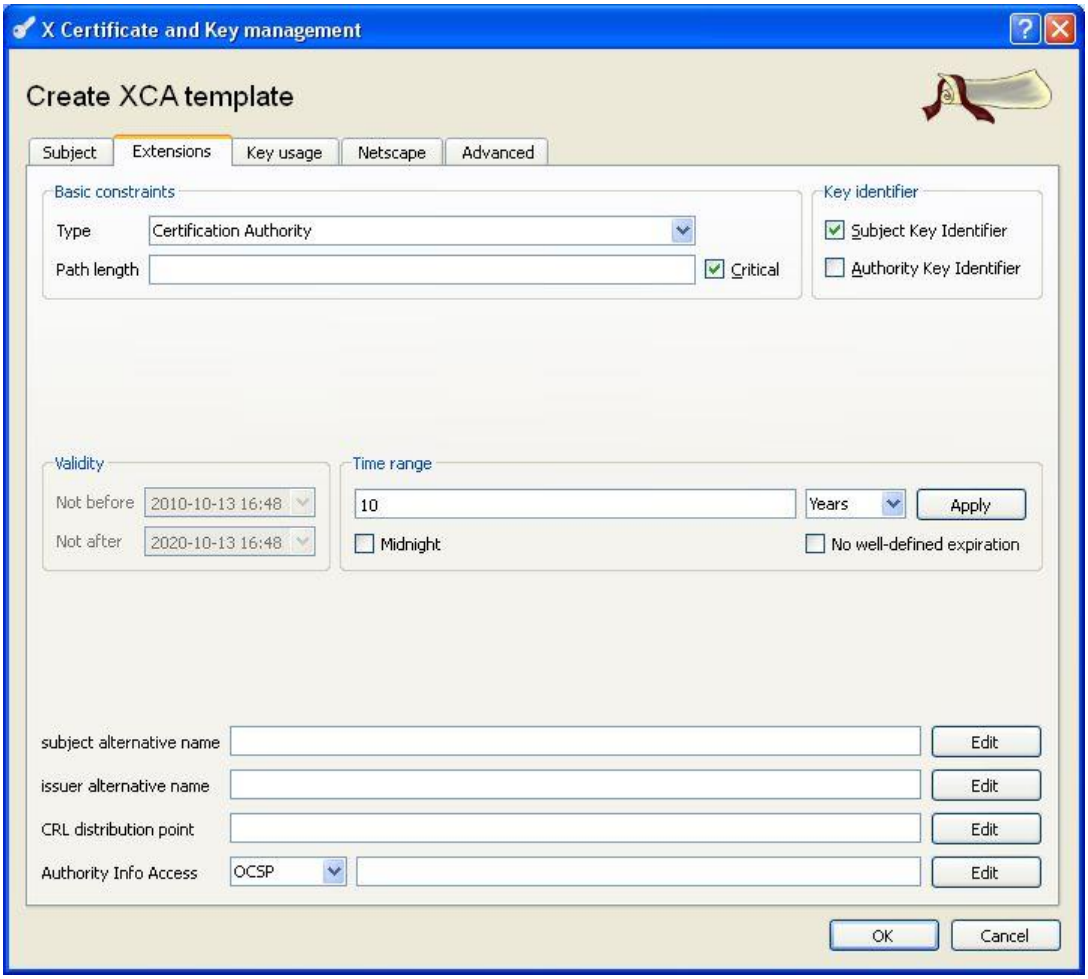
   ✓ The template value selection window appears:

3. Select "CA" and click on OK.

✓ The template creation window appears:



4. Define your default values without specifying a "Common Name".
5. Change to the "Extensions" tab.



6. If required, adjust the validity period of the certificate and click on OK.

   ⓘ *Select a time range that is reasonable for your purpose. The default values are a good guideline. Too long time ranges may cause security or compatibility problems.*

7. Confirm the template creation with OK.

   ✓ You have created a CA certificate template with this. When using this template while creating a CA certificate, the respective fields are initialised with the default values entered here.

Creating a Server Template

When creating the server certificate template, proceed in the same way as for the CA, but select "HTTPS_server" when selecting the preset template values.

Creating a Client Template

When creating the client certificate template, proceed in the same way as for the CA or server template, but select "HTTPS_client" when selecting the preset template values.

2.2 Creating Certificates

Creating a Certificate Structure with XCA

A Public Key Infrastructure (PKI) comprises services for encryption and digital signature on the basis of public key procedures.

First, the files for the CA (Certification Authority) are generated. Then, a key pair is generated for the server and each client. One key pair for both clients (participants) is necessary for setting up an IPsec connection. These key pairs will be uploaded to the respective devices later.

You will need the following files for setting up an OpenVPN network with certificate-based authentication:

For the OpenVPN server:

the CA certificate (e.g. ca.crt)

the server certificate (e.g. server.crt)

the server key (e.g. server.key)

a Diffie-Hellman parameter set (e.g. dh1024.pem)

ⓘ *The generation of a Diffie-Hellman parameter set using XCA (menu File – Generate DH parameter) is not described here, because such is stored on each INSYS router in delivery state. The Diffie-Hellman parameter set can be downloaded in the INSYS router web interface on the "OpenVPN-Server" page in the "Authentication based on certificate" section.*

For <u>each</u> OpenVPN client (1-n):

the CA certificate (e.g. ca.crt)

a client certificate (e.g. client1.crt)

a client key (e.g. client1.key)

ⓘ *A separate pair of certificate and key is necessary for each OpenVPN client.*

ⓘ *The CA certificate is the same for each client (and also the server).*

ⓘ *The respective keys are secret and may only be known by the related OpenVPN participant besides the issuing CA. The CA key is essential for the security of the OpenVPN network. It must be kept top secret by the CA and never be exported.*

You will need the following files for setting up an IPsec connection with certificate-based authentication:

For <u>each of both</u> IPsec participants:

the CA certificate (e.g. ca.crt)

a participant certificate (e.g. peer1.crt)

a participant key (e.g. peer1.key)

ⓘ *The respective keys are secret and may only be known by the related VPN participant besides the issuing CA. The CA key is essential for the security of the VPN network and must be kept top secret by the CA.*

Generate the files in the sequence of the following sections:

- Generating CA Certificate and Key
- Generating Certificate and Key for a Server
- Generating Certificate and Key for a Client

Generating CA Certificate and Key

How to create your own certification authority (CA, Certificate Authority) with XCA. The CA certificate structure comprises the secret key and the public certificate.

ⓘ *The non-disclosure of the key is essential for the security of the complete network.*

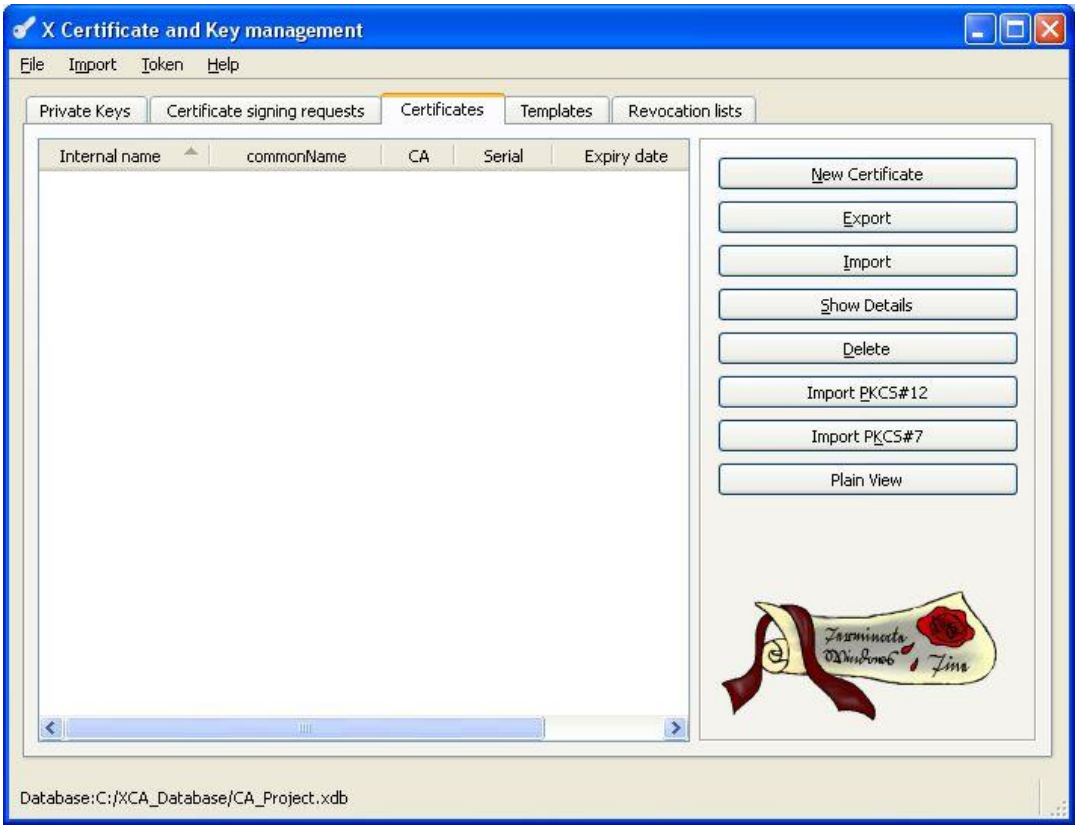
→ The XCA software is started and the project database is opened.

→ A CA template has been created.

→ Time and date of the PC are correct.

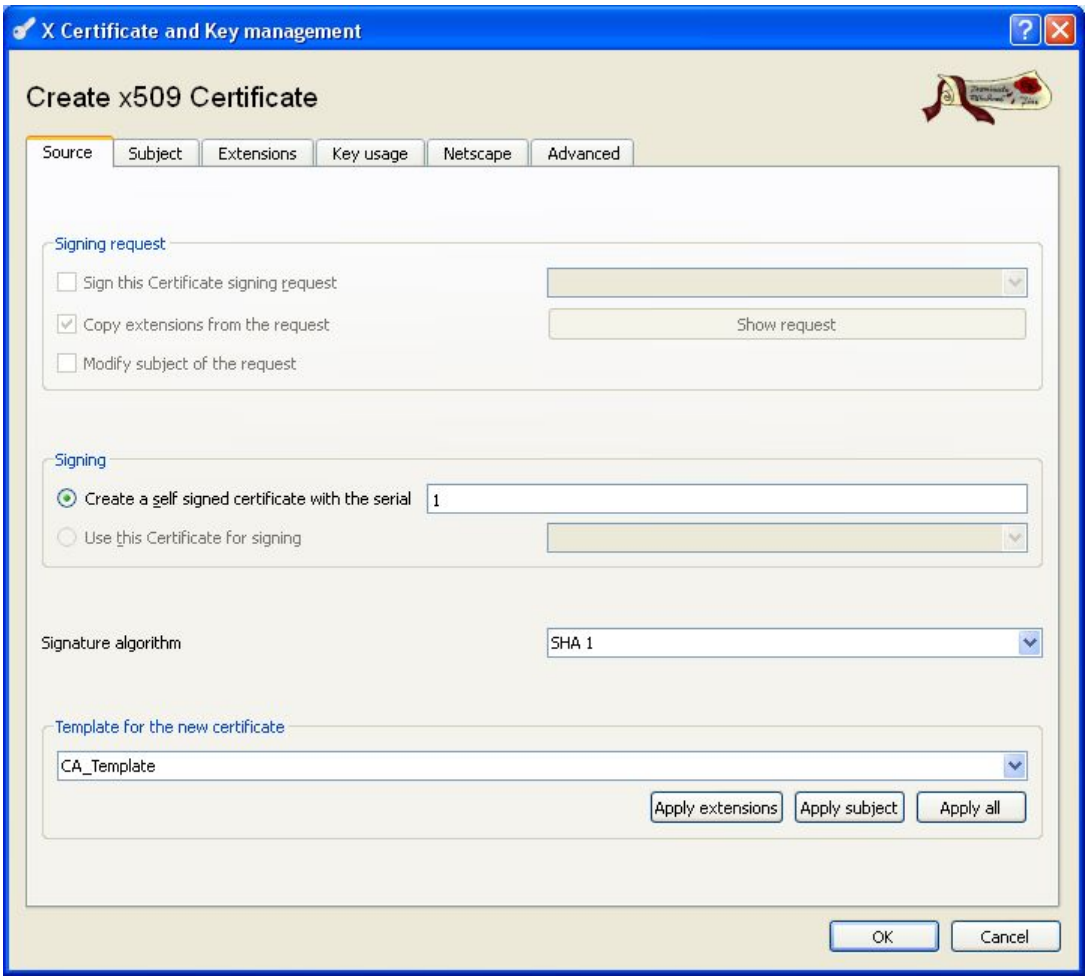
ⓘ *Certificates have an expiry date. A wrong system time (time and date) is a frequent failure source. Therefore, ensure that the system time of the PC and the INSYS router is correct when creating as well as commissioning the server or clients.*

1. Change to the "Certificates" tab.

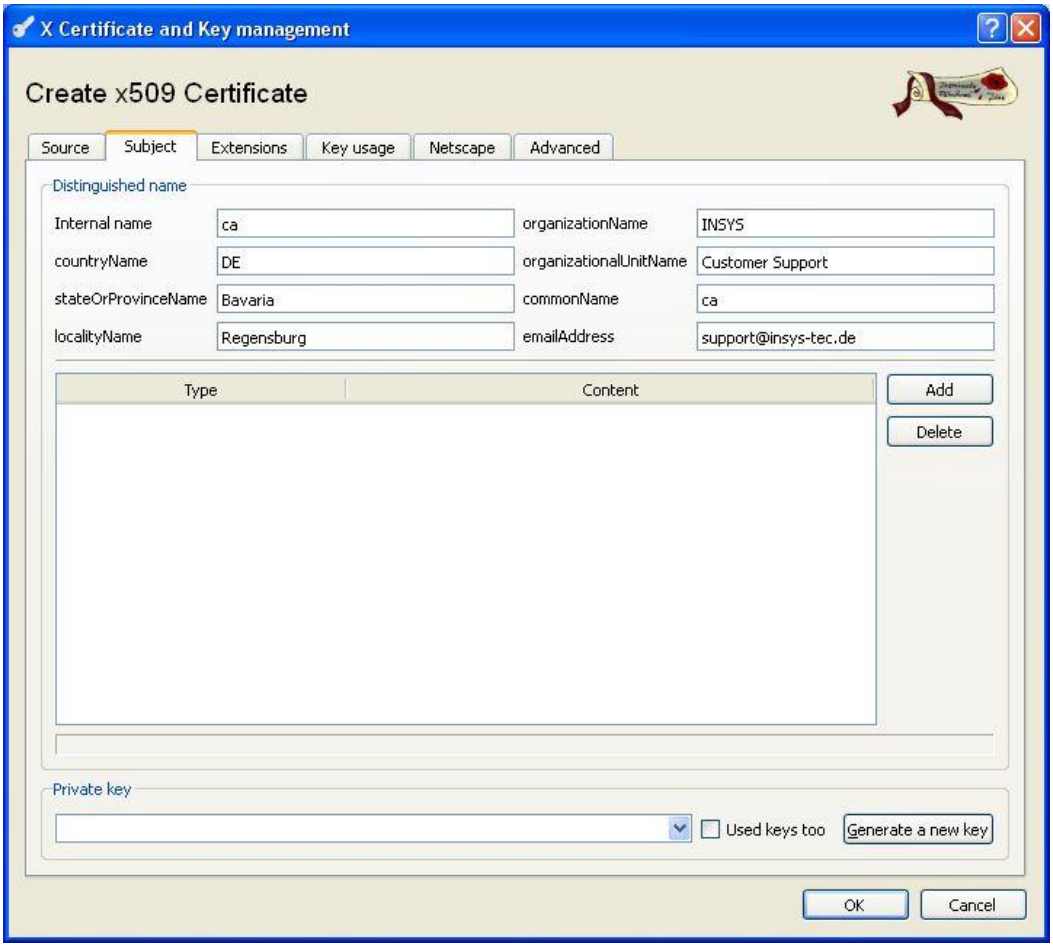


2. Select New Certificate.

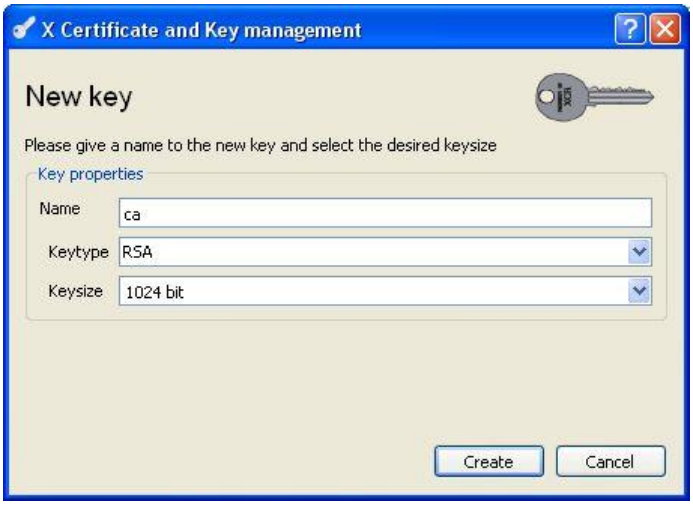
✓ The dialogue window for creating a certificate appears:



3. Select the previously created CA template as template.
4. Click on Apply all.
5. Change to the "Subject" tab.



6. Specify the "Common Name" and assign this also as internal name (e.g. "ca").
7. Click on Create a new key.
   ✓ The dialogue window for creating a new key appears:



8. Preferably assign the same name like the "Common Name".
9. Click on Create.
10. Confirm the key creation with OK.
11. Click on OK.
12. Confirm the certificate creation with OK.
    ✓ The CA creation is completed with this.

Generating Certificate and Key for a Server

How to generate the private key and the public certificate for a server with XCA.

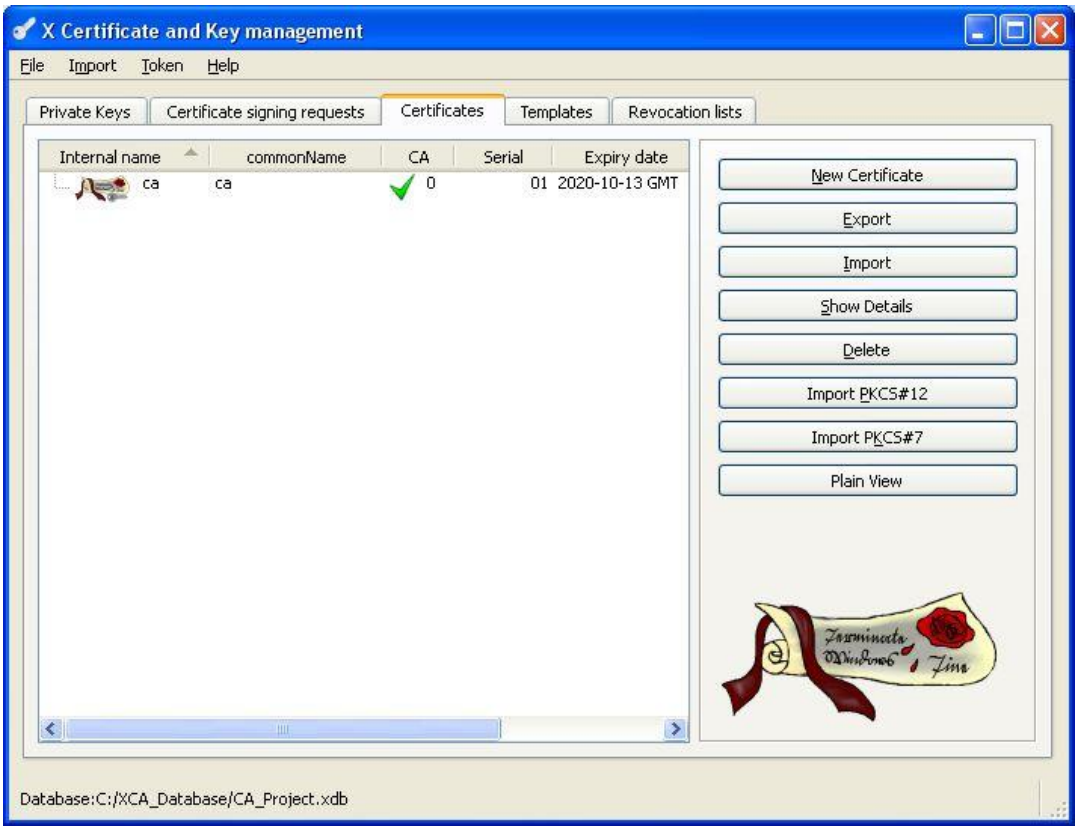
You need a "Common Name" for the server for the generation. The "Common Name" is the unique member name of a participant in the secured network and is used for routing into the client networks for example. The "Common Name" must only be used for one participant and cannot be changed any more after the generation. Observe the capitalization for the "Common Name" and preferably use only one of these possibilities consistently.

ⓘ *The maximum length of the "Common Name" for all INSYS routers is 29 characters (15 characters for MoRoS 1.3).*

→ The XCA software is started and the project database is opened.
→ A server template has been created.
→ A CA certificate has been created.
→ Time and date of the PC are correct.

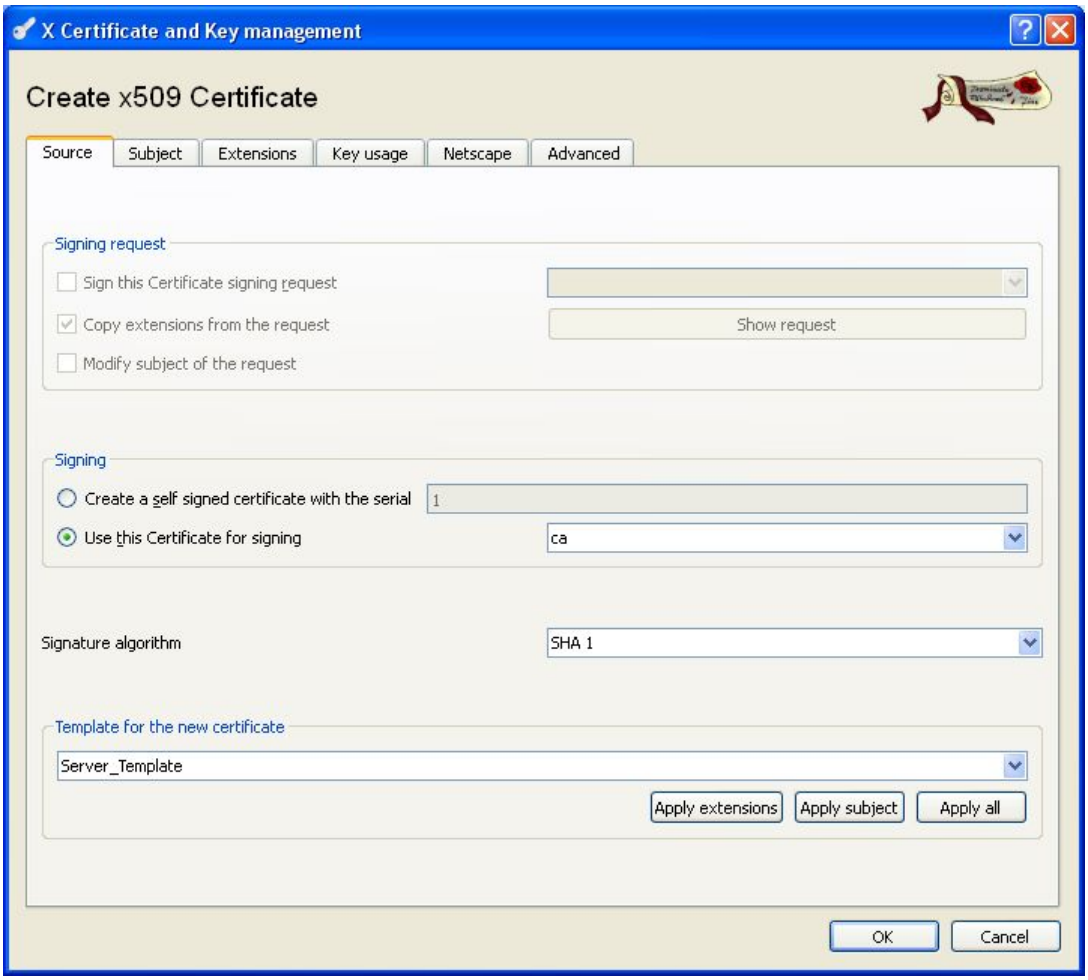
ⓘ *Certificates have an expiry date. A wrong system time (time and date) is a frequent failure source. Therefore, ensure that the system time of the PC and the INSYS router is correct when creating as well as commissioning the server or clients.*

2. Change to the "Certificates" tab.

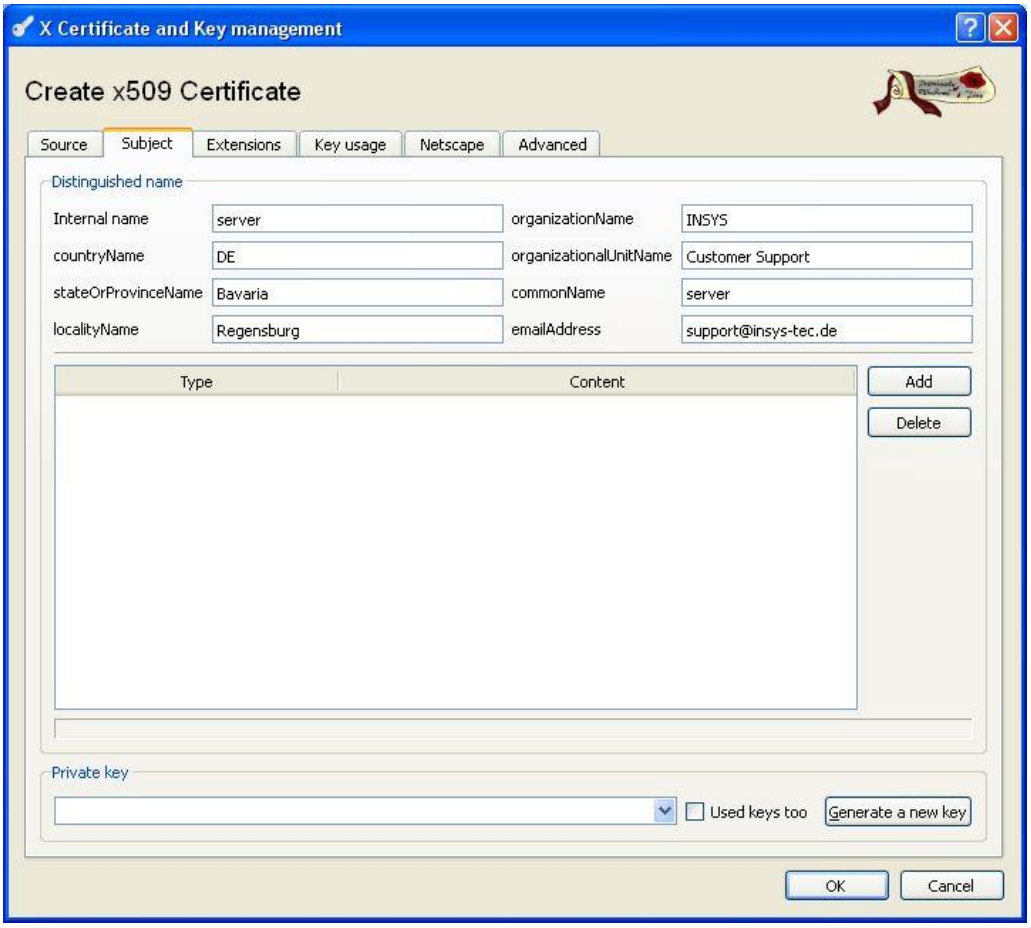


3. Highlight the CA certificate and select New Certificate.

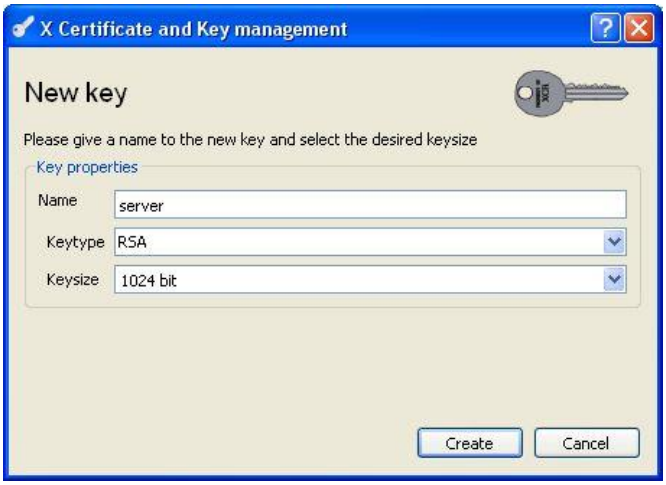
✓ The dialogue window for creating a certificate appears:



4. Select the previously created CA certificate in the "Signing" section.
5. Select the previously created server template in the "Template for new certificate" section.
6. Click on Apply all.
7. Change to the "Subject" tab.



8. Specify the "Common Name" and assign this also as internal name (e.g. "server").
9. Click on Create a new key.
   ✓ The dialogue window for creating a new key appears:



10. Preferably assign the same name like the "Common Name".
11. Click on Create.
12. Confirm the key creation with OK.
13. Click on OK.
14. Confirm the certificate creation with OK.
    ✓ The generation of server certificate and key is completed with this.

Generating Certificate and Key for a Client

When generating certificate and key for a client, proceed in the same way as for the server, but select the client template when selecting a template.

If required, generate further client certificates.

2.3 Exporting Certificates

Exporting Certificates and Keys from XCA

The certificates and keys created with XCA are stored in the respective XCA database. In order to upload the certificates and keys to the respective INSYS router, these must be exported.

XCA offers different file formats for export. We describe the export to the data format PKCS#12 in this manual, because this is suitable for all INSYS routers except MoRoS PRO of version 1. In addition, PKCS#12 allows to export complete key pairs into a container, which reduces the upload effort. Since the certificate chain can also be exported, the CA certificate does not have to be exported separately. A password protection can be applied starting with firmware 2.3.0 with this.

ⓘ *Never export the CA key, because this is essential for the security of the VPN network.*

Export the certificates and keys in the sequence of the following sections:

- Exporting the Server Certificate Container
- Exporting the Client Certificate Container

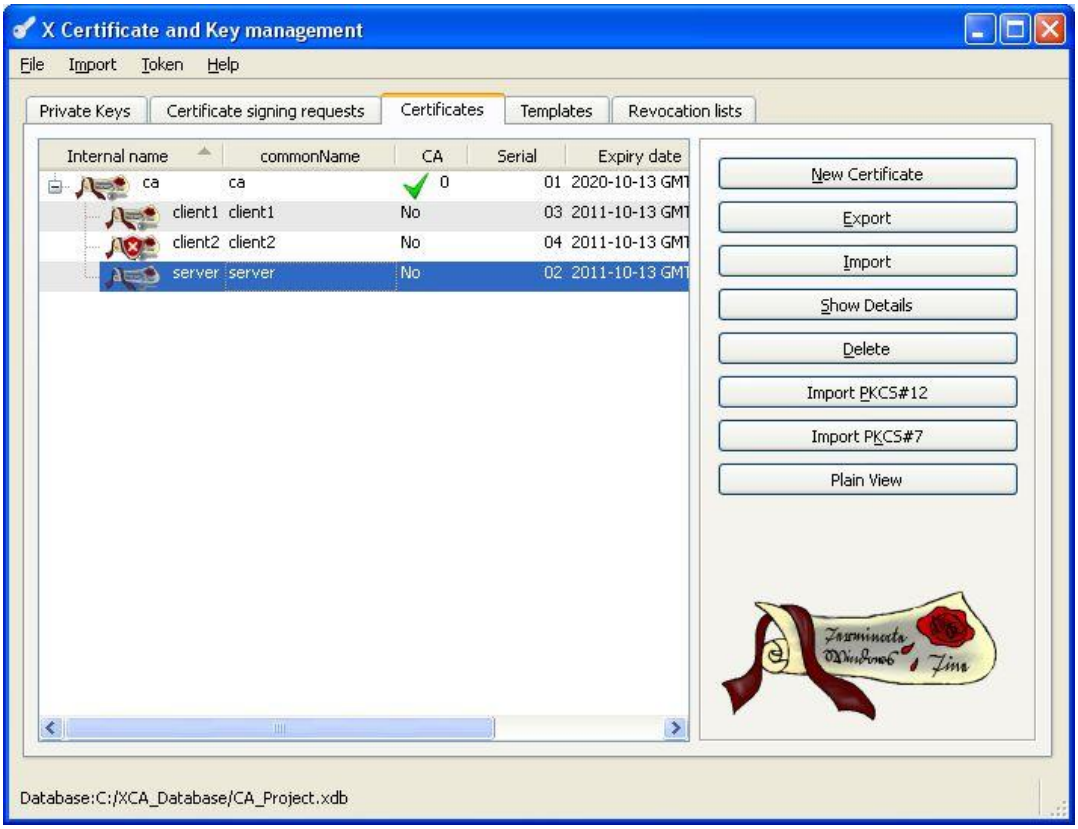
- Exporting the Server Certificate Container

  How to export the generated server key pair from the XCA database into a PKCS#12 container. The container contains the server certificate and the associated public key. If the certificate chain is exported with them, the CA certificate will also be packed into the container.

→ The XCA software is started and the project database is opened.

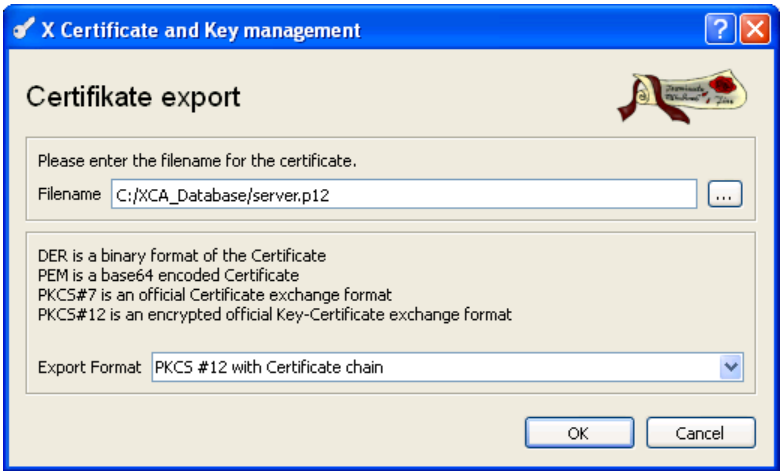
→ A server certificate has been created.

1. Change to the "Certificates" tab.



2. Highlight the server certificate and select Export.

✓ The certificate export dialogue window appears:

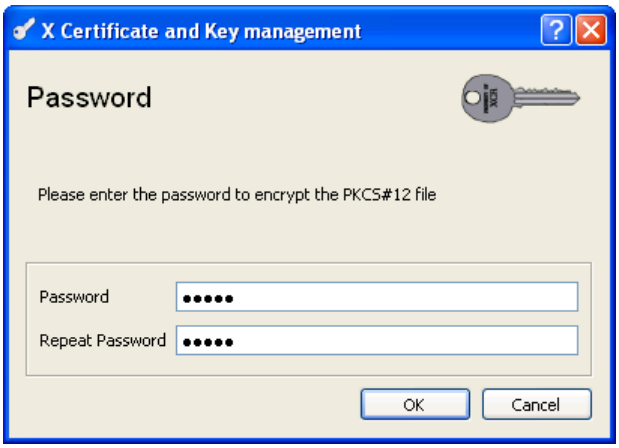


3. Specify a path and file name.

ⓘ *It is recommended to select the file name identical to the "Common Name" to enhance clarity if this is not contrary to any security concerns.*

4. Select the export format "PKCS#12 with Certificate chain".
5. Click on OK.

✓ The password definition window appears:



6. Specify a password if you want to enhance the security of the certificate file transmission and click on OK

   ✓ You have exported the server certificate container with this.

Exporting the Client Certificate Container

When exporting the certificate containers for the individual clients, proceed in the same way as for the export of the server certificate container.

2.4 Revoking Certificates

Revoking Certificates

It is possible to create a Certificate Revocation List (CRL) for OpenVPN, which contains the revoked certificates. If certificates have to be revoked before their expiry (due to misuse for example), they can be entered into this list. Every updated list must then be uploaded to the device, which acts as OpenVPN server.

Proceed in the sequence of the following sections to revoke certificates:

- Revoking a Certificate
- Generating a Certificate Revocation List
- Exporting a Certificate Revocation List

- Revoking a Certificate

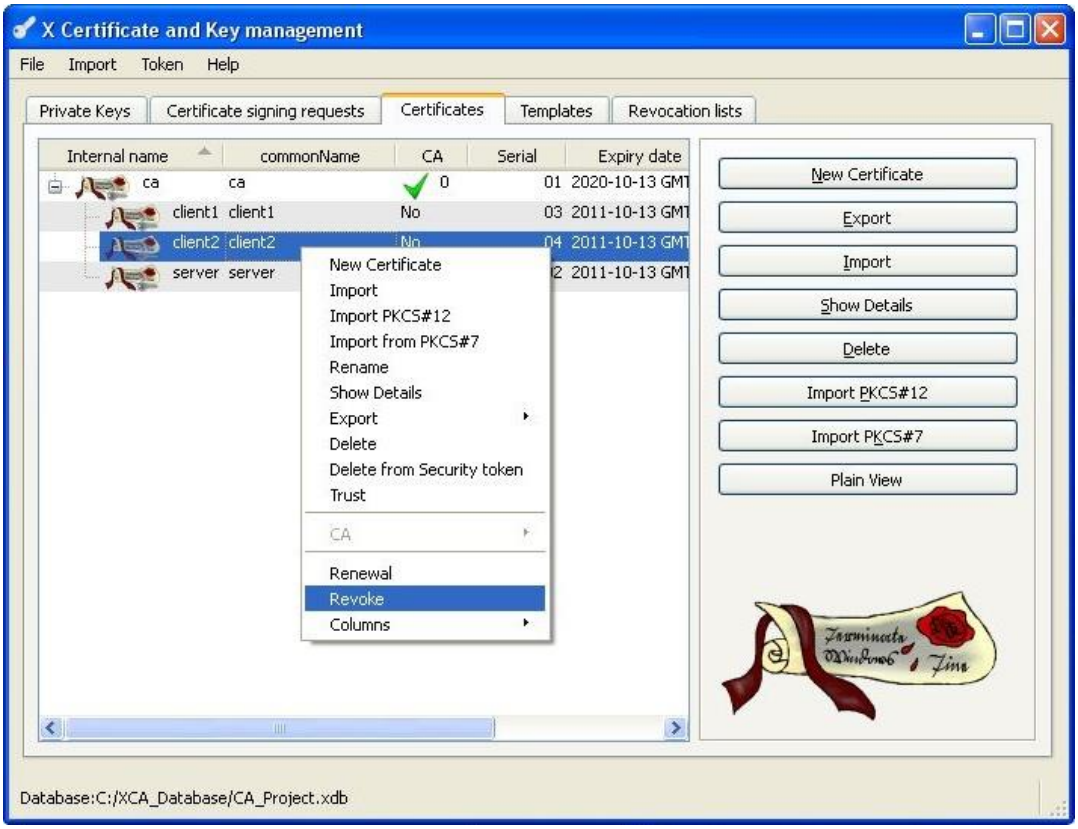
  How to revoke a certificate before its expiry date (due to misuse for example) to add it to the Certificate Revocation List.

  ⓘ *A Certificate Revocation List is not mandatory for setting up an OpenVPN network with certificate-based authentication.*

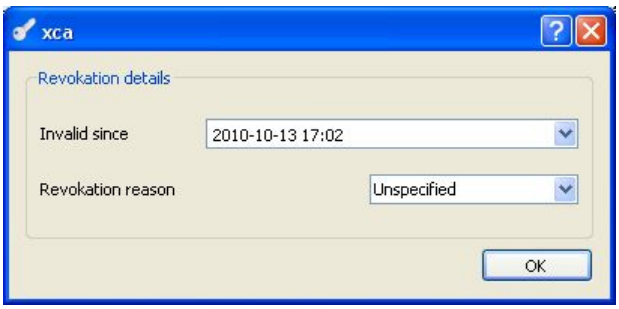
→ The XCA software is started and the project database is opened.

→ Client or server certificates have already been created.

1. Change to the "Certificates" tab.



2. Select the certificate you want to revoke and select in the context menu (right-click) "Revoke".



3. If require, select a reason for the revocation and click on OK.

   ✓ You have prepared the certificate for a revocation with this.

   ⓘ *The Certificate Revocation List must be generated again after this.*

■ Generating a Certificate Revocation List

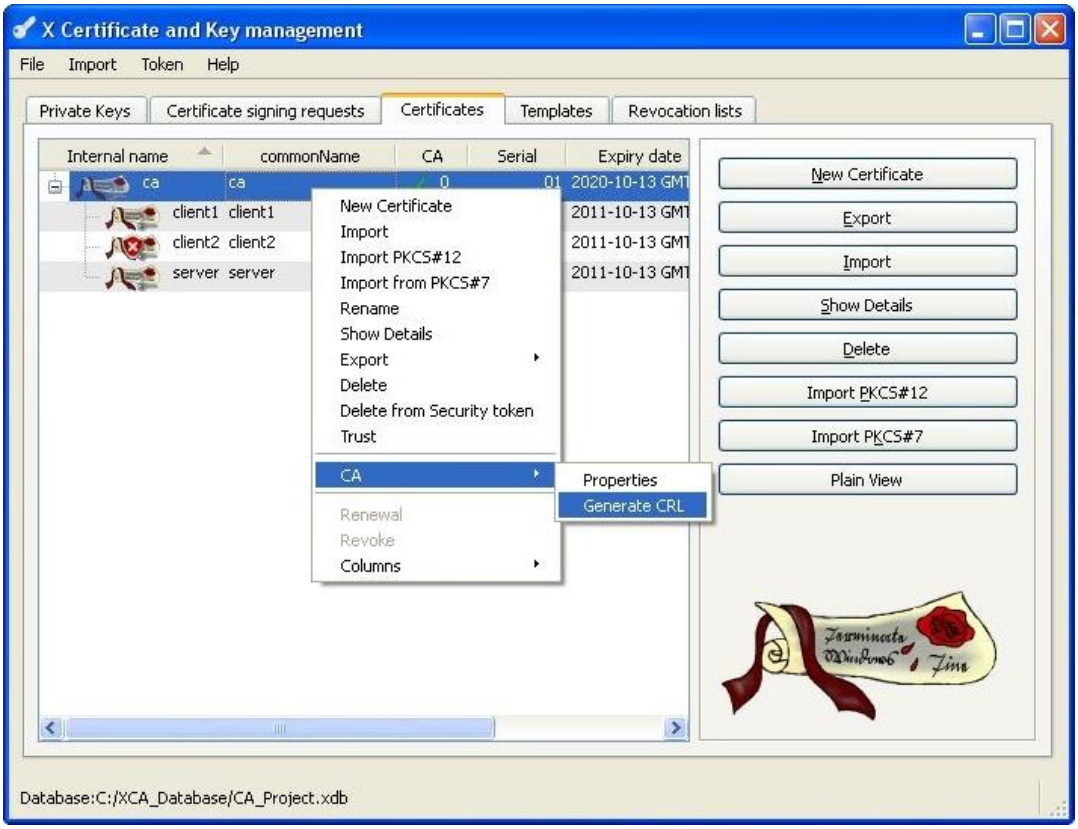
How to create a Certificate Revocation List with XCA.

ⓘ *A Certificate Revocation List is not mandatory for setting up an OpenVPN network with certificate-based authentication.*

→ The XCA software is started and the project database is opened.

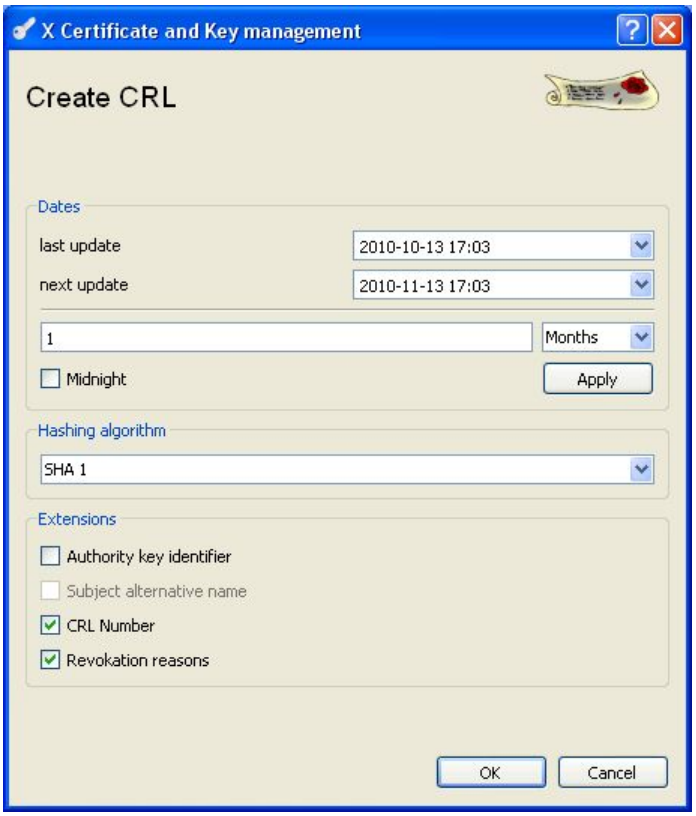
→ At least one certificate has been revoked.

1. Change to the "Certificates" tab.



2. Select the CA certificate and select in the context menu (right-click) CA → Create CRL.

   ✓ The dialogue window for creating a CRL appears:



3. Click on OK.
4. Confirm the generation of the Certificate Revocation List with OK.

✓ You have generated a Certificate Revocation List with this that contains all revoked certificates of this CA.

ⓘ *If further certificates are revoked after generating the Certificate Revocation List, the certificate revocation list must be generated again.*

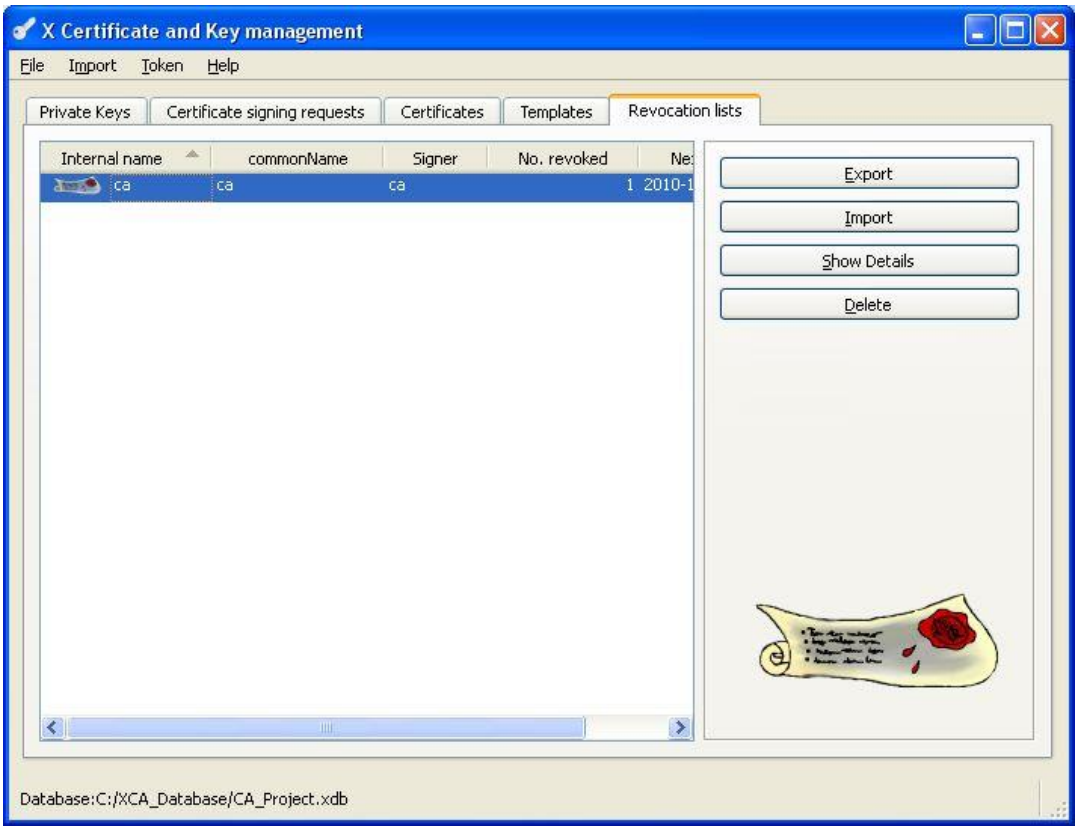
■ Exporting a Certificate Revocation List

How to export the Certificate Revocation List from the XCA database.

→ The XCA software is started and the project database is opened.

→ A Certificate Revocation List has been created.

1. Change to the "Revocation Lists" tab.



2. Highlight the Certificate Revocation List and select Export.

✓ The Certificate Revocation List export dialogue window appears:

3. Specify a path and file name.

   ⓘ *It is recommended to select the file name identical to the "Common Name" of the certificate and change the suffix to "crl" to enhance clarity if this is not contrary to any security concerns.*

4. Select the "PEM" export format.
5. Click on OK.

   ✓ You have exported the Certificate Revocation List with this. The CRL must now be uploaded to the OpenVPN server that the certificates will be revoked.

3 Used Components

Software

Description	Manufacturer	Type	Version
XCA	Christian Hohn-städt (Freeware)	X certificate and key management	0.9.1 or higher
Operating system	Microsoft	Windows	XP, Vista, 7

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