APPLICANT WEB SERVICES SECURITY

Version 1.0

February 16, 2005

Table of Contents

Section 1 – Introduction ____ *3*

Section 2 – Applicant System to Grants.gov Authentication ____ *3*

Section 3 – Client Certificate Requirements for Mutual Authentication ____ *4*

3.1 Client Certificate Requirements for Acceptance Testing ____ **5**

3.3 Generating RSA KeyPairs and Certificates ____ **5**

3.3.1 Using Portecle to Generate a RSA Keypair ____ 6

3.3.2 Configuring Mutual Authentication for the Microsoft .NET Platform__ 11

Section 4 – Obtaining a CA Signed Certificate ____ *14*

4.1 Using Portecle to Generate a Certificate Signing Request (CSR) ____ **14**

4.2 Importing the CA Reply ____ **15**

Appendix I – Secure Socket Layer (SSL) and Digital Certificate ____ *17*

Appendix II – FAQs ____ *18*

Section 1 – Introduction

This document provides Grantee Organizations (applicants) with details on the Grants.gov security model and instructions on how to create digital certificates complying with the Grants.gov mutual authentication requirements.

Section 2 – Applicant System to Grants.gov Authentication

Grants.gov uses SSL with mutual authentication to establish a secure connection with applicant systems. (For more detailed information on SSL please refer to Appendix 1.) To do so, applicant systems are required to obtain and install a digital certificate on their application server. This certificate will be used to authenticate the applicant server when sending requests to Grants.gov over SSL.

Once the authentication step is completed and a secure connection is established, the Grants.gov system conducts an internal authorization process to ensure that the requesting applicant server has been assigned the appropriate roles before performing the requested transaction. After the certificate has been registered with Grants.gov, the applicant is ready to establish a secure layer between an applicant system and Grants.gov:

- The applicant sends a request via an https:// call to a Grants.gov web server that has registered the public certificate. The acceptance testing environment address is https://atws.grants.gov:446 and the production site is https://ws.grants.gov:446. **Note**: the server conducting the Web Service calls must have access to **port 446.**
- Next, Grants.gov validates the applicant certificate's serial number against the information in the certificate's profile. It also checks the valid period and the CA of the certificate. If validation fails, the SSL will not be established. If validation succeeds, the following steps occur.
    - Grants.gov web server presents the applicant system with its public key certificate.
    - If the applicant system accepts the certificate, it uses the public key to encrypt the data it is about to send.
    - Grants.gov using its own certificate private key decrypts the sent encrypted data and a secure connection is established. The subsequent request/response message exchanges occur over the secure socket.

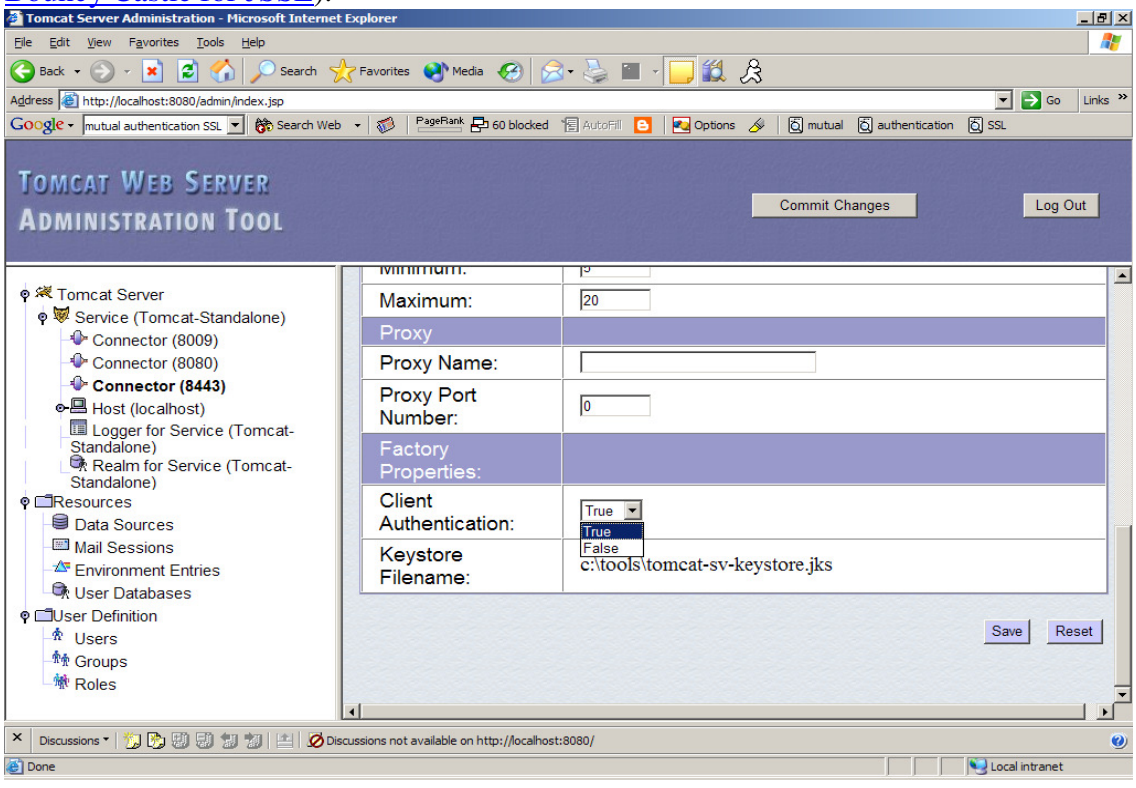
Once authentication is completed and a secure connection established, the Grants.gov system conducts an internal authorization process to ensure the requesting applicant server has been assigned AOR privileges before performing the requested transaction.

Section 3 – Client Certificate Requirements for Mutual Authentication

Each applicant system shall provide a digital certificate to interact with Grants.gov. In addition, Grants.gov requires mutual authentication to complete the SSL handshake. Mutual authentication will require the client application to authenticate itself by sending its server certificate. Grants.gov only supports certificates generated using the **RSA** algorithm and signed by a recognized CA.

Grants.gov recommends that developers test mutual authentication with the reference implementation server application. Testing with the reference implementation allows developers to minimize the time required to flush out potential SSL handshake issues within client applications. To test mutual authentication with the reference implementation it will be necessary to set the HTTPS connector's "Client Authentication" property to "True" in the Tomcat administration tool. Please refer to the reference implementation instructions for more information on the Tomcat setup.

Note: Tomcat and Sun's default JCE provider for JSSE does not support 1024 bit RSA. Ensure when creating an RSA keypair to use 2048 bit key sizes (or see Configuring Bouncy Castle for JSSE).



3.1 Client Certificate Requirements for Acceptance Testing

- The applicant system shall provide Grants.gov a copy of their public certificate.
- Certificates shall be created using 1024 or 2048 bit RSA.
- The certificate must be signed by a recognized CA (see 5.0 Obtaining a CA Signed Certificate).

3.2 Client Certificates Requirements for Production

- Certificates shall be created using 1024 or 2048 bit RSA.
- A well-know public CA must sign the client certificate for production usage. Listed below are several popular CAs:
  - Access Certificates For Electronic Services (ACES) - http://www.trustdst.com/federal/aces.html
  - Entrust - http://www.entrust.com
  - Thawte - http://www.thawte.com
  - VeriSign - http://www.verisign.com
- **Self-signed certificates will not be allowed**.

3.2.1 Configuring Bouncy Castle for JSSE.

The Sun default JCE provider packaged with J2SE 1.4 currently does not support 1024 bit RSA certificates. Applicant systems using JSSE with 1024-bit RSA must, therefore, use an alternate JCE provider to enable mutual authentication with Grants.gov. One option that has been used with success by other testers is Bouncy Castle (**http://www.bouncycastle.org/**). Bouncy Castle provides a free implementation of the JCE framework that is compatible with many versions of the J2SE. Applicants may also use other providers capable of providing the same functionality.

Installation and configuration of Bouncy Castle is very simple. For detailed instructions see the following URL (http://www.bouncycastle.org/specifications.html).

3.3 Generating RSA KeyPairs and Certificates

There are many tools available for applicants to generate the required RSA keypair including Microsoft IIS, OpenSSL, Keytool, and many others.

Grants.gov provides reference instructions for Portecle to generate the applicant system's RSA keypair and client certificate.
Portecle (formerly know as KeyTool GUI) is an open source GUI for the java keytool. It can be downloaded at: http://sourceforge.net/projects/portecle/

The Java 2 Standard development kit is also required and may be downloaded at: http://java.sun.com/

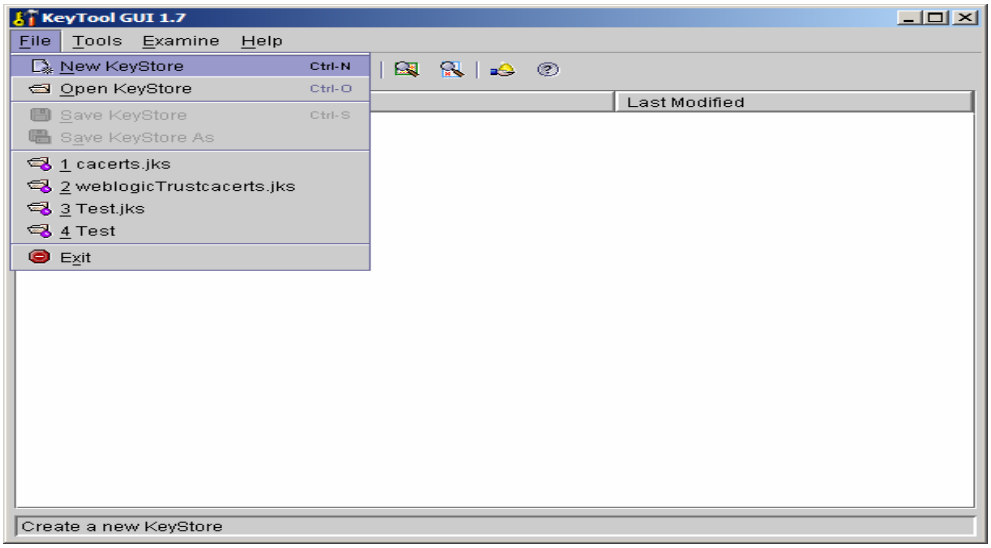
3.3.1 Using Portecle to Generate a RSA Keypair

Portecle is a GUI version of the command-line keytool provided with the JAVA SDK. Portecle can be downloaded at the following URL:
http://sourceforge.net/projects/portecle

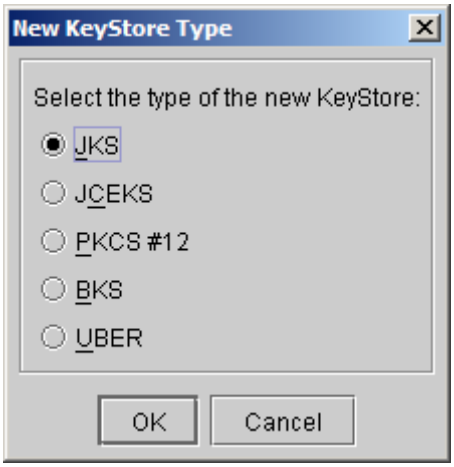
Follow the instructions below to generate a Keystore, RSA keypair, and a digital certificate. Upon completion the instructions below, applicant systems can expect to a have fully compliant digital certificate for Grants.gov Web Services.

Open Portecle and follow the steps below:

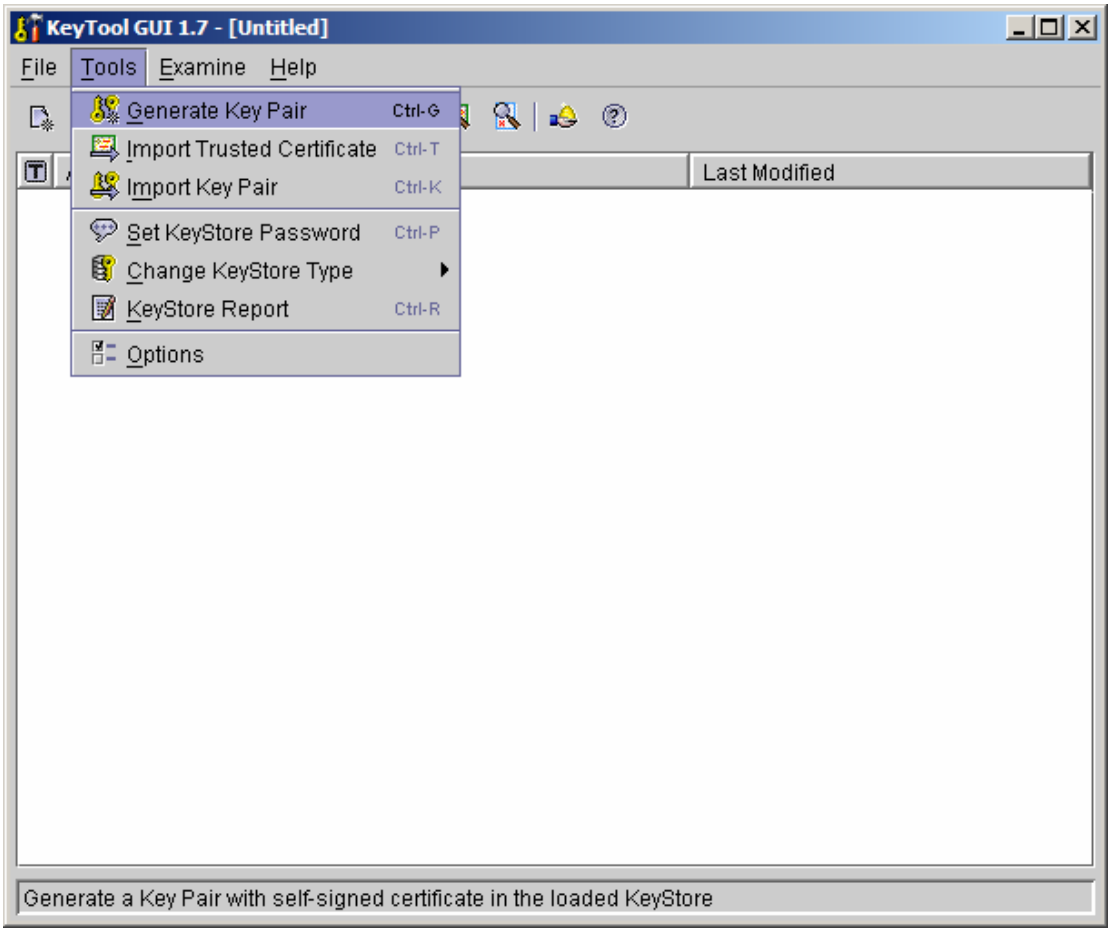
1. Create a new keystore. Select File→New KeyStore.



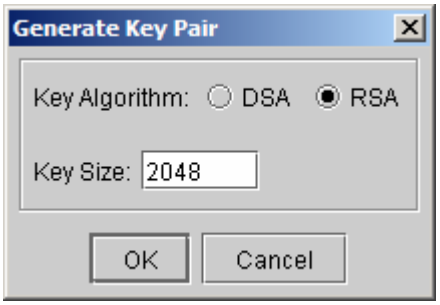
2. Select the JKS Format (for Java implementations) and click OK.



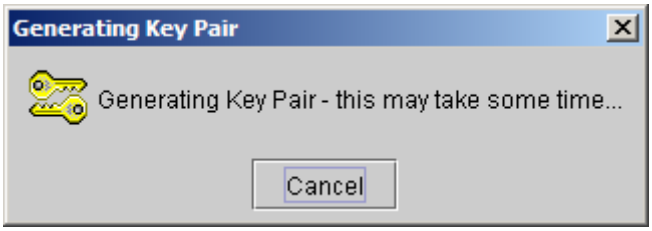
3. Select Tools→Generate KeyPair



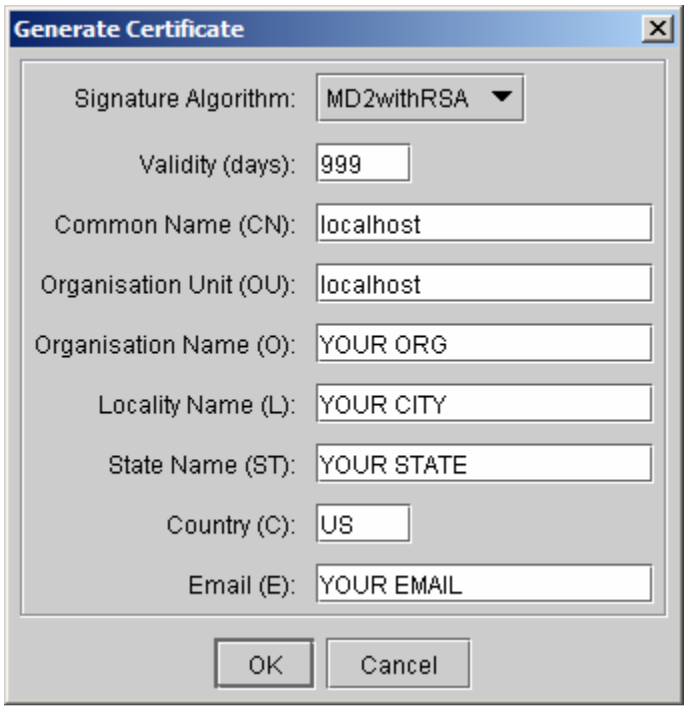
4. Select 2048 bit RSA and click OK.



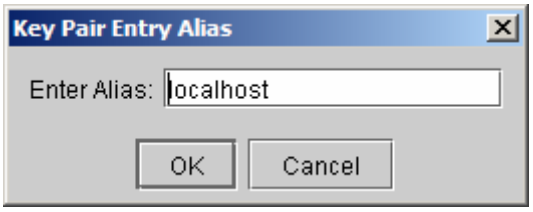
5. The RSA keypair will be generated.



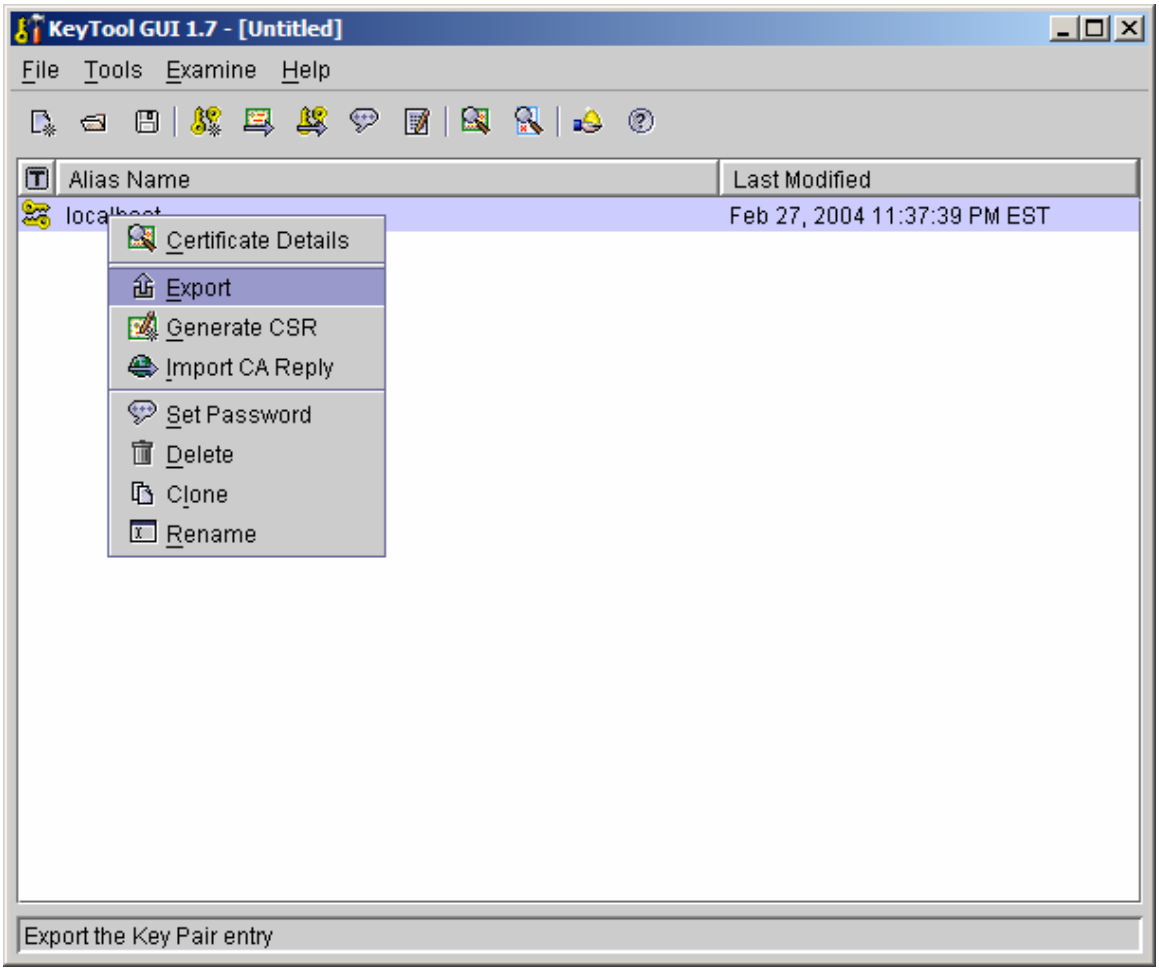
6. Select a Signature Algorithm and enter the information specific to the organization.
Notes: Microsoft .NET users should select MD5 with RSA.
The Common Name must be set to the server's DNS name.



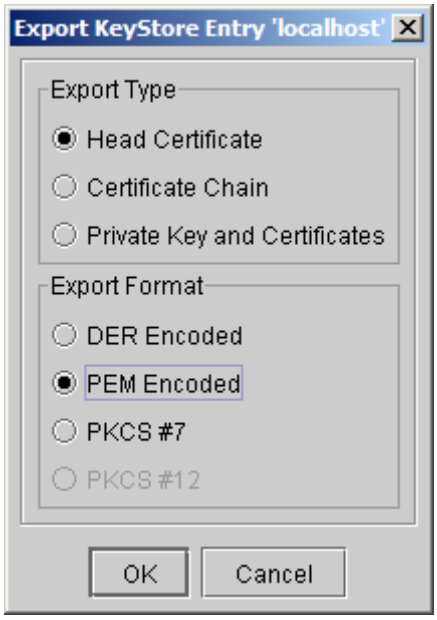
7. Enter the alias.



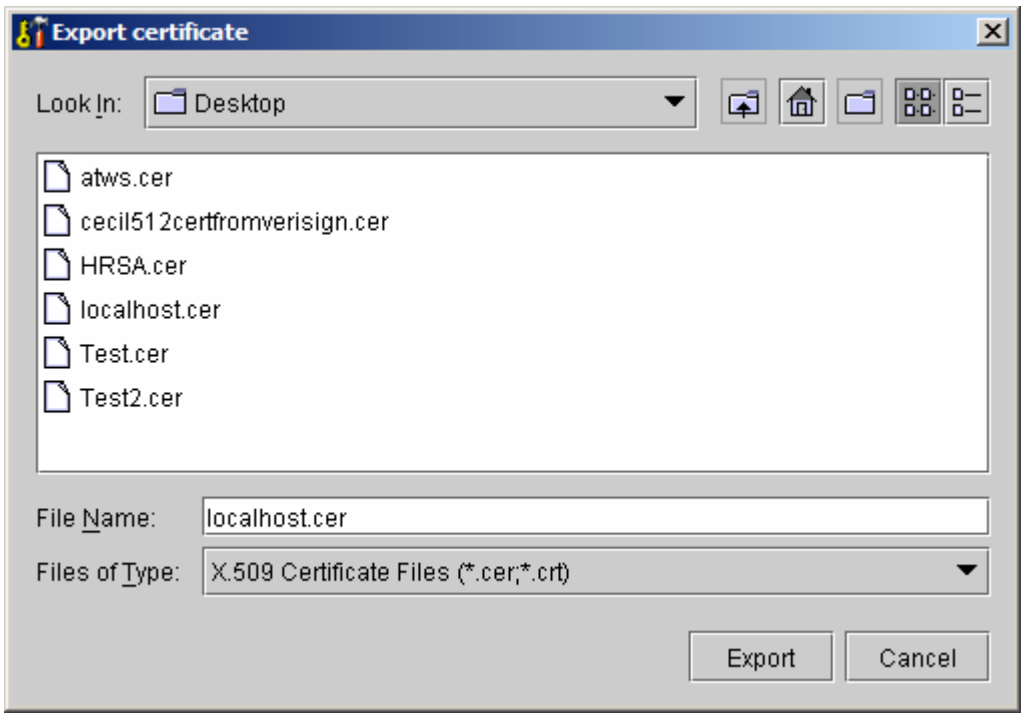
8. Create a password and click OK.
9. Export a client certificate for Grants.gov. Right click the keypair generated in step 8 and select Export.



10. Export the Head Certificate and Select the PEM Encoded Export Format.



11. Save and name the client certificate.



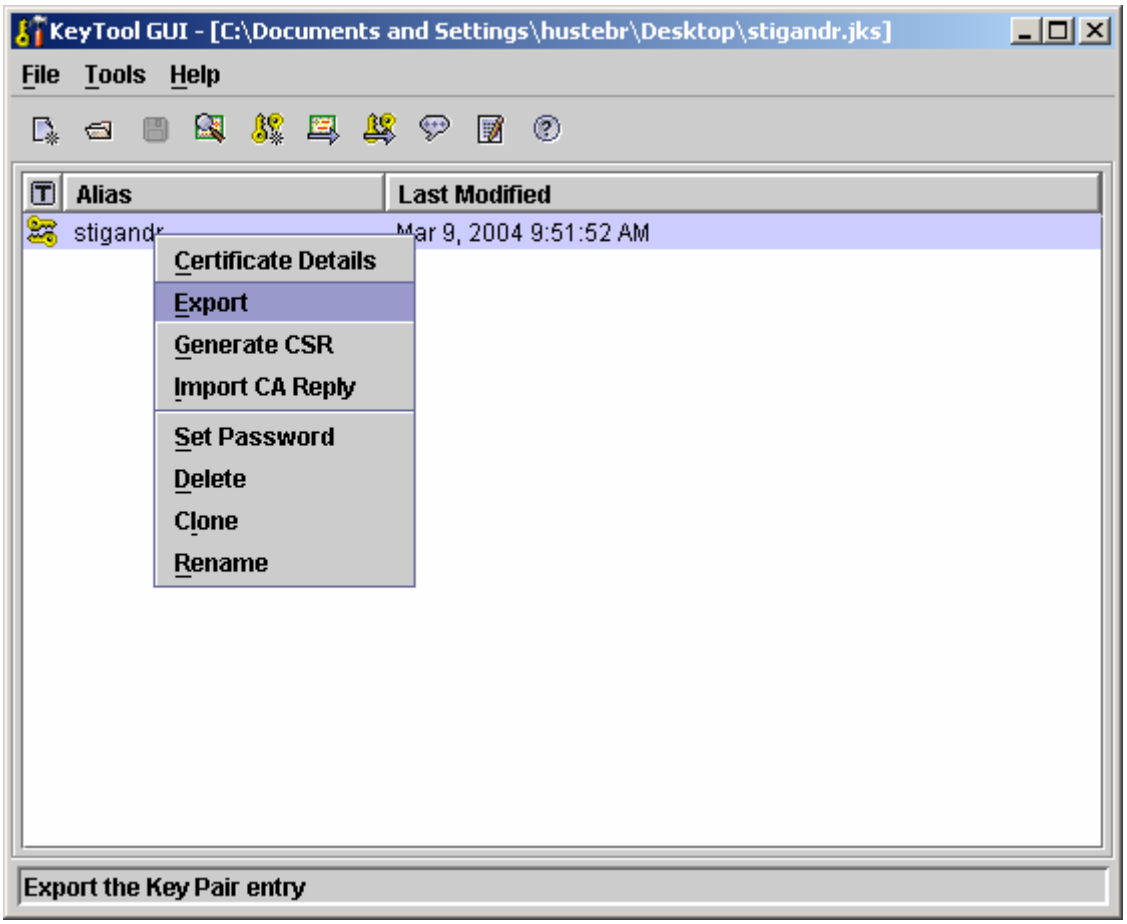
At this point, the client application will need access to the keystore generated from above. The public certificate created above should be sent to Grants.gov WebServices team.

The WebServices team will add the certificate to the Grants.gov truststore, register its serial number and associate it with the applicant system's profile.

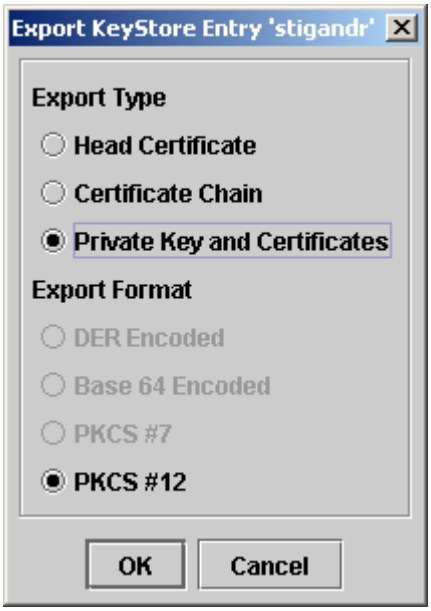
3.3.2 Configuring Mutual Authentication for the Microsoft .NET Platform

1. Follow the instructions for creating a Key Pair from above and be sure to select *MD5 with SHA* as the signature algorithm.

2. Once the certificate has been created, right click on the public private key pair and select export.

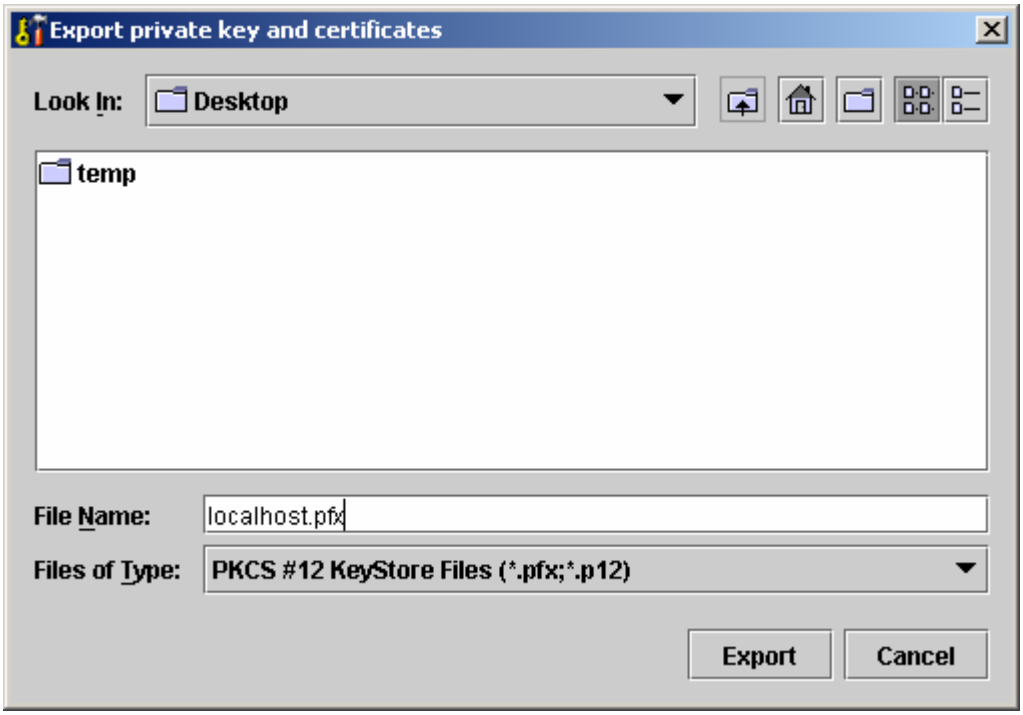


3. Export the Private Key and Certificates using PKCS #12 format



4. Enter a new password for the PKCS #12 keystore

5. Save the newly created PKCS #12 keystore with a .pfx extension to the local drive.



6. Double click on the .pfx file that was just created, this will open up and pop up which will walk you through the installation process for the certificate.

7. Once the certificate has been installed, click on START and then RUN and then type MMC

8. When the MMC opens, click on the CONSOLE menu and then click on the Add/remove Snap In.

9. Click Add and then Choose Certificates.

10. Click Add and then Choose Computer Account and then local computer

11. Once you see the certificates under the MMC, open up the certificates and here you will see the various certificates that are installed.

12. Right click on the certificate that has to be exported and go to all tasks and then export.

13. Select no when prompted if the private keys should be exported

14. Next select BASE64 encoded, as opposed to DER encoded, as the export format of the public certificate.

15. Save this to a file with a .CER extension and forward to the Grants.gov Web Services team.

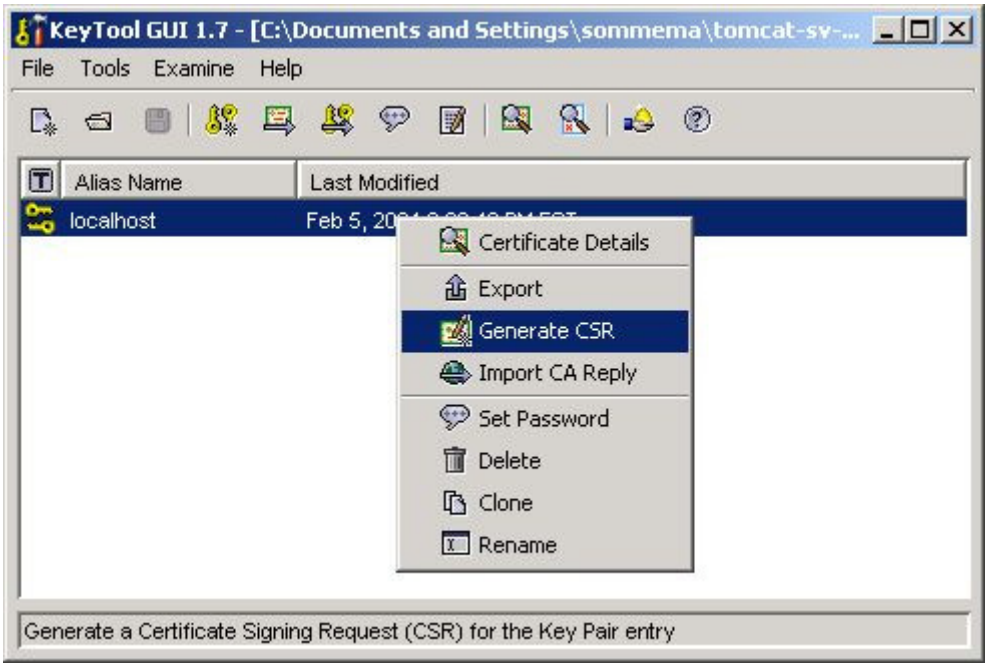
Section 4 – Obtaining a CA Signed Certificate

To receive a certificate digitally signed by a CA, you must send a Certificate Signing Request (CSR) to the CA. A CSR is a text file containing information about the requester's server's client public certificate. The CA will use the CSR to generate and send you your signed digital certificate.

4.1 Using Portecle to Generate a Certificate Signing Request (CSR)

1. Start Portecle and open up the keystore created in the Using Portecle to Generate a RSA Keypair section.

2. Right click the mouse on the key pair and select Generate CSR

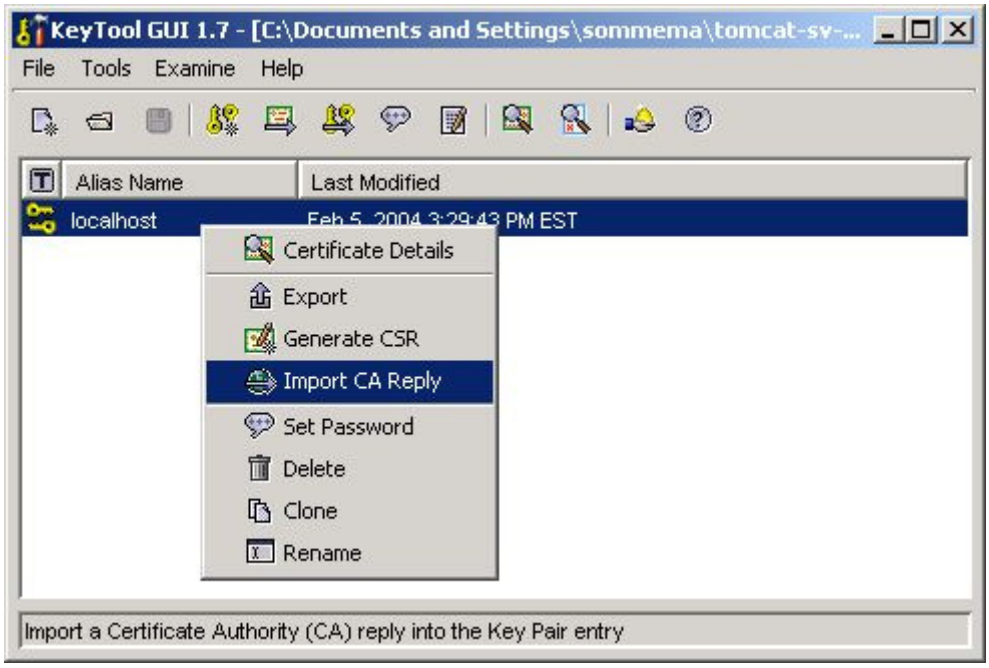


3. Save the generated CSR file with a .csr extension and submit it to your selected CA.

4.2 Importing the CA Reply

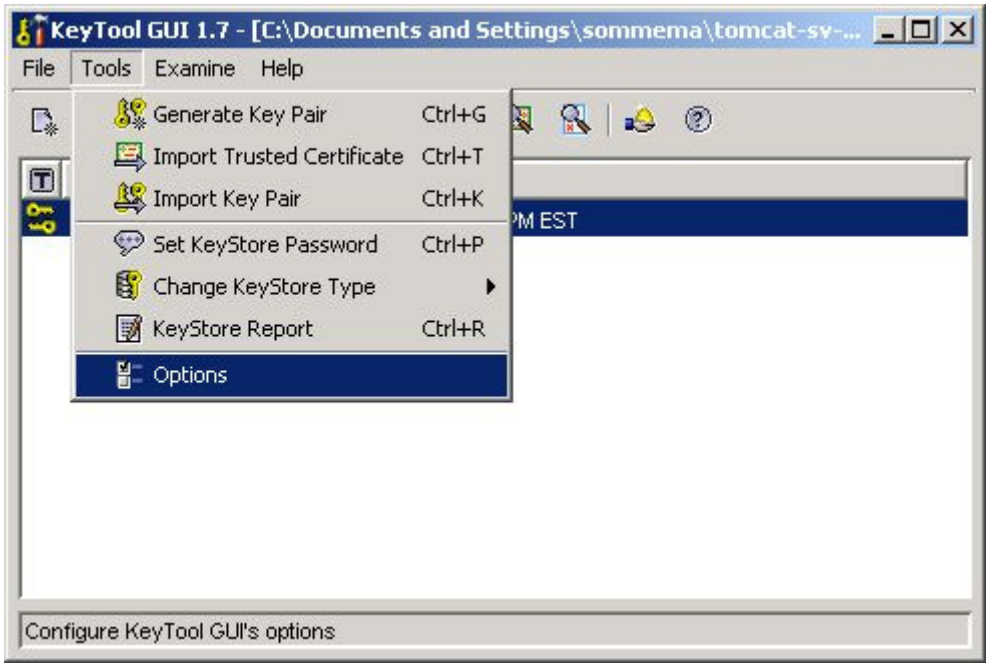
1. Once you have received your signed digital certificate from the CA, you must import the certificate into your keystore. To do this, use Portecle to open your original keystore that was used to generate the CSR.

2. Right click on the key pair and select Import CA Reply.



3. Select the signed certificate you received from your CA, click OK, and save the changes to the keystore. Your public/private key pair has now been digitally signed by the CA.

Note: You may need to set the location of the Java cacerts file that contains the root certificates of most signing authorities. Portecle uses these certificates to verify your signed certificate. This setting can be found under Tools > Options.



Typically the cacerts file can be found in <Java_Home>\jre\lib\security\

Appendix I – Secure Socket Layer (SSL) and Digital Certificate

SSL is a commonly used protocol for managing the security of a message transmission on the Internet. SSL contains its own server-side authentication and an optional client authentication. SSL is a framework that specifies how two hosts connect, pass certificate between one another, negotiate which keys to use, and decide on an encryption mechanism.

SSL comes in two strengths, 40-bit and 128-bit, which refer to the length of the "session key" generated by every encrypted transaction. The longer the key, the more difficult it is to break the encryption code. Most browsers support 40-bit SSL sessions, and the latest browsers enable users to encrypt transactions in 128-bit sessions - trillions of times stronger than 40-bit sessions.

Encryption is performed in two ways: symmetric and asymmetric. In symmetric cryptography, the sender and the receiver share the same private key to encrypt the information that is sent between them. In asymmetric cryptography, the sender and the receiver have different private keys. The length of a private key can range from 512bit to 2048bit. The larger a key length, the more difficult it is to derive the private key from the public key, hence, making it more secure and less likely to be spoofed.

When HTTP is passed over the SSL infrastructure, HTTP can use all features of SSL. This combination of HTTP and SSL is commonly used for secure Internet systems and it is referred to as HTTPS.

SSL is normally used in tandem with a Digital Certificate. This means that it uses a third party, a Certification Authority (CA), to identify one end or both ends of the transactions. Digital certificates are electronic files used to uniquely identify people and resources over the Internet. They contain information about the ownership of the certificate as well as information about the issuing CA. SSL also provides a legal basis to perform transactions on the Internet and is an integral part of the process for establishing the validity of digital certificates.

Virtually all web servers and the leading browsers, including Internet Explorer and Netscape Communicator, are optimized and ready for SSL. To activate SSL sessions a digital certificate is required.

Appendix II – FAQs

Q1. What types of digital certificates does Grants.gov support?
A1. Grants.gov only supports certificates that use the RSA algorithm. It does not support DSA certificates.

Q2. Where are the SSL URLs for the Grants.gov Web Services?
A2. The Acceptance Testing site where applicant system's may conduct testing is located at https://atws.grants.gov:446/. The production site is located at https://ws.grants.gov:446/. Note that both sites require you to access them via port 446.

Q3. My organization is not ready to invest in a CA signed certificate; can we begin testing with a self-signed certificate?
A3. You may use the self-signed certificate provided with the Reference Implementation for testing in the Grants.gov Acceptance Testing environment. However, applicants **must** purchase and test using a CA signed certificate before moving to production.

Q4. Typically, what should be the length of my private key?
A4. 1024 or 2048 bit is normally the recommend length

Q5. What is the difference between a keystore and a truststore?
A5. A keystore is the digital file that contains both your private and public key. A truststore is a set of public CA root certificates that are used to validate the authenticity of a CA signed server certificate.

Q6. Why does Grants.gov require a CA signed certificate?
A6. There are two reasons for doing this:
1) Grants.gov is only required to maintain the root CA certificates, rather than each organization's certificate.
2) A CA signed certificate is more secure and difficult to spoof than a self-signed certificate.