Client X.509 Certificate Authentication and User Enrollment

fork and edit tutorial (https://github.ibm.com/MFPSamples/DevCenter/tree/master/tutorials/en/foundation/7.0/authentication-security/client-x-509-certificate-authentication-user-enrollment.html) | report issue (https://github.ibm.com/MFPSamples/DevCenter/issues/new)

This tutorial covers the following topics:

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- Understanding how user certificate authentication works
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Overview

The X.509 User Certificate Authentication feature is a user realm that establishes user identity with an X.509 client certificate.

The user identity is established for a particular user on a specific device and application.

This feature provides SSL client-side certificate authentication and user enrollment capabilities.

SSL client-side certificate authentication consists of establishing a two-way SSL handshake the between MobileFirst client and server which, in turn, enables the client and server both to present their identities and therefore establish mutual trust through the SSL/TLS protocol.

You can enroll new users to the MobileFirst Platform Mobile Application Management system and your PKI of choice with the user enrollment capabilities.

A basic embedded PKI is provided with this feature which is meant to get you started quickly for educational and non-production environments only.

For production environments, this feature makes it easy to integrate with your existing PKI.

You can use either the PKI Bridge Java™ interface or built-in MobileFirst adapters to delegate certificate management functions down to an external PKI system.

Prerequisites

You must have a general understanding of MobileFirst user realms and adapters.

It is assumed that you follow these instructions by using an application that currently supports form-based

authentication.

- The form-based authentication module uses non-validating login modules. These login modules are not recommended for production environments
- Use other user authentication realms, like WASLTPA in production.

Understanding how user certificate authentication works

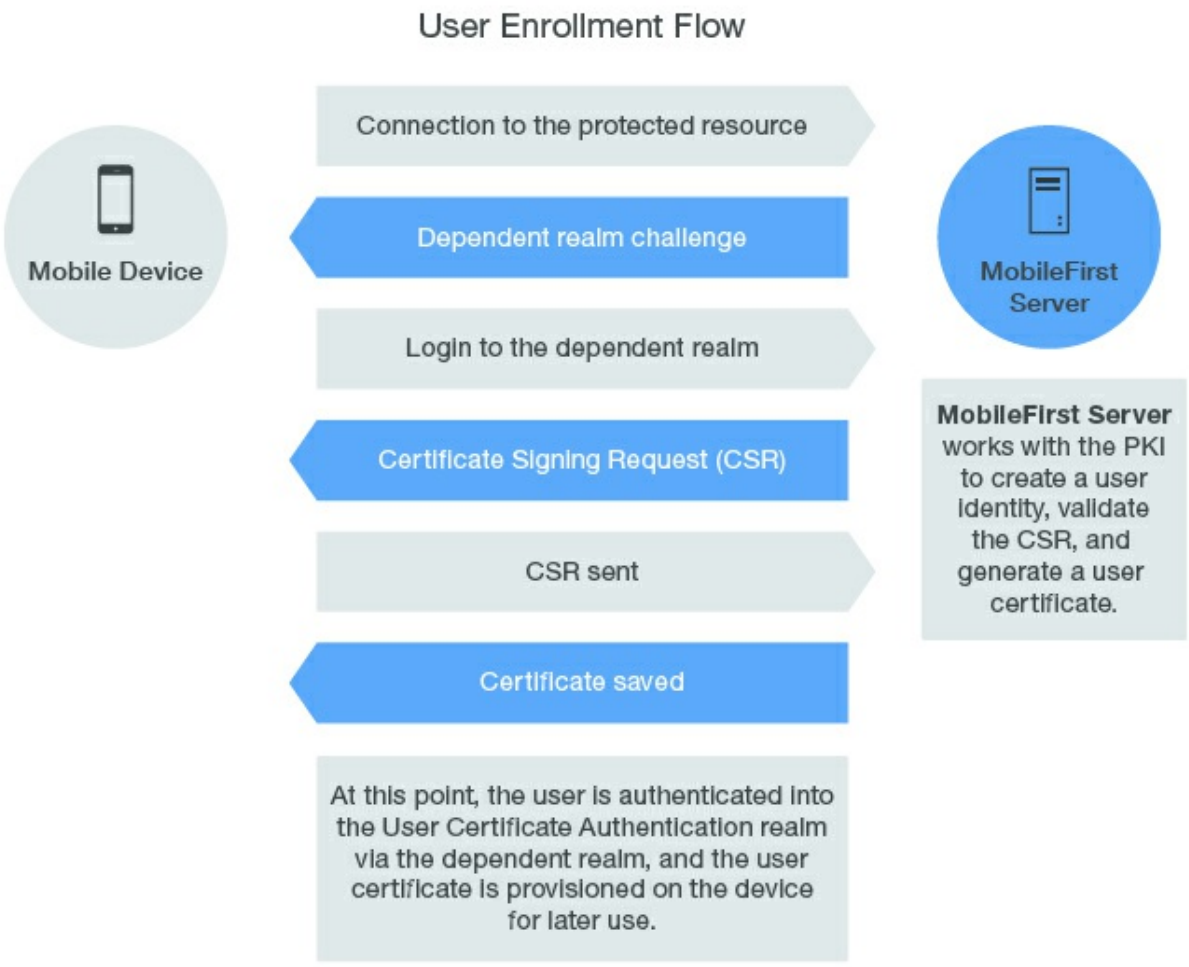
User certificate authentication is the process in which an X.509 certificate is issued by an existing PKI through te MobileFirst server to a specific user on a specific application and device.

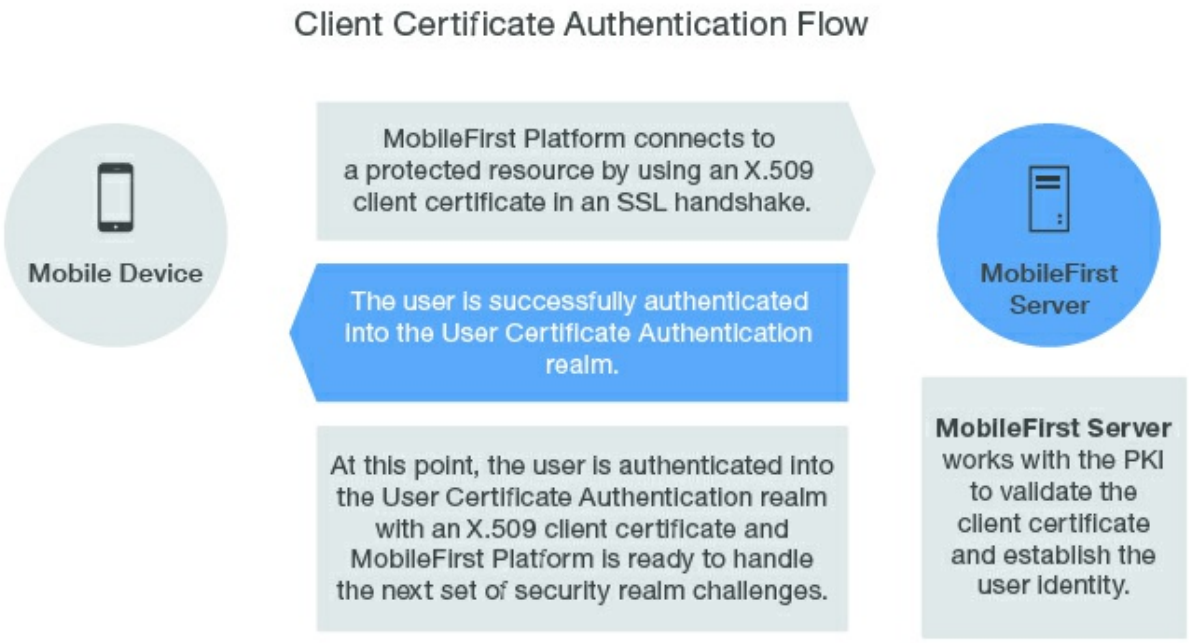
The relevant user information is obtained during the user enrollment process with the specified dependent user realm.

The user enrollment process relies on a dependent user realm to help it establish the initial user identity to which the X.509 certificate is issued.

IBM MobileFirst Platform Foundation then provisions the device with the X.509 client certificate for use in subsequent connections to the server.

The first time a user connects to the MobileFirst server, that user must authenticate through the dependent realm to initiate the enrollment process. After a user is enrolled into the User Certificate Authentication realm, subsequent connections to the server occur through the two way SSL/TLS handshake, where the client certificate is presented as the SSL client entity.





X.509 certificate and certificate authorities (CAs)

For security reasons, during testing, it is not recommended to use an established CA that uses an embedded PKI in your infrastructure.

It is possible to create a self-signed CA that can sign both a server certificate and user certificates.

This module uses the OpenSSL command-line utility.

OpenSSL is included in most Linux distributions and in Mac OS X. Windows users can obtain an OpenSSL binary from the OpenSSL website.

The commands that are shown in this module work on Linux and Mac OS X. For Windows, use the equivalent MS-DOS commands.

Create root CAs, signing CAs, and certificates

1. Create an empty directory and navigate to that path in your system terminal.
2. Create a basic OpenSSL configuration file that is named `openSSL.cnf`.
3. Move this file to the directory that you created.

If you want different policy requirements, see the OpenSSL configuration documentation for instructions on how to configure the various options.

`openSSL.cnf` sample file:

```
[ req ]
    default_bits          = 2048                  # size of keys
    default_keyfile       = key.pem               # name of generated keys
    default_md            = sha1                  # message digest algorithm
    string_mask           = nombstr               # permitted characters
    distinguished_name    = req_distringuished_name

[ req_distinguished_name ]
0.organizationName
organizationUnitName
emailAddress
emailAddress_max
localityName
stateOrProvinceName
countryName
countryName_min
countryName_max
commonName
commonName_max

[ policy_match ]
countryName             = optional
stateOfProvinceName     = optional
localityName            = optional
organizationName        = optional
organizationalUnitName  = supplied
commonName              = optional
emailAddress            = optional
```

Create a root CA

Append the following section to the `openSSL.cnf` configuration file to set up the root CA requirements.

```
[ root_authority ]
basicConstraints        = CA:TRUE
subjectKeyIdentifier    = hash

[ root_authority_ca_config ]
dir             = ./rootca
certs           = $dir/certs
new_certs_dir   = $dir/newcerts
database        = $dir/index.txt
certificate     = $dir/root_ca.crt
private_key     = $dir/root_ca_key.pem
serial          = $dir/serial
RANDFILE        = $dir/.rand
policy          = $dir/policy_match
```

- Using a terminal, create the folder structure and requirements for the root CA.
    1. Create a root CA certificate directory structure.

        ```
        mkdir rootca
        mkdir rootca/certs rootca/crl rootca/newcerts
        touch rootca/serial

        export HEXOUT=0123456789ABCDEF
        ```

    2. Create a serial list of random numbers.

```
for y in {1..2048}
do
export output="";
for i in {1..16}
do
   export randomnum=$RANDOM%16;
   export output=$output${HEXOUT:$randomnum:1};
done
echo "$output" >> rootca/serial
done

touch rootca/index.txt
```

- For Windows, create the folder structure and requirements for the root CA.
  1. Create a root CA certificate directory structure.

     ```
     MKDIR rootca
     MKDIR rootca\certs
     MKDIR rootca\crl
     MKDIR rootca\newcerts
     ```

  2. Create a serial list of random numbers for the root CA.

     ```
     openssl rand -hex -out rootca\serial 8
     ```

  3. Create an index for the root CA.

     ```
     COPY NUL rootca\index.txt
     ```

- Using a terminal, generate an RSA key pair and then self-sign a root CA certificate.
  The password must remain secure, even for a test environment. For the following example, the password is `passRoot`.

  ```
  export ROOT_CA_SUBJECT="Development Root CA"
  ```

  1. Create the RSA key pair.
     The parameter, `2048`, represents the key length.

     ```
     openssl genrsa -des3 -out rootca/root_ca_key.pem -passout pass:passRoot 2048
     ```

  2. Sign a certificate with the key pair.

     ```
     openssl req -new -x509 -nodes -sha1 -days 365 -key rootca/root_ca_key.pem -out rootca/root_ca.crt -config P
     ATH_TO_/openssl.conf -subj "/CN=$ROOT_CA_SUBJECT" -extensions root_authority -passin pass:passRoot
     ```

- For Windows, generate an RSA key pair and then self-sign a root CA certificate.
  The password must remain secure, even for a test environment. For the following example, the password is `passRoot`.

  1. Create the RSA key pair.
     The parameter, `2048`, represents the key length.

     ```
     openssl genrsa -des3 -out rootca\root_ca_key.pem -passout pass:passRoot 2048
     ```

  2. Sign a certificate with the key pair.

     ```
     openssl req -new -x509 -nodes -sha1 -days 365 -key rootca\root_ca_key.pem -out rootca\root_ca.cert -config o
     penssl.cnf -subj "/CN=Development Root CA" -extensions root_authority -passin pass:passRoot
     ```

Create a signing CA

To set up the signing CA configuration options, edit the `openssl.conf` file that you created earlier and append the following configuration:

```
[ signing_authority ]
basicConstraints            = CA:TRUE,pathlen:0
subjectKeyIdentifier        = hash
authorityKeyIdentifier      = keyid:always, issuer:always

[ signing_authority_ca_config ]
dir             = ./signingca
certs           = $dir/certs
new_certs_dir   = $dir/newcerts
database        = $dir/index.txt
certificate     = $dir/signing_ca.crt
private_key     = $dir/signing_ca_key.pem
serial          = $dir/serial
RANDFILE        = $dir/.rand
policy          = policy_match
email_in_dn     = false
```

- Using the terminal, create the folder structure and requirements for the signing CA. Run these commands from the base directory.
    1. Create a signing CA certificate directory structure.

        ```
        mkdir signingca
        mkdir signingca/certs signingca/crl signingca/newcerts
        touch signingca/serial
        export HEXOUT=0123456789ABCDEF
        ```

    2. Create a serial list of random numbers.

        ```
        for y in {1..2048}
        do
        export output="";
        for i in {1..16}
        do
            export randomnum=$RANDOM%16;
            export output=$output${HEXOUT:$randomnum:1};
        done
        echo "$output" >> signingca/serial
        done

        touch signingca/index.txt
        ```

- For Windows, create the folder structure and requirements for the signing CA. Run these commands from the base directory.
    1. Create a signing CA certificate directory structure.

        ```
        MKDIR signingca
        MKDIR signingca\certs
        MKDIR signingca\crl
        MKDIR signingca\newcerts
        ```

    2. Create a serial list of random numbers for the signing CA.

        ```
        openssl rand -hex -out signingca\serial 8
        ```

    3. Create index for signing CA.

```
COPY NUL signingca\index.txt
```

- Using the terminal, generate an RSA key pair, and then sign a signing CA CSR with the root CA.
  For this example, the password is `passSigning`. Run these commands from the base directory.

```
export SIGNING_CA_SUBJECT="Development Signing CA"

openssl genrsa -des3 -out signingca/signing_ca_key.pem -passout pass:passSigning 2048

openssl req -new -key signingca/signing_ca.csa -out signingca/signing_ca.crt -keyfile rootca/root_ca_key.pem -cert ro
otca/root_ca.crt -config openssl.cnf -name root_authority_ca_config -extensions signing_authority -md sha512 -days 3
65 -passin pass:passRoot
```

- For Windows, generate an RSA key pair,and then sign a signing CA CSR with the root CA.
  For this example, the password is `passSigning`. Run these commands from the base directory.

```
openssl genrsa -des3 -out signingca\signing_ca_key.pem -passout pass:passSigning 2048

openssl req -new -key signingca\signing_ca_key.pem -out signingca\signing_ca.csr -config openssl.cnf -subj "/CN=De
velopment Signing CA" -passin pass:passSigning

openssl ca -in signing_ca.csr -out signingca\signing_ca.crt -keyfile rootca\root_ca_key.pem -cert rootca\root_ca.crt -c
onfig openssl.cnf -name root_authority_ca_config -extensions signing_authority -md sha512 -days 365 -passin pass:p
assRoot
```

Create a server certificate

Edit the `openssl.cnf` file that you create earlier and append the following configuration to set up the server certificate configuration options.

```
[ server_identity ]
basicConstraints       = CA:TRUE
subjectKeyIdentifier   = hash
authorityKeyIdentifier  = keyid:always;issuer:always
```

- Working from the terminal, generate an RSA key pair and sign the new certificate with the signing CA.
  This certificate is your server identity certificate. The example uses `passServer` as the password. Run these commands from the base directory.

  1. Use the full host name of your MobileFirst Platform server. SSL will break if the full hostname is not provided, or if an IP address is used as the host name.

     ```
     export SERVER_FULL_HOSTNAME=dev.yourcompany.com
     mkdir server
     ```

  2. Create the RSA key pair and generate a CSR.

     ```
     openssl genrsa -des3 -out server/server_key.pem -passout pass:passServer 2048
     openssl req -new -key server/server_key.pem -out server/server.csr -config openssl.cnf -subj "/CN=$SERVER_
     FULL_HOSTNAME" -passin pass:passServer
     ```

  3. Sign the CSR with the signing CA.

     ```
     openssl ca -in server/server.csr -out server/server.crt -keyfile signingca/signing_ca_key.pem -cert signignca/sig
     ning_ca.crt -config openssl.cnf -name signing_authority_ca_config -extensions sever_identity -md sha512 -day
     s 365 -passin pass:passSigning
     ```

- For Windows, generate an RSA key pair and sign the new certificate with the signing CA.

This certificate is your server identity certificate. The example uses `passServer` as the password. Run these commands from the base directory.

1. Use the full host name of your MobileFirst Platform server. SSL will break if the full host name is not provided or if an IP address is used as the host name.

   ```
   REM mkdir server
   ```

2. Create the RSA key pair and generate a CSR.

   ```
   REM openssl genrsa -des3 -out server\server_key.pem -passout pass:passServer 2048
   openssl req -new -key server\server_key.pem -out server\server.csr -config openssl.cnf -subj "/CN=%HOSTNAME%" -passin pass:passServer
   ```

3. Sign the CSR with the signing CA.

   ```
   REM openssl ca -in server\server.csr -out server\server.crt -keyfile signingca\signing_ca_key.pem -cert signingca\signing_ca.crt -config openssl.cnf -name signign_authority_ca_config -extensions server_identity -md sha512 -days 365 -passin pass:passSigning
   ```

Create a certificate chain for the server certificate

- Using the terminal, send a full certificate chain all the way up to the trust anchor (root CA) for iOS and Android environments. You can concatenate the certificate files to the trust anchor (root CA).
  1. Create a chain for the signing CA.

     ```
     cat signingca/signing_ca.crt rootca/root_ca.crt > signing_ca_chain.crt
     ```

  2. Create a chain for the server certificate.

     ```
     cat server/server.crt signingca/signing_ca.crt rootca/root_ca.crt > server_chain.crt
     ```

- For Windows, send a full certificate chain all the way up to the trust anchor (root CA) for Windows environments. You can concatenate the certificate files to the trust anchor (root CA).
  1. Create a chain for the signing CA.

     ```
     copy rootca\root_ca.crt+signingca\signing_ca.crt signing_ca_chain.crt
     ```

  2. Create a chain for the server certificate

     ```
     copy rootca\root_ca.crt+signingca\signing_ca.crt+server\server.crt server_chain.crt
     ```

Export a PKCS12 file for the signing CA

Export the private key and certificate for the signing CA into a `.p12` keystore file so that the embedded PKI can sign the user certificates with the signing CA.

```
openssl pkcs12 -export -in signingca/signing_ca.crt -inkey signingca/signing_ca_key.pem -out signingca/signing_ca.p12 -passin pass:passSigning -passout pass:passSigningP12
```

Export a PKCS12 file for the server certificate

Export the private key and certificate for the server into a `.p12` keystore file so that the server can send the client a valid server certificate.

```
openssle pkcs12 -export -in server_chain.crt -inkey server/server_key.pem -out server/server.p12 -passout pass:passServerP12 -passin pass:passServer
```

Configuring IBM WebSphere Application Server Liberty profile (Liberty)

Enable the `ssl-1.0` and `appSecurity-2.0` features in the `server.xml` file:

```
<featureManager>
  <feature>ssl-1.0</feature>
  <feature>appSecurity-2.0</feature
>
</featureManager>
```

Liberty requires setting up the keystore and truststore to establish trust for the generated client certificates. For more information, see the WebSphere Application Server Network Deployment documentation (http://pic.dhe.ibm.com/infocenter/wasinfo/v8r5/index.jsp?topic=/com.i bm.websphere.wlp.nd.doc/ae/rwlp_ssl.html).

1. Set up your server keystore to use the `server.p12` file that was generated earlier.
2. Set up your truststore to use the `signing_ca.p12` file that was generated earlier.
3. Configure your server HTTP endpoint and allow (but do not require) client-side certificates. To make this configuration available, set the `clientAuthenticationSupported="true"` property in the Liberty SSL element.

The following example shows the updated SSL configuration:

```
<!-- default SSL configuration is defaultSSLSettings -->
<sslDefault sslRef="defaultSSLSettings"/>
<ssl clientAuthenticationSupported="true" id="defaultSSLSettings" keyStoreRef="defaultKeyStore" trustStoreRef="d
efaultTrustStore"/>
<keyStore id="defaultKeyStore" location="server.p12" password="passServerP12" type="PKCS12" />
<keyStore id="defaultTrustStore" location="signing_ca.p12" password="passSigningP12" type="PKCS12"/>
```

Configuring the authenticationConfig.xml file

1. Uncommon the `UserCertificate Login Module` section of the `authenticationConfig.xml` file, as shown below.

   ```
   <!-- Login Module for User Certificate Authentication -->
   <loginModule name="WLUSERCertificateLoginModule">
     <className>com.worklight.core.auth.ext.UserCertificateLoginModule</className
   >
   </loginModule>
   ```

2. Uncommon the `wl_userCertificateAuthRealm` section, as shown below.

   ```
   <!-- Login Module for User Certificate Authentication -->
   <realm name="wl_userCertificateAuthRealm" loginModule="WLUserCertificateLoginModule">
     <className>com.worklight.core.auth.ext.UserCertificateAuthenticator</className>
     <parameter name="dependent-user-auth-realm" value="SampleAppRealm"/>
     <parameter name="pki-bridge-class" value="com.worklight.core.auth.ext.UserCertificateEmbeddedPKI"/
   >
   </realm>
   ```

3. Update the value of the `embedded-pki-bridge-ca-p12-file-path` element to the full path of your signing CA

`.p12` file.

4. Update the value of the `embedded-pki-bridge-ca-p12-password` element to the `passSigningP12` password that was used to create the `.p12` file.
5. Update the value of the `dependent-user-auth-realm` realm to the dependent realm that you want to use (`SampleAppRealm`).
   You cannot change the realm name (`wl_userCertificateAuthRealm`).

   The following examples shows the updates made above.

```
<!--For User Certificate Authentication -->
<realm name="wl_userCertificateAuthRealm" loginModule="WLUserCertificateLoginModule">
  <className>com.worklight.core.auth.ext.UserCertificateAuthenticator</className>
  <parameter name="dependent-user-auth-realm" value="SampleAppRealm"/>
  <parameter name="pki-bridge-class" value="com.worklight.core.auth.ext.UserCertificateEmbeddedPKI"/>
  <parameter name="embedded-pki-bridge-ca-p12-file-path" value="YOUR_BASE_DIRECTORY/signing_ca.
p12"/>
  <parameter name="embedded-pki-bridge-ca-p12-password" calue="passSigningP12"/>
</realm>
```

6. Define a security test that uses `wl_userCertificateAuthRealm`.

```
<!--For User Certificate Authentication -->
<customSecurityTest name="customx509Tests">
  <test realm="wl_antiXSRFRealm" step="1"/>
  <test realm="wl_authenticityRealm" step="1"/>
  <test realm="wl_directUpdateRealm" mode="perSession" step="1"/>
  <test realm="wl_userCertificateAuthRealm" isInternalUserID="true" step="1"/>
  <test realm="wl_deviceNoProvisioningRealm" isInternalUserID="true" step="2"/
>
</customSecurityTest>
```

Configuring the application-descriptor.xml file

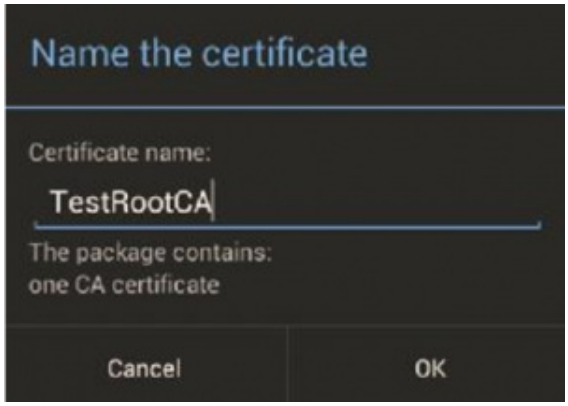
1. Ensure that you added the iOS or Android environment to your MobileFirst application.
2. Protect your application or environment with your custom security test.

```
<!--For User Certificate Authentication -->
<android securityTest="customx509Tests" version="1.0">
<iPhone bundleId="com.SampleApp" securityTest="customx509Tests" version="1.0">
```

3. Build and deploy your application and adapters to MobileFirst Server.

Installing a root CA on iOS and Android

You must install the root CA that you generated in the previous steps onto your client devices for your devices to trust MobileFirst Server over SSL. Email or host the `root_ca.crt` file, and then open the file on your device. The iOS and Android devices ask for approval when you manually attempt to install certificates.



Installing and testing the application

1. Deploy your application to MobileFirst Server by selecting **Run as > Run on *server_name***.
2. Update the deploy target for HTTPS.
    1. Select **Run as > Build Settings and Deploy Target**.
    2. Select **Build the application to work with a different MobileFirst Server**.
    3. Enter the server HTTPS address: `https://host:https port#`
    4. Enter the context path: `/path`.
3. Build the application with the updated deploy target by selecting **Run as > Build All Environments**.
4. Run the application on the specified environments.

Sample application

Click to download (http://public.dhe.ibm.com/software/products/en/MobileFirstPlatform/docs/v700/UserCertificateAuthenticationProject.zip) the Studio project.

To confirm a successful configuration, ensure that you see a log-in form the first time that you try to access a protected resource. If `WL.Client.connect()` is uncommented in the `main.js` file, the log-in form is displayed when the application starts. Otherwise, `WL.Client.connect()` must be invoked before you call an adapter procedure to see a log-in form after the adapter is called.

After you log in through the dependent realm, a successful response from the adapter invocation indicates that the user was successfully enrolled.

On subsequent connections to the server, you are no longer asked to log in and the adapter calls continue to return successfully.

> For more information, see User certificate authentication (http://www-01.ibm.com/support/knowledgecenter/SSHS8R_7.0.0/com.ibm.worklight.monitor.doc/monitor/c_user_CA.html?lang=en) topic in the user documentation.