X.509v3 Certificates for SSH Authentication

The X.509v3 Certificates for SSH Authentication feature uses the X.509v3 digital certificates in server and user authentication at the secure shell (SSH) server side.

This module describes how to configure server and user certificate profiles for a digital certificate.

Prerequisites for X.509v3 Certificates for SSH Authentication

- The X.509v3 Certificates for SSH Authentication feature introduces the `ip ssh server algorithm authentication` command to replace the `ip ssh server authenticate user` command. If you use the `ip ssh server authenticate user` command, the following deprecation message is displayed.

  Warning: SSH command accepted but this CLI will be deprecated soon. Please move to new CLI "ip ssh server algorithm authentication". Please configure "default ip ssh server authenticate user" to make CLI ineffective.

- Use the `default ip ssh server authenticate user` command to remove the `ip ssh server authenticate user` command from effect. The IOS secure shell (SSH) server then starts using the `ip ssh server algorithm authentication` command.

Restrictions for X.509v3 Certificates for SSH Authentication

- The X.509v3 Certificates for SSH Authentication feature implementation is applicable only on the IOS secure shell (SSH) server side.

- IOS SSH server supports only the x509v3-ssh-rsa algorithm based certificate for server and user authentication on the IOS SSH server side.
Information About X.509v3 Certificates for SSH Authentication

Digital Certificates

The validity of the authentication depends upon the strength of the linkage between the public signing key and the identity of the signer. Digital certificates in the X.509v3 format (RFC5280) are used to provide identity management. A chain of signatures by a trusted root certification authority and its intermediate certificate authorities binds a given public signing key to a given digital identity.

Public key infrastructure (PKI) trustpoint helps manage the digital certificates. The association between the certificate and the trustpoint helps track the certificate. The trustpoint contains information about the certificate authority (CA), different identity parameters, and the digital certificate. Multiple trustpoints can be created to associate with different certificates.

Server and User Authentication using X.509v3

For server authentication, the IOS secure shell (SSH) server sends its own certificate to the SSH client for verification. This server certificate is associated with the trustpoint configured in the server certificate profile (ssh-server-cert-profile-server configuration mode).

For user authentication, the SSH client sends the user's certificate to the IOS SSH server for verification. The SSH server validates the incoming user certificate using public key infrastructure (PKI) trustpoints configured in the server certificate profile (ssh-server-cert-profile-user configuration mode).

By default, certificate-based authentication is enabled for server and user at the IOS SSH server end.

How to Configure X.509v3 Certificates for SSH Authentication

Configuring IOS SSH Server to Use Digital Certificates for Server Authentication

SUMMARY STEPS

1. enable
2. configure terminal
3. ip ssh server algorithm hostkey {x509v3-ssh-rsa [ssh-rsa] | ssh-rsa [x509v3-ssh-rsa]}
4. ip ssh server certificate profile
5. server
6. trustpoint sign PKI-trustpoint-name
7. ocsp-response include
8. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step</td>
<td>Command or Action</td>
</tr>
<tr>
<td>------</td>
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</tr>
</tbody>
</table>
| 2    | **configure terminal**  
**Example:**  
Device# configure terminal | Enters global configuration mode. |
| 3    | ip ssh server algorithm hostkey {x509v3-ssh-rsa [ssh-rsa]  
[ssh-rsa [x509v3-ssh-rsa]]}  
**Example:**  
Device(config)# ip ssh server algorithm hostkey x509v3-ssh-rsa | Defines the order of host key algorithms. Only the configured algorithm is negotiated with the secure shell (SSH) client.  
**Note**  
The IOS SSH server must have at least one configured host key algorithm:  
- ssh-rsa – public key based authentication  
- x509v3-ssh-rsa – certificate-based authentication |
| 4    | ip ssh server certificate profile  
**Example:**  
Device(config)# ip ssh server certificate profile | Configures server certificate profile and user certificate profile and enters SSH certificate profile configuration mode. |
| 5    | server  
**Example:**  
Device(ssh-server-cert-profile)# server | Configures server certificate profile and enters SSH server certificate profile server configuration mode. |
| 6    | trustpoint sign **PKI-trustpoint-name**  
**Example:**  
Device(ssh-server-cert-profile-server)# trustpoint sign trust1 | Attaches the public key infrastructure (PKI) trustpoint to the server certificate profile. The SSH server uses the certificate associated with this PKI trustpoint for server authentication. |
| 7    | ocs-p-response include  
**Example:**  
Device(ssh-server-cert-profile-server)# ocs-p-response include | (Optional) Sends the Online Certificate Status Protocol (OCSP) response or OCSP stapling along with the server certificate.  
**Note**  
By default the “no” form of this command is configured and no OCSP response is sent along with the server certificate. |
| 8    | end  
**Example:**  
Device(ssh-server-cert-profile-server)# end | Exits SSH server certificate profile server configuration mode and enters privileged EXEC mode. |
Configuring IOS SSH Server to Verify User's Digital Certificate for User Authentication

SUMMARY STEPS

1. enable
2. configure terminal
3. ip ssh server algorithm authentication {publickey | keyboard | password}
4. ip ssh server algorithm publickey {x509v3-ssh-rsa [ssh-rsa] | ssh-rsa [x509v3-ssh-rsa]}
5. ip ssh server certificate profile
6. user
7. trustpoint verify PKI-trustpoint-name
8. ocsp-response required
9. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| **Step 1** enable | Enables privileged EXEC mode.  
  Example:  
  Device> enable |
| **Step 2** configure terminal | Enters global configuration mode. |
| Example: | |
| Device# configure terminal | |
| **Step 3** ip ssh server algorithm authentication {publickey | keyboard | password} | Defines the order of user authentication algorithms. Only the configured algorithm is negotiated with the secure shell (SSH) client. |
| Example: | |
| Device(config)# ip ssh server algorithm authentication publickey | |
| **Step 4** ip ssh server algorithm publickey {x509v3-ssh-rsa [ssh-rsa] | ssh-rsa [x509v3-ssh-rsa]} | Defines the order of public key algorithms. Only the configured algorithm is accepted by the SSH client for user authentication. |
| Example: | |

**Note** The IOS SSH server must have at least one configured user authentication algorithm.

**Note** To use the certificate method for user authentication, the publickey keyword must be configured.

**Note** The ip ssh server algorithm authentication command replaces the ip ssh server authenticate user command.
<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Device(config)# ip ssh server algorithm publickey x509v3-ssh-rsa</code></td>
<td>Note: The IOS SSH client must have at least one configured public key algorithm:</td>
</tr>
<tr>
<td></td>
<td>• ssh-rsa – public-key-based authentication</td>
</tr>
<tr>
<td></td>
<td>• x509v3-ssh-rsa – certificate-based authentication</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td></td>
</tr>
<tr>
<td><code>ip ssh server certificate profile</code></td>
<td>Configures server certificate profile and user certificate profile and enters SSH certificate profile configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device(config)# ip ssh server certificate profile</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td></td>
</tr>
<tr>
<td><code>user</code></td>
<td>Configures user certificate profile and enters SSH server certificate profile user configuration mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device(ssh-server-cert-profile)# user</code></td>
<td></td>
</tr>
<tr>
<td><strong>Step 7</strong></td>
<td></td>
</tr>
<tr>
<td><code>trustpoint verify PKI-trustpoint-name</code></td>
<td>Configures the public key infrastructure (PKI) trustpoint that is used to verify the incoming user certificate.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device(ssh-server-cert-profile-user)# trustpoint verify trust2</code></td>
<td>Note: Configure multiple trustpoints by executing the same command multiple times. A maximum of 10 trustpoints can be configured.</td>
</tr>
<tr>
<td><strong>Step 8</strong></td>
<td></td>
</tr>
<tr>
<td><code>ocsp-response required</code></td>
<td>(Optional) Mandates the presence of the Online Certificate Status Protocol (OCSP) response with the incoming user certificate.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device(ssh-server-cert-profile-user)# ocsp-response required</code></td>
<td>Note: By default the “no” form of this command is configured and the user certificate is accepted without an OCSP response.</td>
</tr>
<tr>
<td><strong>Step 9</strong></td>
<td></td>
</tr>
<tr>
<td><code>end</code></td>
<td>Exits SSH server certificate profile user configuration mode and enters privileged EXEC mode.</td>
</tr>
<tr>
<td><strong>Example:</strong></td>
<td></td>
</tr>
<tr>
<td><code>Device(ssh-server-cert-profile-user)# end</code></td>
<td></td>
</tr>
</tbody>
</table>

**Verifying Configuration for Server and User Authentication Using Digital Certificates**

**SUMMARY STEPS**

1. enable
2. show ip ssh
### DETAILED STEPS

**Step 1**  
**enable**  
Enables privileged EXEC mode.  
- Enter your password if prompted.

**Example:**

```
Device> enable
```

**Step 2**  
**show ip ssh**  
Displays the currently configured authentication methods. To confirm the use of certificate-based authentication, ensure that the x509v3-ssh-rsa algorithm is the configured host key algorithm.

**Example:**

```
Device# show ip ssh
SSH Enabled - version 1.99
Authentication methods:publickey,keyboard-interactive,password
Authentication Publickey Algorithms:x509v3-ssh-rsa,ssh-rsa
Hostkey Algorithms:x509v3-ssh-rsa,ssh-rsa
Authentication timeout: 120 secs; Authentication retries: 3
Minimum expected Diffie Hellman key size : 1024 bits
```

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### Configuration Examples for X.509v3 Certificates for SSH Authentication

**Configuring IOS SSH Server to Use Digital Certificates for Server Authentication**

**SUMMARY STEPS**

1. enable  
2. configure terminal  
3. ip ssh server algorithm hostkey \{x509v3-ssh-rsa [ssh-rsa] | ssh-rsa [x509v3-ssh-rsa]\}  
4. ip ssh server certificate profile  
5. server  
6. trustpoint sign PKI-trustpoint-name  
7. ocsp-response include  
8. end

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<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
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<tr>
<td>Device&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
</tbody>
</table>

**Step 2**

**configure terminal**

**Example:**

Device# configure terminal

Enters global configuration mode.

**Step 3**

**ip ssh server algorithm hostkey {x509v3-ssh-rsa [ssh-rsa] | ssh-rsa [x509v3-ssh-rsa]}**

**Example:**

Device(config)# ip ssh server algorithm hostkey x509v3-ssh-rsa

Defines the order of host key algorithms. Only the configured algorithm is negotiated with the secure shell (SSH) client.

**Note** The IOS SSH server must have at least one configured host key algorithm:

• ssh-rsa – public key based authentication

• x509v3-ssh-rsa – certificate-based authentication

**Step 4**

**ip ssh server certificate profile**

**Example:**

Device(config)# ip ssh server certificate profile

Configures server certificate profile and user certificate profile and enters SSH certificate profile configuration mode.

**Step 5**

**server**

**Example:**

Device(ssh-server-cert-profile)# server

Configures server certificate profile and enters SSH server certificate profile server configuration mode.

**Step 6**

**trustpoint sign PKI-trustpoint-name**

**Example:**

Device(ssh-server-cert-profile-server)# trustpoint sign trust1

Attaches the public key infrastructure (PKI) trustpoint to the server certificate profile. The SSH server uses the certificate associated with this PKI trustpoint for server authentication.

**Step 7**

**ocsp-response include**

**Example:**

Device(ssh-server-cert-profile-server)# ocsp-response include

(Optional) Sends the Online Certificate Status Protocol (OCSP) response or OCSP stapling along with the server certificate.

**Note** By default the “no” form of this command is configured and no OCSP response is sent along with the server certificate.

**Step 8**

**end**

**Example:**

Device(ssh-server-cert-profile-server)# end

Exits SSH server certificate profile server configuration mode and enters privileged EXEC mode.
Example: Configuring IOS SSH Server to Verify User's Digital Certificate for User Authentication

Device> enable
Device# configure terminal
Device(config)# ip ssh server algorithm authentication publickey
Device(config)# ip ssh server algorithm publickey x509v3-ssh-rsa
Device(config)# ip ssh server certificate profile
Device(ssh-server-cert-profile)# user
Device(ssh-server-cert-profile-user)# trustpoint verify trust2
Device(ssh-server-cert-profile-user)# end