How to Configure Server Security

Instructions for securing Red Hat JBoss Enterprise Application Platform and its management interfaces.
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Abstract

The purpose of this document is to provide a practical guide to securing Red Hat JBoss Enterprise Application Platform (JBoss EAP). More specifically, this guide details how to secure all of the management interfaces on JBoss EAP. Before reading this guide, users should read through the Security Architecture document for Red Hat JBoss Enterprise Application Platform and have a solid understanding of how JBoss EAP handles security. This document also makes use of the JBoss EAP CLI interface for performing configuration changes. When completing this document, readers should have a solid, working understanding of how to secure JBoss EAP.
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PROVIDING FEEDBACK ON RED HAT DOCUMENTATION

We appreciate your feedback on our documentation. To provide feedback, you can highlight the text in a document and add comments. Follow the steps in the procedure to learn about submitting feedback on Red Hat documentation.

Prerequisites

- Log in to the Red Hat Customer Portal.
- In the Red Hat Customer Portal, view the document in Multi-page HTML format.

Procedure

1. Click Feedback to see existing reader comments.

   NOTE
   The feedback feature is enabled only in the Multi-page HTML format.

2. Highlight the section of the document where you want to provide feedback.

3. In the prompt menu that displays near the text you selected, click Add Feedback.
   A text box opens in the feedback section on the right side of the page.

4. Enter your feedback in the text box and click Submit.
   You have created a documentation issue.

5. To view the issue, click the issue tracker link in the feedback view.
MAKING OPEN SOURCE MORE INCLUSIVE

Red Hat is committed to replacing problematic language in our code, documentation, and web properties. We are beginning with these four terms: master, slave, blacklist, and whitelist. Because of the enormity of this endeavor, these changes will be implemented gradually over several upcoming releases. For more details, see our CTO Chris Wright’s message.
CHAPTER 1. SECURING THE SERVER AND ITS INTERFACES

1.1. BUILDING BLOCKS

1.1.1. Interfaces and socket bindings

JBoss EAP utilizes its host’s interfaces, for example **inet-address** and **nic**, as well as ports for communication for both its web applications as well as its management interfaces. These interfaces and ports are defined and configured through the **interfaces** and **socket-binding-groups** settings in the JBoss EAP.

For more information on how to define and configure **interfaces** and **socket-binding-groups**, see the **Socket Bindings** section of the JBoss EAP **Configuration Guide**.

Example: Interfaces

```xml
<interfaces>
  <interface name="management">
    <inet-address value="${jboss.bind.address.management:127.0.0.1}"/>
  </interface>
  <interface name="public">
    <inet-address value="${jboss.bind.address:127.0.0.1}"/>
  </interface>
</interfaces>
```

Example: Socket Binding Group

```xml
<socket-binding-group name="standard-sockets" default-interface="public" port-offset="${jboss.socket.binding.port-offset:0}" port="${jboss.management.http.port:9990}">
  <socket-binding name="management-http" interface="management" port="${jboss.management.http.port:9990}"/>
  <socket-binding name="management-https" interface="management" port="${jboss.management.https.port:9993}"/>
  <socket-binding name="ajp" port="${jboss.ajp.port:8009}"/>
  <socket-binding name="http" port="${jboss.http.port:8080}"/>
  <socket-binding name="https" port="${jboss.https.port:8443}"/>
  <socket-binding name="txn-recovery-environment" port="4712"/>
  <socket-binding name="txn-status-manager" port="4713"/>
<outbound-socket-binding name="mail-smtp">
  <remote-destination host="localhost" port="25"/>
</outbound-socket-binding>
</socket-binding-group>
```

1.1.2. Elytron Subsystem

1.1.2.1. Enable Elytron Security Across the Server

There is a simple way to enable Elytron across the server. JBoss EAP 7.1 introduced an example configuration script that enables Elytron as the security provider. This script resides in the **EAP_HOME/docs/examples** directory in the server installation.

Execute the following command to enable Elytron security across the server.
1.1.2.2. Create an Elytron Security Domain

Security domains in the elytron subsystem, when used in conjunction with security realms, are used for both core management authentication as well as for authentication with applications.

**IMPORTANT**

Deployments are limited to using one Elytron security domain per deployment. Scenarios that may have required multiple legacy security domains can now be accomplished using a single Elytron security domain.

Add a Security Domain Using the Management CLI

```
/subsystem=elytron/security-domain=domainName:add(realms=[{realm=realmName,role-decoder=roleDecoderName}],default-realm=realmName,permission-mapper=permissionMapperName,role-mapper=roleMapperName,...)
```

Add a Security Domain Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.

2. Navigate to Configuration → Subsystems → Security (Elytron) → Other Settings and click View.

3. Select SSL → Security Domain and use the Add button to configure a new security domain.

1.1.2.3. Create an Elytron Security Realm

Security realms in the elytron subsystem, when used in conjunction with security domains, are used for both core management authentication as well as for authentication with applications. Security realms are also specifically typed based on their identity store, for example jdbc-realm, filesystem-realm, properties-realm, etc.

Add a Security Realm Using the Management CLI

```
/subsystem=elytron/type-of-realm=realmName:add(....)
```

Examples of adding specific realms, such as jdbc-realm, filesystem-realm, and properties-realm can be found in previous sections.

Add a Security Realm Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.


3. Select the appropriate security realm type from the Security Realm tab and click Add to configure a new security realm.
1.1.2.4. Create an Elytron Role Decoder

A role decoder converts attributes from the identity provided by the security realm into roles. Role decoders are also specifically typed based on their functionality, for example empty-role-decoder, simple-role-decoder, and custom-role-decoder.

Add a Role Decoder Using the Management CLI

```
/subsystem=elytron/ROLE-DECODER-TYPE=roleDeoderName:add(....)
```

Add a Role Decoder Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.
3. Click on Role Decoder, select the appropriate role decoder type and click Add to configure a new role decoder.

1.1.2.5. Adding a source-address-role-decoder to the elytron subsystem

You can use either the management CLI or the Management Console to add the source-address-role-decoder role decoder to the elytron subsystem. By configuring this role decoder in the mappers element, you make use of the IP address of a client when making authorization decisions.

The source-address-role-decoder extracts the IP address of a client and checks if it matches the IP address specified in the pattern attribute or the source-address attribute. If the IP address of the client matches the IP address specified in either attribute then elytron uses the roles attribute to assign roles to the user.

**NOTE**

The procedure uses the management CLI to add source-address-role-decoder to the mappers element in the elytron subsystem. If you want to use the Management Console to complete this task, refer to the link provided in the Additional resources section.

Prerequisites

- Note the IP address of the server’s client.

Procedure

1. In the elytron subsystem, use the management CLI to add source-address-role-decoder. For a source-address-role-decoder, you must specify an IP address and at least one role for a user.

   Example of adding the source-address-role-decoder to the mappers element:

   ```
   /subsystem=elytron/source-address-role-decoder=decoder1:add(source-address="10.10.10.10", roles=["Administrator"])
   ```

   The example shows a configured source-address-role-decoder, named as decoder1. When a client attempts to connect to a server, the elytron subsystem uses the source-address-role-
**decoder** to check that the client’s IP address matches the IP address that was specified in either the **pattern** attribute or the **source-address** attribute. In the previous example, the **source-address-role-decoder** checks if the client’s IP address is 10.10.10.10. If the client’s IP address is 10.10.10.10 then **elytron** uses the **roles** attribute to assign the **Administrator** role to the user.

**NOTE**

You can configure a **source-address-role-decoder** to assign specific roles to a user who needs to establish connections from different networks.

2. In the **security-domain**, reference the configured **source-address-role-decoder** in the **role-decoder** attribute. This ensures that an Elytron security domain uses **source-address-role-decoder** when making authorization decisions.

Example of referencing a configured **source-address-role-decoder**, decoder1, in the **role-decoder** attribute:

```
/subsystem=elytron/security-domain=domainName:add(role-decoder=decoder1,default-realm=realmName,realms=[{realm=realmName}])
```

**Additional resources**

- For information about adding a role decoder with the management console, see **Elytron Subsystem**.
- For information about the **elytron** subsystem, see **Elytron Subsystem** in the **Security Architecture** guide.

### 1.1.3. Configuring an **aggregate-role-decoder** to the **elytron** subsystem

The **aggregate-role-decoder** consists of two or more role decoders. You can use an **aggregate-role-decoder** to aggregate the roles returned from each role decoder.

**Prerequisites**

- Configure at least two role decoders in the **elytron** subsystem.

**Procedure**

- Add at least two role decoders to the **aggregate-role-decoder** role decoder.

Example of adding decoder1 and decoder2 to the **aggregate-role-decoder** role decoder:

```
/subsystem=elytron/aggregate-role-decoder=aggregateDecoder:add(role-decoders=[decoder1, decoder2])
```

**Additional resources**

- For information about available role decoders in the **elytron** subsystem, see **Resources in the Elytron Subsystem** in the **Security Architecture** guide.
For information about creating a role decoder, see Elytron Subsystem.

1.1.3.1. Create an Elytron Role Mapper

A role mapper maps roles after they have been decoded to other roles. Examples include normalizing role names or adding and removing specific roles from principals after they have been decoded. Role mappers are also specifically typed based on their functionality, for example add-prefix-role-mapper, add-suffix-role-mapper, and constant-role-mapper.

Adding a Role Mapper Takes the General Form

/subsystem=elytron/ROLE-MAPPER-TYPE=roleMapperName:add(...)

Adding a Role Mapper Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.


3. Click on Role Mapper, select the appropriate role mapper type and click Add to configure a new role mapper.

1.1.3.2. Create an Elytron Permission Set

Permission sets can be used to assign permissions to an identity.

Add a Permission Set Using the Management CLI

/subsystem=elytron/permission-set=PermissionSetName:add(permissions=[{class-name="...", module="...", target-name="...", action="..."}...])

The permissions parameter consists of a set of permissions, where each permission has the following attributes:

- class-name is the fully qualified class name of the permission. This is the only permission attribute that is required.
- module is an optional module used to load the permission.
- target-name is an optional target name passed to the permission as it is constructed.
- action is an optional action passed to the permission as it is constructed.

1.1.3.3. Create an Elytron Permission Mapper

In addition to roles being assigned to a identity, permissions may also be assigned. A permission mapper assigns permissions to an identity. Permission mappers are also specifically typed based on their functionality, for example logical-permission-mapper, simple-permission-mapper, and custom-permission-mapper.

Add a Permission Mapper Using the Management CLI

/subsystem=elytron/simple-permission-mapper=PermissionMapperName:add(...)
Add a Permission Mapper Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.


3. Click on Principal Decoder, select the appropriate principal decoder type and click Add to configure a new principal decoder.

### 1.1.3.4. Creating an Authentication Configuration

An authentication configuration contains the credentials to use when making a connection. For more information on authentication configurations, see Configure Client Authentication with Elytron Client in How to Configure Identity Management for JBoss EAP.

**NOTE**

Instead of a credential store, you can configure an Elytron security domain to use the credentials of the accessing user. For instance, a security domain can be used in conjunction with Kerberos for authenticating incoming users. Follow the instructions in Configure the Elytron Subsystem in How to Set Up SSO with Kerberos for JBoss EAP, and set obtain-kerberos-ticket=true in the Kerberos security factory.

Add an Authentication Configuration Using the Management CLI

```
/subsystem=elytron/authentication-configuration=AUTHENTICATION_CONFIGURATION_NAME:add(authentication-name=AUTHENTICATION_NAME, credential-reference={clear-text=PASSWORD})
```

Add an Authentication Configuration Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.

2. Navigate to Configuration → Subsystems → Security (Elytron) → Other Settings and click View.

3. Click on Authentication → Authentication Configuration and click Add to configure a new authentication configuration.

For the full list of authentication-configuration attributes, see Elytron Subsystem Components Reference.

### 1.1.3.5. Creating an Authentication Context

An authentication context contains a set of rules and either authentication configurations or SSL contexts to use for establishing a connection. For more information on authentication contexts, see Configure Client Authentication with Elytron Client in How to Configure Identity Management for JBoss EAP.

Add an Authentication Context Using the Management CLI

An authentication context can be created using the following management CLI command.
Typically, an authentication context will contain a set of rules and either an authentication configuration or a SSL context. The following CLI command provides demonstrates defining an authentication context that only functions when the hostname is localhost.

```
/subsystem=elytron/authentication-context=AUTHENTICATION_CONTEXT_NAME:add(match-rules=[{authentication-configuration=AUTHENTICATION_CONFIGURATION_NAME, match-host=localhost}])
```

Add an Authentication Context Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.
2. Navigate to Configuration → Subsystems → Security (Elytron) → Other Settings and click View.
3. Click on Authentication → Authentication Context and click Add to configure a new authentication context.

For the full list of authentication-context attributes, see Elytron Subsystem Components Reference.

### 1.1.3.6. Create an Elytron Authentication Factory

An authentication factory is an authentication policy used for specific authentication mechanisms. Authentication factories are specifically based on the authentication mechanism, for example http-authentication-factory, sasl-authentication-factory and kerberos-security-factory.

Add an Authentication Factory Using the Management CLI

```
/subsystem=elytron/AUTH-FACTORY-TYPE=authFactoryName:add(....)
```

Add an Authentication Factory Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.
3. Click on HTTP Factories, SASL Factories, or Other Factories, choose the appropriate factory type, and click Add to configure a new factory.

### 1.1.3.7. Create an Elytron Keystore

A key-store is the definition of a keystore or truststore including the type of keystore, its location, and the credential for accessing it.

To generate an example keystore for use with the elytron subsystem, use the following command:

```
$ keytool -genkeypair -alias localhost -keyalg RSA -keysize 1024 -validity 365 -keystore keystore.jks -dname "CN=localhost" -keypass secret -storepass secret
```

Add a Keystore Using the Management CLI
To define a `key-store` in Elytron that references the newly made keystore, execute the following management CLI command. This command specifies the path to the keystore, relative to the file system path provided, the credential reference used for accessing the keystore, and the type of keystore.

```
/subsystem=elytron/key-store=newKeyStore:add(path=keystore.jks,relative-to=jboss.server.config.dir,credential-reference={clear-text=secret},type=JKS)
```

**NOTE**

The above command uses `relative-to` to reference the location of the keystore file. Alternatively, you can specify the full path to the keystore in `path` and omit `relative-to`.

### Add a Keystore Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.
2. Navigate to Configuration → Subsystems → Security (Elytron) → Other Settings and click View.
3. Click on Stores → Key Store and click Add to configure a new keystore.

### 1.1.3.8. Create an Elytron Key Manager

A `key-manager` references a `key-store`, and is used in conjunction with an SSL context.

### Add a Key Manager Using the Management CLI

The following command specifies the underlying keystore to reference, the algorithm to use when initializing the key manager, and the credential reference for accessing the entries in the underlying keystore.

```
/subsystem=elytron/key-manager=newKeyManager:add(key-store=KEY_STORE,algorithm="PKIX",credential-reference={clear-text=secret})
```

**IMPORTANT**

If an algorithm is not specified, then it will be set to the default `KeyManagerFactory` algorithm name.

The available key manager algorithms are provided by the JDK in use. For example, a JDK that uses SunJSSE provides the `PKIX` and `SunX509` algorithms.

### Add a Key Manager Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.
2. Navigate to Configuration → Subsystems → Security (Elytron) → Other Settings and click View.
3. Click on SSL → Key Manager and click Add to configure a new key manager.

### 1.1.3.9. Create an Elytron Truststore
To create a truststore in Elytron execute the following CLI command.

```
/subsystem=elytron/key-store=default-trust-store:add(type=JKS, relative-to=jboss.server.config.dir, path=application.truststore, credential-reference={clear-text=password})
```

In order to successfully execute the command above you must have an `application.truststore` file inside your `EAP_HOME/standalone/configuration` directory. The truststore must contain the certificates associated with the endpoint or a certificate chain in case the end point’s certificate is signed by a CA.

Red Hat recommends you to avoid using self-signed certificates. Ideally, certificates should be signed by a CA and your truststore should contain a certificate chain representing your ROOT and intermediary CAs.

1.1.3.10. Create an Elytron Trust Manager

To define a trust manager in Elytron execute the following CLI command.

```
/subsystem=elytron/trust-manager=default-trust-manager:add(key-store=TRUST-STORE-NAME)
```

This sets the defined truststore as the source of the certificates that the application server trusts.

1.1.3.11. Using the Out of the Box Elytron Components

JBoss EAP provides a default set of Elytron components configured in the `elytron` subsystem. You can find more details on these pre-configured components in the Out of the Box section of the Security Architecture guide.

1.1.3.11.1. Securing Management Interfaces

You can find more details on the enabling JBoss EAP to use the out of the box Elytron components for securing the management interfaces in the User Authentication with Elytron section.

1.1.3.11.2. Securing Applications

The `elytron` subsystem provides `application-http-authentication` for `http-authentication-factory` by default, which can be used to secure applications. For more information on how to configure `application-http-authentication`, see the Out of the Box section of the Security Architecture guide.

To configure applications to use `application-http-authentication`, see Configure Web Applications to Use Elytron or Legacy Security for Authentication in How to Configure Identity Management Guide. You can also override the default behavior of all applications using the steps in the Override an Application’s Authentication Configuration section of the JBoss EAP How to Configure Identity Management Guide.

1.1.3.11.3. Using SSL/TLS

JBoss EAP does provide a default one-way SSL/TLS configuration using the legacy core management authentication, but it does not provide one in the `elytron` subsystem. You can find more details on configuring SSL/TLS using the `elytron` subsystem for both the management interfaces as well as for applications in the following sections:

- Enable One-way SSL/TLS for the Management Interfaces Using the Elytron Subsystem
- Enable Two-Way SSL/TLS for the Management Interfaces using the Elytron Subsystem
- Enable One-way SSL/TLS for Applications using the Elytron Subsystem
- Enable Two-Way SSL/TLS for Applications using the Elytron Subsystem

### 1.1.3.11.4. Using Elytron with Other Subsystems

In addition to securing applications and management interfaces, Elytron also integrates with other subsystems in JBoss EAP.

**batch-jberet**

You can configure the `batch-jberet` subsystem to run batch jobs using an Elytron security domain. For more information, see Configure Security for Batch Jobs in the Configuration Guide.

**datasources**

You can use a credential store or an Elytron security domain to provide authentication information in a datasource definition. For more information, see Datasource Security in the Configuration Guide.

**ejb3**

You can create mappings for Elytron security domains in the `ejb3` subsystem to be referenced by deployments. For more information, see Elytron Integration with the EJB Subsystem in Developing Jakarta Enterprise Beans Applications.

**iiop-openjdk**

You can use the `elytron` subsystem to configure SSL/TLS between clients and servers using the `iiop-openjdk` subsystem. For more information, see Configure IIOP to use SSL/TLS with the Elytron Subsystem in the Configuration Guide.

**jca**

You can use the `elytron-enabled` attribute to enable Elytron security for a work manager. For more information, see Configuring the JCA Subsystem in the Configuration Guide.

**jgroups**

You can configure the `SYM_ENCRYPT` and `ASYM_ENCRYPT` protocols to reference keystores or credential references defined in the `elytron` subsystem. For more information, see Securing a Cluster in the Configuration Guide.

**mail**

You can use a credential store to provide authentication information in a server definition in the `mail` subsystem. For more information, see Use a Credential Store for Passwords in the Configuration Guide.

**messaging-activemq**

You can secure remote connections to the remote connections used by the `messaging-activemq` subsystem. For more information, see the Using the Elytron Subsystem section of Configuring Messaging.

**modcluster**

You can use an Elytron client `ssl-context` to communicate with a load balancer using SSL/TLS. For more information, see Elytron Integration with the ModCluster Subsystem.

**remoting**

You can configure inbound and outbound connections in the `remoting` subsystem to reference authentication contexts, SASL authentication factories, and SSL contexts defined in the `elytron` subsystem. For full details on configuring each type of connection, see Elytron Integration with the Remoting Subsystem.

**resource-adapters**

You can secure connections to the resource adapter using Elytron. You can enable security inflow to establish security credentials when submitting work to be executed by the work manager. For more
information, see Configure Resource Adapters to Use the Elytron Subsystem in the Configuration Guide.

undertow

You can use the elytron subsystem to configure both SSL/TLS and application authentication. For more information on configuring application authentication, see Using SSL/TLS and Configure Web Applications to Use Elytron or Legacy Security for Authentication in How to Configure Identity Management.

1.1.3.12. Enable and Disable the Elytron Subsystem

The elytron subsystem comes pre-configured with the default JBoss EAP profiles alongside the legacy security subsystem.

If you are using a profile where the elytron subsystem has not been configured, you can add it by adding the elytron extension and enabling the elytron subsystem.

To add the elytron extension required for the elytron subsystem:

```
extension=org.wildfly.extension.elytron:add()
```

To enable the elytron subsystem in JBoss EAP:

```
/subsystem=elytron:add
reload
```

To disable the elytron subsystem in JBoss EAP:

```
/subsystem=elytron:remove
reload
```

IMPORTANT

Other subsystems within JBoss EAP may have dependencies on the elytron subsystem. If these dependencies are not resolved before disabling it, you will see errors when starting JBoss EAP.

1.1.4. Legacy Security Subsystem

1.1.4.1. Enable and Disable the Security Subsystem

To disable the security subsystem in JBoss EAP:

```
/subsystem=security:remove
```

IMPORTANT

Other subsystems within JBoss EAP may have dependencies on the security subsystem. If these dependencies are not resolved before disabling it, you will see errors when starting JBoss EAP.
To enable the security subsystem in JBoss EAP:

/subsystem=security:add

### 1.1.5. Legacy Security Realms

JBoss EAP uses security realms to define authentication and authorization mechanisms, such as local, LDAP, properties, which can then be used by the management interfaces. For more background information on security realms, see the Security Realms section of the Red Hat JBoss Enterprise Application Platform Security Architecture guide.

**Example: Security Realms**

```xml
<security-realms>
  <security-realm name="ManagementRealm">
    <authentication>
      <local default-user="$local" skip-group-loading="true"/>
      <properties path="mgmt-users.properties" relative-to="jboss.server.config.dir"/>
    </authentication>
    <authorization map-groups-to-roles="false">
      <properties path="mgmt-groups.properties" relative-to="jboss.server.config.dir"/>
    </authorization>
  </security-realm>
  <security-realm name="ApplicationRealm">
    <authentication>
      <local default-user="$local" allowed-users="*" skip-group-loading="true"/>
      <properties path="application-users.properties" relative-to="jboss.server.config.dir"/>
    </authentication>
    <authorization>
      <properties path="application-roles.properties" relative-to="jboss.server.config.dir"/>
    </authorization>
  </security-realm>
</security-realms>
```

**NOTE**

In addition to updating the existing security realms, JBoss EAP also allows you to create new security realms. You can create new security realms via the management console as well as invoking the following command from the management CLI:

```
/core-service=management/security-realm=NEW-REALM-NAME:add()
```

If you create a new security realm and want to use a properties file for authentication or authorization, you must create a new properties file specifically for the new security domain. JBoss EAP does not reuse existing files used by other security domains nor does it automatically create new files specified in the configuration if they do not exist.

### 1.1.6. Using Authentication and Socket Bindings for Securing the Management Interfaces

By default, JBoss EAP defines an [http-interface](http://example.com) to connect to the management interfaces:

```
[standalone@localhost:9990 ] / /core-service=management:read-resource(recursive=true)
```
You can use a combination of socket-binding, http-authentication-factory, and http-upgrade to secure the management interfaces using the elytron subsystem. Alternatively, you can use socket-binding with security-realm to secure the management interfaces with the legacy core management authentication. You can also disable the management interfaces, and configure users of the interfaces to have various roles and access rights.

1.2. HOW TO SECURE THE MANAGEMENT INTERFACES

The following sections show how to perform various operations related to securing the JBoss EAP management interfaces and related subsystems.

NOTE

The management CLI commands shown assume that you are running a JBoss EAP standalone server. For more details on using the management CLI for a JBoss EAP managed domain, see the JBoss EAP Management CLI Guide.

Elytron Integration with the Management CLI

The management interfaces can be secured using resources from the elytron subsystem in the same way as it is done by the legacy security realms.

The SSL configuration for connections comes from one of these locations:

- Any SSL configuration within the CLI specific configuration.
- The default SSL configuration that automatically prompts users to accept the server’s certificate.
- The java system property.
Client configuration can be modified using the `wildfly-config.xml` file.

**NOTE**

If you set the `-Dwildfly.config.url` property, any file can be used by the client for configuration.

### 1.2.1. Configure Networking and Ports

Depending on the configuration of the host, JBoss EAP may be configured to use various network interfaces and ports. This allows JBoss EAP to work with different host, networking, and firewall requirements.

For more information on the networking and ports used by JBoss EAP, as well as how to configure these settings, see the **Network and Port Configuration** section of the JBoss EAP **Configuration Guide**.

### 1.2.2. Disabling the Management Console

Other clients, such as JBoss Operations Network, operate using the HTTP interface for managing JBoss EAP. In order to continue using these services, just the web-based management console itself may be disabled. This is accomplished by setting the `console-enabled` attribute to **false**:

```
/core-service=management/management-interface=http-interface/:write-attribute(name=console-enabled,value=false)
```

### 1.2.3. Disabling Remote Access to Jakarta Management

Remote access to the `jmx` subsystem allows for JDK and application management operations to be triggered remotely. To disable remote access to Jakarta Management in JBoss EAP, remove the remoting connector in the `jmx` subsystem:

**Removing the Remoting Connector**

```
/subsystem=jmx/remoting-connector=jmx/:remove
```

For more information on Jakarta Management, see the **Jakarta Management** section of the Red Hat JBoss Enterprise Application Platform **Security Architecture** guide.

### 1.2.4. Silent Authentication

The default installation of JBoss EAP contains a method of silent authentication for a local management CLI user. This allows the local user the ability to access the management CLI without user name or password authentication. This functionality is enabled as a convenience, and to assist local users running the management CLI scripts without requiring authentication. It is considered a useful feature given that access to the local configuration typically also gives the user the ability to add their own user details or otherwise disable security checks.

The convenience of silent authentication for local users can be disabled where greater security control is required. This can be achieved by removing the local element within the `security-realm` attribute of the configuration file. This is applicable to both standalone instance as well as managed domain.
IMPORTANT

The removal of the local element should only be done if the impact on the JBoss EAP instance and its configuration is fully understood.

To remove silent authentication when using the *elytron* subsystem:

```bash
[standalone@localhost:9990 ]/subsystem=elytron/sasl-authentication-factory=managenet-sasl-authentication:read-resource
{
    "outcome" => "success",
    "result" => {
        "mechanism-configurations" => [ {
            "mechanism-name" => "JBOSS-LOCAL-USER",
            "realm-mapper" => "local"
        }, {
            "mechanism-name" => "DIGEST-MD5",
            "mechanism-realm-configurations" => [{"realm-name" => "ManagementRealm"]
        }]
        "sasl-server-factory" => "configured",
        "security-domain" => "ManagementDomain"
    }
}
```

```
/subsystem=elytron/sasl-authentication-factory=temp-sasl-authentication:list-remove(name=mechanism-configurations,index=0)
```

```
reload
```

To remove silent authentication when using a legacy security realm:

```bash
/core-service=management/security-realm=REALM_NAME/authentication=local:remove
```

### 1.2.5. Enable One-way SSL/TLS for the Management Interfaces Using the Elytron Subsystem

In JBoss EAP, you can enable one-way SSL/TLS for the management interfaces using the JBoss EAP management CLI or the management console.

In the management CLI, one-way SSL/TLS can be enabled in two ways:

- Using security command.
- Using *elytron* subsystem commands.

#### Using a Security Command

The `security enable-ssl-management` command can be used to enable one-way SSL/TLS for the management interfaces.

**Example: Wizard Usage**
security enable-ssl-management --interactive

Please provide required pieces of information to enable SSL:
Key-store file name (default management.keystore): keystore.jks
Password (blank generated): secret
What is your first and last name? [Unknown]: localhost
What is the name of your organizational unit? [Unknown]:
What is the name of your organization? [Unknown]:
What is the name of your City or Locality? [Unknown]:
What is the name of your State or Province? [Unknown]:
What is the two-letter country code for this unit? [Unknown]:
Is CN=Unknown, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown correct y/n [y]?
Validity (in days, blank default): 365
Alias (blank generated): localhost
Enable SSL Mutual Authentication y/n (blank n): n

SSL options:
key store file: keystore.jks
distinguished name: CN=localhost, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown
password: secret
validity: 365
alias: localhost
Server keystore file keystore.jks, certificate file keystore.pem and keystore.csr file will be generated in server configuration directory.
Do you confirm y/n :y

**NOTE**

Once the command is executed, the management CLI will reload the server and reconnect to it.

**Using Elytron Subsystem Commands**
The *elytron* subsystem commands can also be used to enable one-way SSL/TLS for the management interfaces.

1. Configure a **key-store**.

```
/subsystem=elytron/key-store=httpsKS:add(path=keystore.jks,relative-to=jboss.server.config.dir,credential-reference={clear-text=secret},type=JKS)
```

**NOTE**

The above command uses **relative-to** to reference the location of the keystore file. Alternatively, you can specify the full path to the keystore in **path** and omit **relative-to**.

If the keystore file does not exist yet, the following commands can be used to generate an example key pair:

```
/subsystem=elytron/key-store=httpsKS:generate-key-pair(alias=localhost,algorithm=RSA,key-size=1024,validity=365,credential-reference={clear-
```
2. Create a **key-manager** and **server-ssl-context**.

```
/subsystem=elytron/key-store=httpsKS:store()
/subsystem=elytron/key-manager=httpsKM:add(key-store=httpsKS,algorithm="SunX509",credential-reference={clear-text=secret})
/subsystem=elytron/server-ssl-context=httpsSSC:add(key-manager=httpsKM,protocols=["TLSv1.2"])```

**IMPORTANT**

You need to know what key manager algorithms are provided by the JDK you are using. For example, a JDK that uses SunJSSE provides the **PKIX** and **SunX509** algorithms. You also need to determine what HTTPS protocols you want to support. The example commands above use **TLSv1.2**. You can use the `cipher-suite-filter` argument to specify which cipher suites are allowed, and the `use-cipher-suites-order` argument to honor server cipher suite order. The `use-cipher-suites-order` attribute by default is set to `true`. This differs from the legacy security subsystem behavior, which defaults to honoring client cipher suite order.

3. Enable HTTPS on the management interface.

```
/core-service=management/management-interface=http-interface:write-attribute(name=ssl-context, value=httpsSSC)
/core-service=management/management-interface=http-interface:write-attribute(name=secure-socket-binding, value=management-https)
```

4. Reload the JBoss EAP instance.

```
reload
```

One-way SSL/TLS is now enabled for the management interfaces.

**IMPORTANT**

In cases where you have both a **security-realm** and **ssl-context** defined, JBoss EAP will use the SSL/TLS configuration provided by **ssl-context**.

**NOTE**

You can disable one-way SSL/TLS for the management interfaces using the `disable-ssl-management` command.

```
security disable-ssl-management
```

This command does not delete the Elytron resources. It configures the system to use the **ApplicationRealm** legacy security realm for its SSL configuration.
Using Management Console
You can enable SSL for the management interface used by the management console using an SSL wizard in the management console.

To access the wizard:

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.
2. Navigate to Runtime, click the appropriate server name.
3. Click View next to server name.
4. Click HTTP Management... to open the HTTP Management Interface configuration page.
5. Click Enable SSL to launch the wizard.

The wizard guides you through the following scenarios for enabling SSL:

- You want to create a certificate store and generate a self-signed certificate.
- You want to obtain a certificate from Let’s Encrypt Certificate Authority.
- You already have the certificate store on the file system, but no keystore configuration.
- You already have a keystore configuration that uses a valid certificate store.

Using the wizard, you can optionally create a truststore for mutual authentication.

1.2.6. Enable Two-way SSL/TLS for the Management Interfaces Using the Elytron Subsystem

1. Obtain or generate your client keystores:

```
$ keytool -genkeypair -alias client -keyalg RSA -keysize 1024 -validity 365 -keystore client.keystore.jks -dname "CN=client" -keypass secret -storepass secret
```

2. Export the client certificate:

```
$ keytool -exportcert -keystore client.keystore.jks -alias client -keypass secret -storepass secret -file /path/to/client.cer
```

3. In JBoss EAP, two-way SSL/TLS for the management interfaces can be enabled either by using a security command or by using the elytron subsystem commands.

   a. Using a security command:

      The security enable-ssl-management command can be used to enable two-way SSL/TLS for the management interfaces.

      **NOTE**

      The following example does not validate the certificate as no chain of trust exists. If you are using a trusted certificate, then the client certificate can be validated without issue.

Example: Wizard Usage
security enable-ssl-management --interactive

Please provide required pieces of information to enable SSL:
Key-store file name (default management.keystore): server.keystore.jks
Password (blank generated): secret
What is your first and last name? [Unknown]: localhost
What is the name of your organizational unit? [Unknown]:
What is the name of your organization? [Unknown]:
What is the name of your City or Locality? [Unknown]:
What is the name of your State or Province? [Unknown]:
What is the two-letter country code for this unit? [Unknown]:
Is CN=Unknown, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown correct y/n [y]?
Validity (in days, blank default): 365
Alias (blank generated): localhost
Enable SSL Mutual Authentication y/n (blank n): y
Client certificate (path to pem file): /path/to/client.cer
Validate certificate y/n (blank y): n
Trust-store file name (management.truststore): server.truststore.jks
Password (blank generated): secret

SSL options:
key store file: server.keystore.jks
distinguished name: CN=localhost, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown
password: secret
validity: 365
alias: localhost
client certificate: /path/to/client.cer
trust store file: server.trustore.jks
trust store password: secret
Server keystore file server.keystore.jks, certificate file server.pem and server.csr file will be generated in server configuration directory.
Server truststore file server.trustore.jks will be generated in server configuration directory.
Do you confirm y/n: y

NOTE

Once the command is executed, the management CLI will reload the server and attempt to reconnect to it.

To complete the two-way SSL/TLS authentication, you need to import the server certificate into the client truststore and configure your client to present the client certificate.

b. Using Elytron subsystem commands:
The **elytron** subsystem commands can also be used to enable two-way SSL/TLS for the management interfaces.

i. Obtain or generate your keystore. Before enabling one-way SSL/TLS in JBoss EAP, you must obtain or generate the keystores, truststores and certificates you plan on using. To generate an example set of keystores, truststores, and certificates, use the following commands.

A. Configure a key-store
A. Configure a key-store.

/subsystem=elytron/key-store=twoWayKS:add(path=server.keystore.jks,relative-to=jboss.server.config.dir,credential-reference={clear-text=secret},type=JKS)

/subsystem=elytron/key-store=twoWayKS:generate-key-pair(alias=localhost,algorithm=RSA,key-size=1024,validity=365,credential-reference={clear-text=secret},distinguished-name="CN=localhost")

/subsystem=elytron/key-store=twoWayKS:store()

NOTE

The above command uses relative-to to reference the location of the keystore file. Alternatively, you can specify the full path to the keystore in path and omit relative-to.

B. Export your server certificate.

/subsystem=elytron/key-store=twoWayKS:export-certificate(alias=localhost,path=/path/to/server.cer,pem=true)

C. Create a key-store for the server trust store and import the client certificate into the server truststore.

NOTE

The following example does not validate the certificate as no chain of trust exists. If you are using a trusted certificate, then the client certificate can be validated without issue.

/subsystem=elytron/key-store=twoWayTS:add(path=server.truststore.jks,relative-to=jboss.server.config.dir,credential-reference={clear-text=secret},type=JKS)

/subsystem=elytron/key-store=twoWayTS:import-certificate(alias=client,path=/path/to/client.cer,credential-reference={clear-text=secret},trust-cacerts=true,validate=false)

/subsystem=elytron/key-store=twoWayTS:store()

ii. Configure a key-manager, trust-manager, and server-ssl-context for the server keystore and truststore.

/subsystem=elytron/key-manager=twoWayKM:add(key-store=twoWayKS,credential-reference={clear-text=secret})

/subsystem=elytron/trust-manager=twoWayTM:add(key-store=twoWayTS,algorithm="SunX509")

/subsystem=elytron/server-ssl-context=twoWaySSC:add(key-manager=twoWayKM,protocols=["TLSv1.2"],trust-manager=twoWayTM,want-client-auth=true,need-client-auth=true)
IMPORTANT

You need to know what key manager algorithms are provided by the JDK you are using. For example, a JDK that uses SunJSSE provides the PKIX and SunX509 algorithms. You also need to determine what HTTPS protocols you want to support. The example commands above use TLSv1.2. You can use the cipher-suite-filter argument to specify which cipher suites are allowed, and the use-cipher-suites-order argument to honor server cipher suite order. The use-cipher-suites-order attribute by default is set to true. This differs from the legacy security subsystem behavior, which defaults to honoring client cipher suite order.

A. Enable HTTPS on the management interface.

/core-service=management/management-interface=http-interface:write-attribute(name=ssl-context, value=twoWaySSC)
/core-service=management/management-interface=http-interface:write-attribute(name=secure-socket-binding, value=management-https)

B. Reload the JBoss EAP instance.

reload

NOTE

To complete the two-way SSL/TLS authentication, you need to import the server certificate into the client truststore and configure your client to present the client certificate.

C. Configure your client to use the client certificate.

You need to configure your client to present the trusted client certificate to the server to complete the two-way SSL/TLS authentication. For example, if using a browser, you need to import the trusted certificate into the browser’s trust store.

This results in a forced two-way SSL/TLS authentication, without changing the original authentication to the server management.

If you want to change the original authentication method, see Configure Authentication with Certificates in How to Configure Identity Management for JBoss EAP.

Two-way SSL/TLS is now enabled for the management interfaces.

IMPORTANT

In cases where you have both a security-realm and ssl-context defined, JBoss EAP will use the SSL/TLS configuration provided by ssl-context.
NOTE

You can disable two-way SSL/TLS for the management interfaces using the `disable-ssl-management` command.

```
security disable-ssl-management
```

This command does not delete the Elytron resources. It configures the system to use the `ApplicationRealm` legacy security realm for its SSL configuration.

1.2.7. Enable SASL Authentication for the Management Interfaces Using the CLI Security Command

In JBoss EAP, SASL authentication, using an elytron SASL authentication factory, can be enabled for the management interfaces with the `security enable-sasl-management` command. This command creates all of the non-existing resources required to configure authentication. By default this command associates the included SASL factory with the `http-interface`.

**Example: Enable SASL Authentication**

```
security enable-sasl-management
```

Server reloaded.
Command success.
Authentication configured for management http-interface
sasl authentication-factory=management-sasl-authentication
security-domain=ManagementDomain

NOTE

Once the command is executed, the management CLI will reload the server and reconnect to it.

If a SASL factory already exists, then the factory is updated to use the mechanism defined by the `--mechanism` argument.

For a list of arguments, see [Authorization Security Arguments](#).

**Reorder SASL Mechanisms**

The order of defined SASL mechanisms dictate how the server authenticates the request, with the first matching mechanism being sent to the client. This order can be changed by passing a comma-separated list into the following command.

```
security reorder-sasl-management --mechanisms-order=MECHANISM1,MECHANISM2,...
```

**Disable SASL Authentication for the Management Interfaces**

To remove the active SASL authentication factory use the following command.

```
security disable-sasl-management
```

Alternatively, the command can be used to remove specific mechanisms from the active SASL authentication factory.
security disable-sasl-management --mechanism=MECHANISM

1.2.8. Enable HTTP Authentication for the Management Interfaces Using the CLI Security Command

In JBoss EAP, HTTP authentication, using an elytron HTTP authentication factory, can be enabled for the management interfaces with the `security enable-http-auth-management` command. This command can only target the `http-interface`, and with no additional arguments the included HTTP authentication factory will be associated with this interface.

**Example: Enable HTTP Authentication**

```
security enable-http-auth-management
```

Server reloaded.
Command success.
Authentication configured for management http-interface
http authentication-factory=management-http-authentication
security-domain=ManagementDomain

**NOTE**

Once the command is executed, the management CLI will reload the server and reconnect to it.

If an HTTP factory already exists, then the factory is updated to use the mechanism defined by the `--mechanism` argument.

For a list of arguments, see [Authorization Security Arguments](#).

Disable HTTP Authentication for the Management Interfaces

To remove the active HTTP authentication factory use the following command.

```
security disable-http-auth-management
```

Alternatively, you can use the following command to remove specific mechanisms from the active HTTP authentication factory.

```
security disable-http-auth-management --mechanism=MECHANISM
```

1.2.9. Configure the Management Interfaces for One-way SSL/TLS with Legacy Core Management Authentication

Configuring the JBoss EAP management interfaces for communication only using one-way SSL/TLS provides increased security. All network traffic between the client and the management interfaces is encrypted, which reduces the risk of security attacks such as a man-in-the-middle attack.

In this procedure unencrypted communication with the JBoss EAP instance is disabled. This procedure applies to both standalone server and managed domain configurations. For a managed domain, prefix the management CLI commands with the name of the host, for example: `/host=master`. 
IMPORTANT

While performing the steps for enabling one-way SSL/TLS on the management interfaces, do not reload the configuration unless explicitly instructed. Doing so may cause you to be locked out of the management interfaces.

1. Create a keystore to secure the management interfaces.
2. Ensure the management interfaces bind to HTTPS.
3. Optional: Implement a custom socket-binding-group.
4. Create a new security realm.
5. Configure the management interfaces to use the new security realm.
6. Configure the management interfaces to use the keystore.
7. Update the jboss-cli.xml.

Create a Keystore to Secure the Management Interfaces

NOTE

This keystore must be in JKS format as the management interfaces are not compatible with keystores in JCEKS format.

Use the following to generate a keystore, replacing the example values for the parameters, for example alias, keypass, keystore, storepass and dname, with the correct values for the environment.

```
```

NOTE

The parameter validity specifies for how many days the key is valid. A value of 730 equals two years.

Ensure the Management Interfaces Bind to HTTPS

Running a Standalone Server

To ensure the management interfaces bind to HTTPS, you must add the management-https configuration and remove the management-http configuration.

Use the following CLI commands to bind the management interfaces to HTTPS:

```
/core-service=management/management-interface=http-interface:write-attribute(name=secure-socket-binding, value=management-https)
/core-service=management/management-interface=http-interface:undefined-attribute(name=socket-binding)
```
Running a Managed Domain

Change the socket element within the `management-interface` attribute by adding `secure-port` and removing port configuration.

Use the following commands to bind the management interfaces to HTTPS:

```
/host=master/core-service=management/management-interface=http-interface:write-attribute(name=secure-port,value=9993)
/host=master/core-service=management/management-interface=http-interface:undefine-attribute(name=port)
```

Optional: Implement a Custom socket-binding-group

If you want to use a custom `socket-binding-group`, you must ensure the `management-https` binding is defined, which by default is bound to port 9993. You can verify this from the `socket-binding-group` attribute of the server’s configuration file or using the management CLI:

```
/socket-binding-group=standard-sockets/socket-binding=management-https:read-resource(recursive=true)
{
  "outcome" => "success",
  "result" => {
    "client-mappings" => undefined,
    "fixed-port" => false,
    "interface" => "management",
    "multicast-address" => undefined,
    "multicast-port" => undefined,
    "name" => "management-https",
    "port" => expression "${jboss.management.https.port:9993}"
  }
}
```

Create a New Security Realm

In this example, the new security realm using HTTPS, `ManagementRealmHTTPS`, uses a properties file named `https-mgmt-users.properties` located in the `EAP_HOME/standalone/configuration/` directory for storing user names and passwords.

1. Create a properties file for storing user name and passwords.
   User names and passwords can be added to the file later, but for now, you need to create an empty file named `https-mgmt-users.properties` and save it to that location. The below example shows using the `touch` command, but you may also use other mechanisms, such as a text editor.

   **Example: Using the touch Command to Create an Empty File**

   ```bash
   $ touch EAP_HOME/standalone/configuration/https-mgmt-users.properties
   ```

2. Next, use the following management CLI commands to create a new security realm named `ManagementRealmHTTPS`:

   ```
   /core-service=management/security-realm=ManagementRealmHTTPS:add
   /core-service=management/security-
   ```
realm=ManagementRealmHTTPS/authentication=properties:add(path=https-mgmt-users.properties,relative-to=jboss.server.config.dir)

3. Add users to the properties file.
At this point, you have created a new security realm and configured it to use a properties file for authentication. You must now add users to that properties file using the `add-user` script, which is available in the `EAP_HOME/bin/` directory. When running the `add-user` script, you must specify both the properties file and the security realm using the `-up` and `-r` options respectively. From there, the `add-user` script will interactively prompt you for the user name and password information to store in the `https-mgmt-users.properties` file.

```
$ EAP_HOME/bin/add-user.sh -up EAP_HOME/standalone/configuration/https-mgmt-users.properties -r ManagementRealmHTTPS
...
Enter the details of the new user to add.
Using realm 'ManagementRealmHTTPS' as specified on the command line.
...
Username : httpUser
Password requirements are listed below. To modify these restrictions edit the add-user.properties configuration file.
- The password must not be one of the following restricted values {root, admin, administrator}
- The password must contain at least 8 characters, 1 alphabetic character(s), 1 digit(s), 1 non-alphanumeric symbol(s)
- The password must be different from the username
...
Password :
Re-enter Password :
About to add user 'httpUser' for realm 'ManagementRealmHTTPS'
...
Is this correct yes/no? yes
...
Added user 'httpUser' to file 'EAP_HOME/configuration/https-mgmt-users.properties'
...
Is this new user going to be used for one AS process to connect to another AS process? e.g. for a slave host controller connecting to the master or for a Remoting connection for server to server EJB calls.
yes/no? no
```

**IMPORTANT**

When configuring security realms that use properties files to store usernames and passwords, it is recommended that each realm use a distinct properties file that is not shared with another realm.

**Configure the Management Interfaces to Use the New Security Realm**
Use the following management CLI command to configure the management interfaces to use the new security realm.

```
/core-service=management/management-interface=http-interface:write-attribute(name=security-realm,value=ManagementRealmHTTPS)
```

**Configure the Management Interfaces to Use the Keystore**
Use the below management CLI command to configure the management interfaces to use the keystore. For the parameters file, password and alias their values must be copied from the Create a Keystore to Secure the Management Interfaces step.

```
/core-service=management/security-realm=ManagementRealmHTTPS/server-identity=ssl:add(keystore-path=identity.jks,keystore-relative-to=jboss.server.config.dir,keystore-password=password1, alias=appserver)
```

**NOTE**

To update the keystore password, use the following CLI command:

```
/core-service=management/security-realm=ManagementRealmHTTPS/server-identity=ssl:write-attribute(name=keystore-password,value=newpassword)
```

At this point, you need to reload the server’s configuration:

```
reload
```

After reloading the server configuration, the log should contain the following, just before the text which states the number of services that are started:

```
13:50:54,162 INFO  [org.jboss.as] (Controller Boot Thread) WFLYSRV0052: Admin console listening on https://127.0.0.1:9993
```

The management interfaces are now listening on port **9993**, which confirms that the procedure was successful.

**IMPORTANT**

At this point, the CLI will disconnect and will be unable to reconnect since the port bindings have changed. Proceed to the next step to update the `jboss-cli.xml` file to allow the management CLI to reconnect.

**Update the jboss-cli.xml File**

If using the management CLI to perform management actions, the following changes must to be made to the `EAP_HOME/bin/jboss-cli.xml` file:

- Update the value of `<default-protocol>` to `https-remoting`.
- In `<default-controller>`, update the value of `<protocol>` to `https-remoting`.
- In `<default-controller>`, update the value of `<port>` to `9993`.

**Example: jboss-cli.xml**

```xml
<jboss-cli xmlns="urn:jboss:cli:2.0">
  <default-protocol use-legacy-override="true">https-remoting</default-protocol>
  <!-- The default controller to connect to when 'connect' command is executed w/o arguments -->
  <default-controller>
    <protocol>https-remoting</protocol>
```
The next time you connect to the management interface using the management CLI, you must accept the server certificate and authenticate against the ManagementRealmHTTPS security realm:

**Example: Accepting Server Certificate and Authenticating**

```bash
$ ./jboss-cli.sh -c
Unable to connect due to unrecognised server certificate
Subject    - CN=appserver,OU=Sales,O=Systems Inc,L=Raleigh,ST=NC,C=US
Issuer     - CN=appserver, OU=Sales, O=Systems Inc, L=Raleigh, ST=NC, C=US
Valid To   - Thu Jun 28 13:38:48 CDT 2018
Authenticating against security realm: ManagementRealmHTTPS
Username: httpUser
Password:
[standalone@localhost:9993 ]
```

**IMPORTANT**

In cases where you have both a **security-realm** and **ssl-context** defined, JBoss EAP will use the SSL/TLS configuration provided by **ssl-context**.

### 1.2.10. Setting up Two-way SSL/TLS for the Management Interfaces with Legacy Core Management Authentication

Two-way SSL/TLS authentication, also known as **client authentication**, authenticates both the client and the server using SSL/TLS certificates. This differs from the **Configure the Management Interfaces for One-way SSL/TLS** section in that both the client and server each have a certificate. This provides assurance that not only is the server who it says it is, but the client is also who it says it is.

In this section the following conventions are used:

**HOST1**

The JBoss server hostname. For example: `jboss.redhat.com`.

**HOST2**

A suitable name for the client. For example: `myclient`. Note this is not necessarily an actual hostname.

**CA_HOST1**

The DN (distinguished name) to use for the HOST1 certificate. For example: `cn= jboss,dc=redhat,dc=com`.

**CA_HOST2**

The DN (distinguished name) to use for the HOST2 certificate. For example: `cn=myclient,dc=redhat,dc=com`.
Prerequisites

NOTE

If a password vault is used to store the keystore and truststore passwords, which is recommended, the password vault should already be created. For more information on the password vault, see the Password Vault section as well as the Password Vault System section of the Red Hat JBoss Enterprise Application Platform 7 Security Architecture guide.

WARNING

Red Hat recommends that SSLv2, SSLv3, and TLSv1.0 be explicitly disabled in favor of TLSv1.1 or TLSv1.2 in all affected packages.

1. Generate the keystores.

   ```
   $ keytool -genkeypair -alias HOST1_alias -keyalg RSA -keysize 1024 -validity 365 -keystore HOST1.keystore.jks -dname "CA_HOST1" -keypass secret -storepass secret
   $ keytool -genkeypair -alias HOST2_alias -keyalg RSA -keysize 1024 -validity 365 -keystore HOST2.keystore.jks -dname "CA_HOST2" -keypass secret -storepass secret
   ```

2. Export the certificates.

   ```
   $ keytool -exportcert -keystore HOST1.keystore.jks -alias HOST1_alias -keypass secret -storepass secret -file HOST1.cer
   $ keytool -exportcert -keystore HOST2.keystore.jks -alias HOST2_alias -keypass secret -storepass secret -file HOST2.cer
   ```

3. Import the certificates into the opposing truststores.

   ```
   $ keytool -importcert -keystore HOST1.truststore.jks -storepass secret -alias HOST2_alias -trustcacerts -file HOST2.cer
   $ keytool -importcert -keystore HOST2.truststore.jks -storepass secret -alias HOST1_alias -trustcacerts -file HOST1.cer
   ```


   Define a CertificateRealm in the configuration for the server (`host.xml` or `standalone.xml`) and point the interface to it. This can be done using the following commands:

   ```
   /core-service=management/security-realm=CertificateRealm:add()
   /core-service=management/security-realm=CertificateRealm/server-identity=ssl:add(keystore-path=/path/to/HOST1.keystore.jks, keystore-password=secret,alias=HOST1_alias)
   ```
5. Change the security-realm of the http-interface to the new CertificateRealm.

6. Add the SSL/TLS configuration for the CLI.

**IMPORTANT**

In addition to adding the two-way SSL/TLS, the management interface should also be configured to bind to HTTPS. For details, see Ensure the Management Interfaces Bind to HTTPS in the section entitled Configure the Management Interfaces for One-way SSL/TLS with Legacy Core Management Authentication.

Add the SSL/TLS configuration for the CLI, which uses `EAP_HOME/bin/jboss-cli.xml` as a settings file.

To store the keystore and truststore passwords in plain text, edit `EAP_HOME/bin/jboss-cli.xml` and add the SSL/TLS configuration using the appropriate values for the variables:

**Example: jboss-cli.xml Storing Keystore and Truststore Passwords in Plain Text**

```xml
<ssl>
  <alias>HOST2_alias</alias>
  <key-store>/path/to/HOST2.keystore.jks</key-store>
  <key-store-password>secret</key-store-password>
  <trust-store>/path/to/HOST2.truststore.jks</trust-store>
  <trust-store-password>secret</trust-store-password>
  <modify-trust-store>true</modify-trust-store>
</ssl>
```

To use the keystore and truststore passwords stored in a password vault, you need to add the vault configuration and appropriate vault values to `EAP_HOME/bin/jboss-cli.xml`:

**Example: jboss-cli.xml Storing Keystore and Truststore Passwords in a Password Vault**

```xml
<ssl>
  <vault>
    <vault-option name="KEYSTORE_URL" value="path-to/vault/vault.keystore"/>
    <vault-option name="KEYSTORE_PASSWORD" value="MASK-5WNXs8oEbrs"/>
    <vault-option name="KEYSTORE_ALIAS" value="vault"/>
    <vault-option name="SALT" value="12345678"/>
    <vault-option name="ITERATION_COUNT" value="50"/>
    <vault-option name="ENC_FILE_DIR" value="EAP_HOME/vault"/>
  </vault>
  <alias>HOST2_alias</alias>
  <key-store>/path/to/HOST2.keystore.jks</key-store>
  <key-store-password>VAULT::VB::cli_pass::1</key-store-password>
  <key-password>VAULT::VB::cli_pass::1</key-password>
</ssl>
```
IMPORTANT

In cases where you have both a `security-realm` and `ssl-context` defined, JBoss EAP will use the SSL/TLS configuration provided by `ssl-context`.

1.2.11. HTTPS Listener Reference

For a full list of attributes available for the HTTPS listener, see the Undertow Subsystem Attributes section in the JBoss EAP Configuration Guide.

1.2.11.1. About Cipher Suites

You can configure a list of the encryption ciphers which are allowed. For JSSE syntax, it must be a comma-separated list. For OpenSSL syntax, it must be a colon-separated list. Ensure that only one syntax is used. The default is the JVM default.

IMPORTANT

Using weak ciphers is a significant security risk. See NIST Guidelines for NIST recommendations on cipher suites.

See the OpenSSL documentation for a list of available OpenSSL ciphers. Note that the following are not supported:

- `@SECLEVEL`
- `SUITEB128`
- `SUITEB128ONLY`
- `SUITEB192`

See the Java documentation for a list of the standard JSSE ciphers.

To update the list of enabled cipher suites, use the `enabled-cipher-suites` attribute of the HTTPS listener in the `undertow` subsystem.

Example: Management CLI Command for Updating the List of Enabled Cipher Suites

```
/subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=enabled-cipher-suites,value="TLS_RSA_WITH_AES_128_CBC_SHA,TLS_RSA_WITH_AES_256_CBC_SHA")
```

NOTE

The example only lists two possible ciphers, but real-world examples will likely use more.

1.2.12. Enabling support for the TLS 1.3 protocol with the OpenSSL provider
You can enable support for the TLS 1.3 protocol with the OpenSSL provider for TLS by configuring the `cipher-suite-names` attribute in the `ssl-context` configuration. Choose one of the following methods for configuring JBoss EAP to use the OpenSSL TLS provider:

- Configure the Elytron subsystem to use the OpenSSL TLS provider by default.
- Configure the `providers` attribute of a `server-ssl-context` component or a `client-ssl-context` component to use the OpenSSL TLS provider.

**IMPORTANT**

Compared with TLS 1.2, you might experience reduced performance when running TLS 1.3 with JDK 11. This can occur when clients make a very large number of TLS 1.3 requests to a server. A system upgrade to a newer JDK version can improve performance. Test your setup with TLS 1.3 for performance degradation before enabling it in production.

**Prerequisites**

- Enable one-way SSL/TLS or two-way SSL/TLS for applications.

**Procedure**

1. Choose one of the following methods to configure your JBoss EAP 7.4 instance to use the OpenSSL TLS provider:
   
   a. Configure the `elytron` subsystem to use the OpenSSL TLS provider by default. To do this, remove the default `final-providers` configuration, which registers the OpenSSL TLS provider after all globally registered providers.

   ```
   /subsystem=elytron:undefined-attribute(name=final-providers)
   reload
   ```

   Next, register the OpenSSL TLS provider ahead of all globally registered providers.

   ```
   /subsystem=elytron:write-attribute(name=initial-providers, value=combined-providers)
   ```

   b. Configure the `providers` attribute of a `server-ssl-context` or a `client-ssl-context` to use the OpenSSL TLS provider.

   **Example of setting the providers attribute for an existing server-ssl-context called serverSSC.**

   ```
   /subsystem=elytron/server-ssl-context=serverSSC:write-
   attribute(name=providers,value=openssl)
   reload
   ```

2. Optional: If you configured your `ssl-context` to use a protocol other than the TLS 1.3 protocol, you must configure the `protocols` attribute in the `ssl-context` to include the TLS 1.3 protocol:

   ```
   /subsystem=elytron/server-ssl-context=serverSSC:write-attribute(name=protocols,value=
   [TLSv1.3])
   ```

3. Enable support for the TLS 1.3 protocol with the OpenSSL provider by configuring the `cipher-suite-names` attribute in the `ssl-context` configuration. The following example sets...
TLS_AES_256_GCM_SHA384:TLS_CHACHA20_POLY1305_SHA256:TLS_AES_128_GCM_SHA256 as the value for the `cipher-suite-names` attribute:

```
/subsystem=elytron/server-ssl-context=serverSSC:write-attribute(name=cipher-suite-names,value=TLS_AES_256_GCM_SHA384:TLS_CHACHA20_POLY1305_SHA256:TLS_AES_128_GCM_SHA256)
```

4. Reload your JBoss EAP instance:

```
reload
```

5. Optional: Test that you can successfully establish an SSL-encrypted connection with the server by using the TLS 1.3 protocol and the TLS 1.3 cipher suite. Use a tool, such as `curl`, to check the output of the configuration:

```
curl -v https://<ip_address>:<ssl_port>
```

Example output showing `TLS_AES_256_GCM_SHA384` with the TLS 1.3 protocol to secure the SSL connection.

```
SSL connection using TLSv1.3 / TLS_AES_256_GCM_SHA384
* ALPN, server accepted to use h2
* Server certificate:
  * subject: C=Unknown; ST=Unknown; L=Unknown; O=Unknown; OU=Unknown; CN=localhost
  * start date: Oct 6 14:58:16 2020 GMT
  * expire date: Nov 5 15:58:16 2020 GMT
  * issuer: C=Unknown; ST=Unknown; L=Unknown; O=Unknown; OU=Unknown; CN=localhost
  * SSL certificate verify result: self signed certificate (18), continuing anyway.
```

Additional resources

- For information about enabling one-way SSL/TLS or two-way SSL/TLS for applications, see [Enable One-way SSL/TLS for Applications Using the Elytron Subsystem](#).
- For information about the `client-ssl-context`, see [Using a client-ssl-context](#).
- For information about the `server-ssl-context`, see [Using a server-ssl-context](#).

### 1.2.13. FIPS 140-2 Compliant Cryptography

It is possible to configure FIPS 140-2 compliant cryptography on Red Hat Enterprise Linux using either of the following methods.

- Using the SunPKCS11 provider with an NSS database
- Using the third party BouncyCastle providers

#### 1.2.13.1. Enable FIPS 140-2 Cryptography for SSL/TLS on Red Hat Enterprise Linux 7 and Later
You can configure Undertow to use FIPS 140-2 compliant cryptography for SSL/TLS. The scope of this configuration example is limited to Red Hat Enterprise Linux 7 and later, using the Mozilla NSS library in FIPS mode.

**IMPORTANT**

The installed Red Hat Enterprise Linux must already be configured to be FIPS 140-2 compliant. For more information, see the solution titled How can I make RHEL 6 or RHEL 7 FIPS 140-2 compliant?, which is located on the Red Hat Customer Portal.

**WARNING**

Using the TLS 1.2 protocol when running JBoss EAP in FIPS mode can cause a NoSuchAlgorithmException to occur. More details on this issue can be found in the solution titled NoSuchAlgorithmException: no such algorithm: SunTls12MasterSecret, which is located on the Red Hat Customer Portal.

Therefore, it is not possible to configure HTTP/2 in FIPS mode because HTTP/2 requires the TLS 1.2 protocol. FIPS mode (PKCS11) supports the TLS 1 and the TLS 1.1 protocols so you can use:

- TLS 1.1 in case of Oracle/OpenJDK
- TLS 1 in case of IBM java

To configure Undertow to use FIPS 140-2 compliant cryptography for SSL/TLS, you must do the following:

- Configure the NSS database.
- Configure the management CLI for FIPS 140-2 compliant cryptography for SSL/TLS.
- Configure the undertow subsystem to use either Elytron or the legacy core management authentication.

**NOTE**

The OpenSSL provider requires a private key, but it is not possible to retrieve a private key from the PKCS11 store. FIPS does not allow the export of unencrypted keys from FIPS compliant cryptographic module. Therefore, for both the elytron subsystem as well as legacy security, it is not possible to use the OpenSSL provider for TLS when in FIPS mode.

**Configuring the NSS database**

1. Create a directory owned by the appropriate user to house the NSS database.

**Example Commands for Creating the NSS Database Directory**
NOTE

- DBM file format, the default database format in RHEL 7 and earlier, has been deprecated. NSS now uses SQL by default.

- The jboss user is only an example. Replace it with an active user on your operating system to run JBoss EAP.

2. Create the NSS configuration file: `usr/share/jboss-as/nss_pkcsll_fips.cfg`. It must specify:

- a name
- the directory where the NSS library is located
- the directory where the NSS database was created in the previous step

**Example:** 

```
name = nss-fips
nssLibraryDirectory=/usr/lib64
nssSecmodDirectory=/usr/share/jboss-as/nssdb
nssDbMode = readOnly
nssModule = fips
```

NOTE

If you are not running a 64-bit version of Red Hat Enterprise Linux 6 then set `nssLibraryDirectory` to `/usr/lib` instead of `/usr/lib64`.

3. Edit the Java security configuration file. This configuration file affects the entire JVM, and can be defined using either of the following methods.

- A default configuration file, `java.security`, is provided in your JDK. This file is used if no other security configuration files are specified. See the JDK vendor’s documentation for the location of this file.

- Define a custom Java security configuration file and reference it by using the `-Djava.security.properties=/path/to/java.security.properties`. When referenced in this manner it overrides the settings in the default security file. This option is useful when having multiple JVMs running on the same host that require different security settings. Add the following line to your Java security configuration file:

**Example:** 

```
security.provider.1=sun.security.pkcs11.SunPKCS11 /usr/share/jboss-as/nss_pkcsll_fips.cfg
```
NOTE

The `nss_pkcsll_fips.cfg` configuration file specified in the above line is the file created in the previous step.

You also need to update the following link in your configuration file from:

```
security.provider.5=com.sun.net.ssl.internal.ssl.Provider
```

to

```
security.provider.5=com.sun.net.ssl.internal.ssl.Provider SunPKCS11-nss-fips
```

IMPORTANT

Any other `security.provider.X` lines in this file, for example `security.provider.2`, must have the value of their `X` increased by one to ensure that this provider is given priority.

4. Run the `modutil` command on the NSS database directory you created in the previous step to enable FIPS mode.

```
modutil -fips true -dbdir /usr/share/jboss-as/nssdb
```

NOTE

You may get a security library error at this point requiring you to regenerate the library signatures for some of the NSS shared objects.

5. Set the password on the FIPS token.

The name of the token must be `NSS FIPS 140-2 Certificate DB`.

```
modutil -changepw "NSS FIPS 140-2 Certificate DB" -dbdir /usr/share/jboss-as/nssdb
```

IMPORTANT

The password used for the FIPS token must be a FIPS compliant password. If the password is not strong enough, you may receive an error: `ERROR: Unable to change password on token "NSS FIPS 140-2 Certificate DB".`

6. Create a certificate using the NSS tools.

**Example Command**

```
$ certutil -S -k rsa -n undertow -t "u,u,u" -x -s "CN=localhost, OU=MYOU, O=MYORG, L=MYCITY, ST=MYSTATE, C=MY" -d /usr/share/jboss-as/nssdb
```

7. Verify that the JVM can read the private key from the PKCS11 keystore by running the following command:
$ keytool -list -storetype pkcs11

**IMPORTANT**

Once you have FIPS enabled, you may see the following error when starting JBoss EAP:

```
10:16:13,993 ERROR [org.jboss.msc.service.fail] (MSC service thread 1-1)
MSC000001: Failed to start service
  jboss.server.controller.management.security_realm.ApplicationRealm.key-manager:
org.jboss.msc.service.StartException in service
  jboss.server.controller.management.security_realm.ApplicationRealm.key-manager:
WFLYDM0018: Unable to start service
  at
org.jboss.as.domain.management.security.AbstractKeyManagerService.start(AbstractKeyManagerService.java:85)
  at
org.jboss.msc.service.ServiceControllerImpl$StartTask.startService(ServiceControllerImpl.java:1963)
  at
org.jboss.msc.service.ServiceControllerImpl$StartTask.run(ServiceControllerImpl.java:1896)
  at
java.util.concurrent.ThreadPoolExecutor.runWorker(ThreadPoolExecutor.java:1142)
  at
java.util.concurrent.ThreadPoolExecutor$Worker.run(ThreadPoolExecutor.java:617)
  at
java.lang.Thread.run(Thread.java:745)
Caused by: java.security.KeyStoreException: FIPS mode: KeyStore must be from
  provider SunPKCS11-nss-fips
  at
sun.security.ssl.KeyManagerFactoryImpl$SunX509.engineInit(KeyManagerFactoryImpl.java:67)
  at
javax.net.ssl.KeyManagerFactory.init(KeyManagerFactory.java:256)
  at
org.jboss.as.domain.management.security.AbstractKeyManagerService.createKeyManagers(AbstractKeyManagerService.java:130)
  at
org.jboss.as.domain.management.security.AbstractKeyManagerService.start(AbstractKeyManagerService.java:83)
  ... 5 more
```

This message will appear if you have any existing key managers configured, such as the default key manager in legacy core management authentication, that do not use FIPS 140-2 compliant cryptography.

Configure the Management CLI for FIPS 140-2 Compliant Cryptography for SSL/TLS

You must configure the JBoss EAP management CLI to work in an environment with FIPS 140-2 compliant cryptography for SSL/TLS enabled. By default, if you try to use the management CLI in such an environment, the following exception is thrown: **org.jboss.as.cli.CliInitializationException**: java.security.KeyManagementException: FIPS mode: only SunJSSE TrustManagers may be used.

- If you are using the legacy `security` subsystem:
  Update the `javax.net.ssl.keyStore` and `javax.net.ssl.trustStore` system properties in the `jboss-cli.sh` file, as shown below:
JAVA_OPTS="$JAVA_OPTS -Djavax.net.ssl.trustStore=NONE -Djavax.net.ssl.trustStoreType=PKCS11"
JAVA_OPTS="$JAVA_OPTS -Djavax.net.ssl.keyStore=NONE -Djavax.net.ssl.keyStoreType=PKCS11 -Djavax.net.ssl.keyStorePassword=P@ssword123"

- If you are using the elytron subsystem:

1. Create an XML configuration file for the management CLI with the following contents:

   Example: cli-wildfly-config.xml

```xml
<configuration>
  <authentication-client xmlns="urn:elytron:client:1.2">
    <key-stores>
      <key-store name="truststore" type="PKCS11">
        <key-store-clear-password password="P@ssword123"/>
      </key-store>
    </key-stores>
    <ssl-contexts>
      <ssl-context name="client-cli-context">
        <trust-store key-store-name="truststore"/>
        <cipher-suite selector="${cipher.suite.filter}"/>
        <protocol names="TLSv1.1"/>
      </ssl-context>
    </ssl-contexts>
    <ssl-context-rules>
      <rule use-ssl-context="client-cli-context"/>
    </ssl-context-rules>
  </authentication-client>
</configuration>
```

**NOTE**

If you are using the IBM JDK, see the IBM management CLI configuration example for the specific configuration required.

2. When starting the management CLI, pass the configuration file to the management CLI script using the -Dwildfly.config.url property. For example:

```
$ jboss-cli.sh -Dwildfly.config.url=cli-wildfly-config.xml
```

Configure the Elytron and Undertow Subsystems

1. Add the FIPS 140-2 compliant cryptography key-store, key-manager and ssl-context.

```
/subsystem=elytron/key-store=fipsKS:add(type=PKCS11,provider-name="SunPKCS11-nss-fips",credential-reference={clear-text="P@ssword123"})

/subsystem=elytron/key-manager=fipsKM:add(key-store=fipsKS,algorithm="SunX509",provider-name=SunPKCS11-nss-fips,credential-reference={clear-text="P@ssword123"})

/subsystem=elytron/server-ssl-context=fipsSSC:add(key-manager=fipsKM,protocols=["TLSv1.1"])
```
2. Update the **undertow** subsystem to use the new **ssl-context**.

**NOTE**

**https-listener** must always have either a **security-realm** or **ssl-context** configured. When changing between the two configurations, the commands must be executed as a single batch, as shown below.

```bash
batch
/subsystem=undertow/server=default-server/https-listener=https:undefine-attribute(name=security-realm)
/subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=ssl-context,value=fipsSSC)
run-batch
reload
```

In the **elytron** subsystem, OpenJDK and Oracle JDK in FIPS mode restrict the usage of any advanced features that are based on providing custom **KeyManager** or **TrustManager** implementations. The following configuration attributes do not work on the server:

- **server-ssl-context.security-domain**
- **trust-manager.certificate-revocation-list**

**Configure Undertow with the Legacy Core Management Authentication**

Optionally, you can still use the legacy core management authentication instead of the **elytron** subsystem to complete the setup of FIPS 140-2 compliant cryptography for SSL/TLS:

1. Configure Undertow to use SSL/TLS.

**NOTE**

The following commands below must either be run in batch mode, or the server must be reloaded after adding the ssl server identity. The example below is shown using batch mode.

```bash
batch
/core-service=management/security-realm=HTTPSRealm:add
/core-service=management/security-realm=HTTPSRealm/server-identity=ssl:add(keystore-provider=PKCS11, keystore-password="strongP@ssword1")
/subsystem=undertow/server=default-server/https-listener=https:add(socket-binding=https, security-realm=HTTPSRealm, enabled-protocols="TLSv1.1")
run-batch
```

The basic details for configuring Undertow to SSL/TLS are covered in Setting up an SSL/TLS for Applications.

2. Configure the cipher suites used by Undertow.
Once you have SSL/TLS configured, you need to configure the https listener and security realm to have a specific set of cipher suites enabled:

### Required Cipher Suites

- SSL_RSA_WITH_3DES_EDE_CBC_SHA, SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA,
- TLS_RSA_WITH_AES_128_CBC_SHA, TLS_DHE_DSS_WITH_AES_128_CBC_SHA,
- TLS_DHE_RSA_WITH_AES_128_CBC_SHA, TLS_RSA_WITH_AES_256_CBC_SHA,
- TLS_DHE_RSA_WITH_AES_256_CBC_SHA,
- TLS_ECDH_ECDSA_WITH_3DES_EDE_CBC_SHA,
- TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA,
- TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA,
- TLS_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA,
- TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA,
- TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA,
- TLS_ECDH_RSA_WITH_3DES_EDE_CBC_SHA,
- TLS_ECDH_RSA_WITH_AES_128_CBC_SHA,
- TLS_ECDH_RSA_WITH_AES_256_CBC_SHA,
- TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA,
- TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA,
- TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA,
- TLS_ECDH_anon_WITH_3DES_EDE_CBC_SHA,
- TLS_ECDH_anon_WITH_AES_128_CBC_SHA,
- TLS_ECDH_anon_WITH_AES_256_CBC_SHA

The basics behind enabling cipher suites for the https listener are covered in About Cipher Suites. To enable cipher suites on the https listener:

**Example Command for Enabling Cipher Suites on the Https Listener**

```bash
/subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=enabled-cipher-suites,value="SSL_RSA_WITH_3DES_EDE_CBC_SHA,SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA,TLS_RSA_WITH_AES_128_CBC_SHA,TLS_DHE_DSS_WITH_AES_128_CBC_SHA,TLS_DHE_RSA_WITH_AES_128_CBC_SHA,TLS_RSA_WITH_AES_256_CBC_SHA,TLS_DHE_RSA_WITH_AES_256_CBC_SHA,TLS_ECDH_ECDSA_WITH_3DES_EDE_CBC_SHA,TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA,TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA,TLS_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA,TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA,TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA,TLS_ECDH_RSA_WITH_3DES_EDE_CBC_SHA,TLS_ECDH_RSA_WITH_AES_128_CBC_SHA,TLS_ECDH_RSA_WITH_AES_256_CBC_SHA,TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA,TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA,TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA,TLS_ECDH_anon_WITH_3DES_EDE_CBC_SHA,TLS_ECDH_anon_WITH_AES_128_CBC_SHA,TLS_ECDH_anon_WITH_AES_256_CBC_SHA")
```

3. Enable cipher suites on the security realm.

**Example Command for Enabling Cipher Suites on the Security Realm**

```bash
/core-service=management/security-realm=HTTPSRealm/server-identity=ssl/write-attribute(name=enabled-cipher-suites,value=[SSL_RSA_WITH_3DES_EDE_CBC_SHA,SSL_DHE_RSA_WITH_3DES_EDE_CBC_SHA,TLS_RSA_WITH_AES_128_CBC_SHA,TLS_DHE_DSS_WITH_AES_128_CBC_SHA,TLS_DHE_RSA_WITH_AES_128_CBC_SHA,TLS_RSA_WITH_AES_256_CBC_SHA,TLS_DHE_RSA_WITH_AES_256_CBC_SHA,TLS_ECDH_ECDSA_WITH_3DES_EDE_CBC_SHA,TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA,TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA,TLS_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA,TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA,TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA,TLS_ECDH_RSA_WITH_3DES_EDE_CBC_SHA,TLS_ECDH_RSA_WITH_AES_128_CBC_SHA,TLS_ECDH_RSA_WITH_AES_256_CBC_SHA,TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA,TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA,TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA,TLS_ECDH_anon_WITH_3DES_EDE_CBC_SHA,TLS_ECDH_anon_WITH_AES_128_CBC_SHA,TLS_ECDH_anon_WITH_AES_256_CBC_SHA])
```
1.2.13.2. Enable FIPS 140-2 Cryptography for SSL/TLS Using Bouncy Castle

You can configure Undertow to use FIPS 140-2 compliant cryptography for SSL/TLS. The scope of this configuration example is limited to Red Hat Enterprise Linux 7 and later. The Bouncy Castle JARs are not provided by Red Hat, and must be obtained directly from Bouncy Castle.

Prerequisites

- Ensure your environment is configured to use the BouncyCastle provider.
- A Bouncy Castle keystore must exist on the server. If one does not exist, it can be created using the following command.

  ```bash
  $ keytool -genkeypair -alias ALIAS -keyalg RSA -keysize 2048 -keypass PASSWORD -keystore KEYSTORE -storetype BCFKS -storepass STORE_PASSWORD
  ```

Configure the Management CLI for FIPS 140-2 Compliant Cryptography for SSL/TLS Using Elytron

You must configure the JBoss EAP management CLI to work in an environment with FIPS 140-2 compliant cryptography for SSL/TLS enabled.

1. Create an XML configuration file for the management CLI with the following contents:

   **Example: cli-wildfly-config.xml**

   ```xml
   <configuration>
   <authentication-client xmlns="urn:elytron:client:1.2">
     <key-stores>
       <key-store name="truststore" type="BCFKS">
         <file name="${truststore.location}" />
         <key-store-clear-password password="${password}" />
       </key-store>
       <key-store name="keystore" type="BCFKS">
         <file name="${keystore.location}" />
         <key-store-clear-password password="${password}" />
       </key-store>
     </key-stores>
   </authentication-client>
   ```
When starting the management CLI, pass the configuration file to the management CLI script using the `-Dwildfly.config.url` property. For example:

```
$ jboss-cli.sh -Dwildfly.config.url=cli-wildfly-config.xml
```

Configure the Elytron and Undertow Subsystems

1. Add the FIPS 140-2 compliant cryptography **key-store**, **key-manager** and **ssl-context**. When defining the keystore, the type must be `BCFKS`.

   ```xml
   <key-stores>
   <ssl-contexts>
   <ssl-context name="client-cli-context">
   <key-store-ssl-certificate algorithm="X509" key-store-name="keystore">
   <key-store-clear-password password="${password} />
   </key-store-ssl-certificate>
   <trust-store key-store-name="truststore" />
   <trust-manager algorithm="X509" />
   </ssl-context>
   </ssl-contexts>
   </key-stores>
   
   <cipher-suite selector="TLS_DHE_DSS_WITH_3DES_EDE_CBC_SHA,TLS_DHE_DSS_WITH_AES_128_CBC_SHA,TLS_DHE_DSS_WITH_AES_128_CBC_SHA256,TLS_DHE_DSS_WITH_AES_256_CBC_SHA,TLS_DHE_DSS_WITH_AES_256_CBC_SHA256,TLS_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA,TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA,TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256,TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256,TLS_RSA_WITH_AES_128_CBC_SHA,TLS_RSA_WITH_AES_128_CBC_SHA256,TLS_RSA_WITH_AES_256_CBC_SHA,TLS_RSA_WITH_AES_256_CBC_SHA256,TLS_RSA_WITH_AES_256_CCM">
   <protocol names="TLSv1.2" />
   </cipher-suite>
   
   <ssl-context>
   </ssl-context>
   </ssl-contexts>
   
   Configure the FIPS 140-2 compliant cryptography **key-store**, **key-manager** and **ssl-context** using the `-Dwildfly.config.url` property. For example:

   ```
   $ jboss-cli.sh -Dwildfly.config.url=cli-wildfly-config.xml
   ```
TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA,
TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384,
TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA,
TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA,
TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256,
TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA,
TLS_RSA_WITH_3DES_EDE_CBC_SHA,
TLS_RSA_WITH_AES_128_CBC_SHA,
TLS_RSA_WITH_AES_128_CBC_SHA256,
TLS_RSA_WITH_AES_256_CBC_SHA,
TLS_RSA_WITH_AES_256_CBC_SHA256,
"TLS_RSA_WITH_AES_128_CCM")

2. Update the undertow subsystem to use the new ssl-context.

NOTE
https-listener must always have either a security-realm or ssl-context configured. When changing between the two configurations, the commands must be executed as a single batch, as shown below.

batch
/subsystem=undertow/server=default-server/https-listener=https:undefine-attribute(name=security-realm)
/subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=ssl-context,value=fipsSSC)
run-batch
reload

1.2.14. FIPS 140-2 Compliant Cryptography on IBM JDK

On the IBM JDK, the IBM Java Cryptographic Extension (JCE) IBMJCEFIPS provider and the IBM Java Secure Sockets Extension (JSSE) FIPS 140-2 Cryptographic Module (IBMJSSE2) for multi-platforms provide FIPS 140-2 compliant cryptography.

For more information on the IBMJCEFIPS provider, see the IBM Documentation for IBM JCEFIPS and NIST IBMJCEFIPS – Security Policy. For more information on IBMJSSE2, see Running IBMJSSE2 in FIPS mode.

1.2.14.1. Key Storage

The IBM JCE does not provide a keystore. The keys are stored on the computer and do not leave its physical boundary. If the keys are moved between computers they must be encrypted.

To run keytool in FIPS-compliant mode use the -providerClass option on each command like this:

keytool -list -storetype JCEKS -keystore mystore.jck -storepass mystorepass -providerClass com.ibm.crypto.fips.provider.IBMJCEFIPS

1.2.14.2. Management CLI Configuration

To configure the management CLI for FIPS 140-2 compliant cryptography on the IBM JDK, you must use a management CLI configuration file specifically for the IBM JDK, such as the following:
Example: cli-wildfly-config-ibm.xml

```
<configuration>
  <authentication-client xmlns="urn:elytron:client:1.2">
    <key-stores>
      <key-store name="truststore" type="JKS">
        <file name="/path/to/truststore"/>
        <key-store-clear-password password="P@ssword123"/>
      </key-store>
    </key-stores>
    <ssl-contexts>
      <ssl-context name="client-cli-context">
        <trust-store key-store-name="truststore"/>
        <cipher-suite selector="${cipher.suite.filter}"/>
        <protocol names="TLSv1"/>
      </ssl-context>
    </ssl-contexts>
    <ssl-context-rules>
      <rule use-ssl-context="client-cli-context"/>
    </ssl-context-rules>
  </authentication-client>
</configuration>
```

1.2.14.3. Examine FIPS Provider Information

To examine information about the IBMJCEFIPS used by the server, enable debug-level logging by adding `-Djavax.net.debug=true` to the `standalone.conf` or `domain.conf` files. Information about the FIPS provider is logged to the `server.log` file, for example:

```
04:22:45,689 INFO [stdout] (http-/127.0.0.1:8443-1) DHCrypt: DH KeyPairGenerator from provider from init IBMJCEFIPS version 1.7
04:22:45,754 INFO [stdout] (http-/127.0.0.1:8443-1) JsseJCE: Using KeyAgreement DiffieHellman from provider IBMJCEFIPS version 1.7
04:22:45,754 INFO [stdout] (http-/127.0.0.1:8443-1) DHCrypt: DH KeyAgreement from provider IBMJCEFIPS version 1.7
04:22:45,754 INFO [stdout] (http-/127.0.0.1:8443-1) DHCrypt: DH KeyAgreement from provider from init IBMJCEFIPS version 1.7
```

1.2.15. Starting a Managed Domain when the JVM is Running in FIPS Mode

Update each host controller and the master domain controller to use SSL/TLS for communication.

Prerequisites
Before you begin, make sure you have completed the following prerequisites.

- You have implemented a managed domain.
  For details about configuring a managed domain, see the Domain Management section in the JBoss EAP Configuration Guide.
- You have configured FIPS.
For details about configuring FIPS, see Enable FIPS 140-2 Cryptography for SSL/TLS on Red Hat Enterprise Linux 7 and later.

- You have created all necessary certificates and have imported the domain controller’s certificate into each controller’s truststore.

**WARNING**

Red Hat recommends that SSLv2, SSLv3, and TLSv1.0 be explicitly disabled in favor of TLSv1.1 in all affected packages.

1. On the master domain controller, create an SSL/TLS security realm that is configured to use your NSS database as a PKCS11 provider.

   **Example: Security Realm on the Master Domain Controller**

   ```xml
   <security-realm name="HTTPSRealm">
   <server-identities>
   <ssl>
   <engine enabled-protocols="TLSv1.1"/>
   <keystore provider="PKCS11" keystore-password="strongP@ssword1"/>
   </ssl>
   </server-identities>
   <authentication>
   <local default-user="\$local"/>
   <properties path="https-users.properties" relative-to="jboss.domain.config.dir"/>
   </authentication>
   </security-realm>
   ```

2. On each host controller, create a security realm with an SSL/TLS truststore for authentication.

   **Example: Security Realm on Each Host Controller**

   ```xml
   <security-realm name="HTTPSRealm">
   <authentication>
   <truststore provider="PKCS11" keystore-password="strongP@ssword1"/>
   </authentication>
   </security-realm>
   ```

**NOTE**

Repeat this process on each host.

3. Secure the HTTP interface on the master domain controller with the security realm you just created.

   **Example: HTTP Interface**

   ```xml
   <management-interfaces>
   ```
4. Use the SSL/TLS realm on each host controller to connect to the master domain controller. Update the security realm used for connecting to the master domain controller. Modify the host controller’s configuration file, for example `host.xml` or `host-slave.xml`, while the server is not running.

Example: Host Controller Configuration File

```xml
<domain-controller>
  <remote security-realm="HTTPSRealm">
    <discovery-options>
      <static-discovery name="primary" protocol="${jboss.domain.master.protocol:remote}" host="${jboss.domain.master.address}" port="${jboss.domain.master.port:9990}"/>
    </discovery-options>
  </remote>
</domain-controller>
```

5. Update how each server connects back to its host controller.

Example: Server Configuration

```xml
<server name="my-server" group="my-server-group">
  <ssl ssl-protocol="TLS" trust-manager-algorithm="SunX509" truststore-type="PKCS11" truststore-password="strongP@ssword1"/>
</server>
```

6. Configure two-way SSL/TLS in a managed domain. To enable two-way SSL/TLS, add a truststore authentication method to the SSL/TLS security realm for the master domain controller, execute the following management CLI commands:

```bash
/host=master/core-service=management/security-realm=HTTPSRealm/authentication=truststore:add(keystore-provider="PKCS11",keystore-password="strongP@ssword1")
reload --host=master
```

You also need to update each host controller’s security realm to have an SSL server identity, execute the following management CLI commands:

```bash
/host=host1/core-service=management/security-realm=HTTPSRealm/server-identity=ssl:add(keystore-provider=PKCS11, keystore-password="strongP@ssword1",enabled-protocols=["TLSv1.1"]) reload --host=host1
```
IMPORTANT
You also need to ensure that each host’s certificate is imported into the domain controller’s truststore.

1.2.16. Secure the Management Console with Red Hat Single Sign-On

You can secure the JBoss EAP management console with Red Hat Single Sign-On using the elytron subsystem.

NOTE
This feature is only available when running a standalone server and is not supported when running a managed domain. It is not supported to use Red Hat Single Sign-On to secure the management CLI.

Use the following steps to set up Red Hat Single Sign-On to authenticate users for the JBoss EAP management console.

2. Install the Red Hat Single Sign-On client adapter on JBoss EAP.

Configure a Red Hat Single Sign-On Server for JBoss EAP Management

2. Start the Red Hat Single Sign-On server. This procedure assumes that you started the server with a port offset of 100.

   $ RHSSO_HOME/bin/standalone.sh -Djboss.socket.binding.port-offset=100

3. Log in to the Red Hat Single Sign-On administration console at http://localhost:8180/auth/. If this is the first time you have accessed the Red Hat Single Sign-On administration console, you are prompted to create an initial administration user.
4. Create a new realm called wildfly-infra.
   a. From the drop down next to the realm name, click Add realm, enter wildfly-infra in the Name field, and click Create.
5. Create a client application called wildfly-console.
   a. Select Clients and click Create.
   b. Enter wildfly-console in the Client ID field and click Save.

6. Create a client application called wildfly-management.
   a. Select Clients and click Create.
   b. Enter wildfly-management in the Client ID field and click Save.
   c. In the Settings screen that appears, set Access Type to bearer-only and click Save.

7. Create a role to grant access to the JBoss EAP management console.
   a. Select Roles and click Add Role.
   b. Enter ADMINISTRATOR in uppercase in the Role Name field and click Save.
      This procedure uses the ADMINISTRATOR role, but other roles are supported. For more information, see the Role-Based Access Control section of JBoss EAP’s Security Architecture.

8. Create a user and assign the ADMINISTRATOR role to them.
   a. Select Users and click Add user.
   b. Enter jboss in the Username field and click Save.
   c. Select the Credentials tab and set a password for this user.
   d. Select the Role Mappings tab, select ADMINISTRATOR and click Add selected to add the role to this user.

Install the Red Hat Single Sign-On Client Adapter on JBoss EAP

1. Download the Red Hat Single Sign-On client adapter for JBoss EAP 7 from the software downloads page.

2. Unzip this file into the root directory of your JBoss EAP installation.

3. Execute the adapter-elytron-install-offline.cli script to configure your JBoss EAP installation.

   $ EAP_HOME/bin/jboss-cli.sh --file=adapter-elytron-install-offline.cli

   **IMPORTANT**
   This script adds the keycloak subsystem and other required resources in the elytron and undertow subsystems to standalone.xml. If you need to use a different configuration file, modify the script as needed.

Configure JBoss EAP to Use Red Hat Single Sign-On

1. In the EAP_HOME/bin/ directory, create a file called protect-eap-mgmt-services.cli with the following contents.

   # Create a realm for both JBoss EAP console and mgmt interface
2. In this file, replace `REALM_PUBLIC_KEY` with the value of the public key. To obtain this value, log in to the Red Hat Single Sign-On administration console, select the `wildfly-infra` realm, navigate to `Realm Settings → Keys` and click `Public key`.

3. Start JBoss EAP.

   $ EAP_HOME/bin/standalone.sh

   **IMPORTANT**

   If you modified the `adapter-elytron-install-offline.cli` script when installing the Red Hat Single Sign-On client adapter to use a configuration file other than `standalone.xml`, be sure to start the JBoss EAP using that configuration.

4. Execute the `protect-eap-mgmt-services.cli` script.

   $ EAP_HOME/bin/jboss-cli.sh --connect --file=protect-eap-mgmt-services.cli

Now, when you access the JBoss EAP management console at `http://localhost:9990/console/`, you are redirected to Red Hat Single Sign-On to log in, and then redirected back to the JBoss EAP management console upon successful authentication.
1.3. SECURITY AUDITING

Security auditing refers to triggering events, such as writing to a log, in response to an authorization or authentication attempt. Auditing is configured differently depending on the security system in use.

- For instructions on configuring auditing with Elytron, see Elytron Audit Logging.
- For instructions on configuring auditing with the legacy security system, see Configure Security Auditing for the Legacy Security Domains.

1.3.1. Elytron Audit Logging

Audit logging for the elytron subsystem enables logging of Elytron authentication and authorization events within the application server. Audit log entries are stored in either JSON or SIMPLE, human readable format. By default, audit logging is disabled in Elytron.

You can enable audit logging by configuring any of the following log handlers for Elytron, and then adding them to the desired security domain:

- file audit logging
- periodic rotating file audit logging
- size rotating file audit logging
- syslog audit logging

**IMPORTANT**

Elytron audit logging is distinct from other audit logging, such as audit logging for the JBoss EAP management interfaces. For more information on management interface audit logging options, see the Management Audit Logging section in the JBoss EAP Configuration Guide.

**File Audit Logging**

File audit logging stores audit log messages in one specified file in the file system, without dividing them into multiple files.

An Elytron file audit logger, named local-audit, is defined by default. Once enabled, it will write Elytron audit logs to $EAP_HOME/standalone/log/audit.log on a standalone server, or $EAP_HOME/domain/log/audit.log for a managed domain host.

The attributes of a file audit logger are:

- **path** and **relative-to**: Defines the location of the log file.
- **autoflush**: Specifies whether the output stream should be flushed after every audit event. If this attribute is undefined, it uses the value of synchronized.
- **synchronized**: Specifies whether the file descriptor should be synchronized after every audit event. The default is true.
- **format**: Use SIMPLE for human readable text format, or JSON for storing individual events in JSON.

1. You can use a command similar to the following to create a file audit log.
2. Enable the defined file audit logger by adding it to a security domain.

/subsystem=elytron/security-domain=domain-with-file-logger:write-attribute(name=security-event-listener, value=my_audit_log)

### Periodic Rotating File Audit Logging

Periodic rotating file audit logging automatically rotates audit log files based on a configured schedule. It has the same basic attributes as the default file audit logger, with the following additional attribute:

- **suffix**: This must be in the `java.text.SimpleDateFormat` format, for example `.yyyy-MM-dd-HH`. The period of the rotation is automatically calculated based on this suffix, and the suffix is appended to the end of the log file names.

1. You can use a command similar to the following to create a periodic rotating file audit log.

/subsystem=elytron/periodic-rotating-file-audit-log=my_periodic_audit_log:add(path="my_periodic_audit.log",relative-to="jboss.server.log.dir",format=SIMPLE,synchronized=false,suffix=".yyyy-MM-dd-HH")

2. Enable the defined periodic rotating file audit logger by adding it to a security domain.

/subsystem=elytron/security-domain=domain-with-periodic-file-logger:write-attribute(name=security-event-listener, value=my_periodic_audit_log)

### Size Rotating File Audit Logging

Size rotating file audit logging automatically rotates audit log files when the log file reaches a configured file size. It has the same basic attributes as the default file audit logger, with the following additional attributes:

- **rotate-size**: The maximum size that the log file can reach before being rotated. The default is 2m for 2 megabytes.

- **max-backup-index**: The maximum number of files to backup when rotating.

- **rotate-on-boot**: By default, a new log file is not created on server restart. You can set this to `true` to rotate the log on server restart.

- **suffix**: This optionally adds a date suffix to a rotated log. This must be in the `java.text.SimpleDateFormat` format, for example `.yyyy-MM-dd-HH`.

When the log file size exceeds the limit defined by the `rotate-size` attribute, the suffix `.1` is appended to the end of the current file and a new log file is created. If there are any existing log files, their suffixed number is incremented by one, for example `audit_log.1` is renamed to `audit_log.2`. This happens until the maximum number of log files defined by `max-backup-index` is reached. When the `max-backup-index` is exceeded, the file that is over limit, for example `audit_log.99`, is removed.

1. You can use a command similar to the following to create a size rotating file audit log.

/subsystem=elytron/size-rotating-file-audit-log=my_size_log:add(path="my_size_audit.log",relative-to="jboss.server.log.dir",format=SIMPLE,synchronized=false,rotate-size="2m",max-backup-index=10)
2. Enable the defined size rotating audit logger by adding it to a security domain.

```
/subsystem=elytron/security-domain=domain-with-size-logger:write-attribute(name=security-event-listener, value=my_size_log)
```

**Syslog Audit Logging**

A syslog handler specifies the parameters by which audit log entries are sent to a syslog server, specifically the syslog server’s host name and port on which the syslog server is listening. Sending audit logging to a syslog server provides more security options than logging to a local file or local syslog server. Multiple syslog handlers can be defined and be active at the same time.

When a syslog logger is defined for the first time, the logger sends an **INFORMATIONAL** priority event to syslog server containing the message:

```
"Elytron audit logging enabled with RFC format: <format>"
```

<format> is the RFC format configured for the audit logging handler, defaulting to RFC5424.

Supported log formats:

- RFC5424
- RFC3164

Supported transmission protocols:

- UDP
- TCP
- TCP with SSL

For a list of **syslog-audit-log** attributes, see **syslog-audit-log Attributes**.

**Procedure**

1. Add a syslog handler.

```
/subsystem=elytron/syslog-audit-log=syslog-logger:add(host-name=HOST_NAME, port=PORT, server-address=SERVER_ADDRESS, format=JSON, transport=UDP)
```

2. Enable the defined syslog audit logger by adding it to a security domain.

```
/subsystem=elytron/security-domain=domain-with-syslog-logger:write-attribute(name=security-event-listener, value=syslog-logger)
```

**IMPORTANT**

To send logs to syslog server over TLS, you can add the following configuration:

```
/subsystem=elytron/syslog-audit-log=remote-audit:add(transport=SSL_TCP,server-address=127.0.0.1,port=9898,host-name=Elytron,ssl-context=audit-ssl)
```
NOTE

To send security events to more destinations, mainly loggers, the `aggregate-security-event-listener` resource is used. This delivers all events to all listeners specified in the aggregate listener definition.

1.3.1.1. Custom Security Event Listeners for Elytron

You can define a custom event listener to adjust how incoming security events are processed. This event listener can be used for custom audit logging, or to authenticate users against your internal identity storage.

1. Create a class that implements the `java.util.function.Consumer<org.wildfly.security.auth.server.event.SecurityEvent>` interface. For example, the following prints a message whenever a user succeeds or fails authentication.

```java
public class MySecurityEventListener implements Consumer<SecurityEvent> {
    public void accept(SecurityEvent securityEvent) {
        if (securityEvent instanceof SecurityAuthenticationSuccessfulEvent) {
            System.err.printf("Authenticated user \%s\n", securityEvent.getSecurityIdentity().getPrincipal());
        } else if (securityEvent instanceof SecurityAuthenticationFailedEvent) {
            System.err.printf("Failed authentication as user \%s\n", ((SecurityAuthenticationFailedEvent)securityEvent).getPrincipal());
        }
    }
}
```

2. Add the JAR providing the custom event listener as a module to JBoss EAP, as outlined in Add a Custom Component to Elytron. The following is an example of the management CLI command that adds a custom event listener as a module to Elytron.

```
/subsystem=elytron/custom-security-event-listener=LISTENER_NAME:add(module=MODULE_NAME, class-name=CLASS_NAME)
```

IMPORTANT

Using the `module` management CLI command to add and remove modules is provided as Technology Preview only. This command is not appropriate for use in a managed domain or when connecting to the management CLI remotely. Modules should be added and removed manually in a production environment. For more information, see the Create a Custom Module Manually and Remove a Custom Module Manually sections of the JBoss EAP Configuration Guide.

Technology Preview features are not supported with Red Hat production service level agreements (SLAs), might not be functionally complete, and Red Hat does not recommend to use them for production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process.

See Technology Preview Features Support Scope on the Red Hat Customer Portal for information about the support scope for Technology Preview features.
3. Reference the newly defined listener from the security domain, such as ApplicationDomain.

   /subsystem=elytron/security-domain=DOMAIN_NAME:write-attribute(name=security-event-listener, value=LISTENER_NAME)

4. Reload the server to begin receiving security events from the provided security domain.

   reload

1.3.2. Configure Security Auditing for the Legacy Security Domains

The goal of an audit module is to provide a way to monitor the events in the security subsystem. This monitoring can be done by means of writing to a log file, email notifications, or any other measurable auditing mechanism.

Auditing uses provider modules. Both included provider modules as well as custom implementations may be used.

To configure security auditing settings for a security domain, the following steps must be performed from the management console:

1. Click on the Configuration tab.


3. Select the security domain to edit and click View.

4. Select the Audit tab and press Add to add a new audit module.

5. Set a name for the module and fill in the Code field with the class name of the provider module.

6. Optionally, add module options by editing the module and adding key/value pairs in the Module Options field. Press Enter to add a new value and press Backspace to remove an existing value.

1.4. CONFIGURE ONE-WAY AND TWO-WAY SSL/TLS FOR APPLICATIONS

1.4.1. Automatic Self-signed Certificate Creation for Applications

When using the legacy security realms, JBoss EAP provides automatic generation of self-signed certificate for development purposes.

Example: Server Log Showing Self-signed Certificate Creation

15:26:09,031 WARN [org.jboss.as.domain.management.security] (MSC service thread 1-7) WFLYDM0111: Keystore /path/to/jboss/standalone/configuration/application.keystore not found, it will be auto generated on first use with a self signed certificate for host localhost

... 

15:26:10,076 WARN [org.jboss.as.domain.management.security] (MSC service thread 1-2) WFLYDM0113: Generated self signed certificate at /path/to/jboss/configuration/application.keystore. Please note that self signed certificates are not secure, and should only be used for testing purposes. Do not use this self signed certificate in production.

SHA-1 fingerprint of the generated key is

SHA-256 fingerprint of the generated key is
...

This certificate is created for testing purposes and is assigned to the HTTPS interface used by
applications. The keystore containing the certificate will be generated if the file does not exist the first
time the HTTPS interface is accessed.

Example: Default ApplicationRealm Using the Self-signed Certificate

```xml
<security-realm name="ApplicationRealm">
  <server-identities>
    <ssl>
      <keystore path="application.keystore" relative-to="jboss.server.config.dir" keystore-password="password" alias="server" key-password="password" generate-self-signed-certificate-host="localhost"/>
    </ssl>
  </server-identities>
...  
</security-realm>
```

Example: Default HTTPS Interface Configuration

```xml
<subsystem xmlns="urn:jboss:domain:undertow:10.0">
  ...
  <server name="default-server">
    ...
    <https-listener name="https" socket-binding="https" security-realm="ApplicationRealm" enable-http2="true"/>
    <host name="default-host" alias="localhost">...
  </server>
  ...
</subsystem>
```

**NOTE**

If you want to disable the self-signed certificate creation, you will need to remove the
`generate-self-signed-certificate-host="localhost"` from the server keystore
configuration. The `generate-self-signed-certificate-host` attribute holds the host name
for which the self-signed certificate should be generated.

**WARNING**

This self-signed certificate is intended for testing purposes only and is not intended
for use in production environments. For more information on configuring SSL/TLS
for applications with Elytron, see the Enable One-way SSL/TLS for Applications
using the Elytron Subsystem and Enable Two-way SSL/TLS for Applications using
the Elytron Subsystem sections. For more information on configuring SSL/TLS for
applications with legacy security, see the Enable One-way SSL/TLS for
Applications Using Legacy Security Realms and Enable Two-way SSL/TLS for
Applications Using Legacy Security Realms sections.
1.4.2. Using Elytron

1.4.2.1. Enable One-way SSL/TLS for Applications Using the Elytron Subsystem

In JBoss EAP, you can enable one-way SSL/TLS for the deployed applications using the JBoss EAP management CLI or the management console.

In the management CLI, one-way SSL/TLS can be enabled in two ways:

- Using `security command`.
- Using `elytron subsystem commands`.

Using a Security Command
The `security enable-ssl-http-server` command can be used to enable one-way SSL/TLS for deployed applications.

Example: Wizard Usage

```
security enable-ssl-http-server --interactive
```

Please provide required pieces of information to enable SSL:
Key-store file name (default `default-server.keystore`): `keystore.jks`
Password (blank generated): `secret`
What is your first and last name? [Unknown]: `localhost`
What is the name of your organizational unit? [Unknown]:
What is the name of your organization? [Unknown]:
What is the name of your City or Locality? [Unknown]:
What is the name of your State or Province? [Unknown]:
What is the two-letter country code for this unit? [Unknown]:
Is CN=Unknown, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown correct y/n [y]? 
Validity (in days, blank default): `365`
Alias (blank generated): `localhost`
Enable SSL Mutual Authentication y/n (blank n): `n`

SSL options:
key store file: `keystore.jks`
distinguished name: `CN=localhost, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown`
password: `secret`
validity: `365`
alias: `localhost`
Server keystore file `keystore.jks`, certificate file `keystore.pem` and `keystore.csr` file will be generated in server configuration directory.
Do you confirm y/n: `y`

NOTE

Once the command is executed, the management CLI will reload the server.

One-way SSL/TLS is now enabled for applications.

Using Elytron Subsystem Commands
In JBoss EAP, you can use the **elytron** subsystem, along with the **undertow** subsystem, to enable one-way SSL/TLS for deployed applications.

1. **Configure a key-store in JBoss EAP.**

   ```
   /subsystem=elytron/key-store=httpsKS:add(path=/path/to/keystore.jks, credential-reference={clear-text=secret}, type=JKS)
   ```

   If the keystore file does not exist yet, the following commands can be used to generate an example key pair:

   ```
   /subsystem=elytron/key-store=httpsKS:generate-key-pair(alias=localhost,algorithm=RSA,key-size=1024,validity=365,credential-reference={clear-text=secret},distinguished-name="CN=localhost")
   /subsystem=elytron/key-store=httpsKS:store()
   ```

2. **Configure a key-manager that references your key-store.**

   ```
   /subsystem=elytron/key-manager=httpsKM:add(key-store=httpsKS, algorithm="SunX509", credential-reference={clear-text=secret})
   ```

   **IMPORTANT**

   You need to know what key manager algorithms are provided by the JDK you are using. For example, a JDK that uses SunJSSE provides the PKIX and SunX509 algorithms.

   The example command above uses SunX509 for the key manager algorithm.

3. **Configure a server-ssl-context that references your key-manager.**

   ```
   /subsystem=elytron/server-ssl-context=httpsSSC:add(key-manager=httpsKM, protocols=["TLSv1.2"])  
   ```

   **IMPORTANT**

   You need to determine what SSL/TLS protocols you want to support. The example command above uses TLSv1.2. You can use the cipher-suite-filter argument to specify which cipher suites are allowed, and the use-cipher-suites-order argument to honor server cipher suite order. The use-cipher-suites-order attribute by default is set to true. This differs from the legacy security subsystem behavior, which defaults to honoring client cipher suite order.

   **WARNING**

   Red Hat recommends that SSLv2, SSLv3, and TLSv1.0 be explicitly disabled in favor of TLSv1.1 or TLSv1.2 in all affected packages.
4. Check and see if the **https-listener** is configured to use a legacy security realm for its SSL configuration.

```
/subsystem=undertow/server=default-server/https-listener=https:read-attribute(name=security-realm)
{
  "outcome" => "success",
  "result" => "ApplicationRealm"
}
```

The above command shows that the **https-listener** is configured to use the **ApplicationRealm** legacy security realm for its SSL configuration. Undertow cannot reference both a legacy security realm and an **ssl-context** in Elytron at the same time so you must remove the reference to the legacy security realm.

**NOTE**

If the result is **undefined**, you do not need to remove the reference to the security realm in the next step.

5. Remove the reference to the legacy security realm, and update the **https-listener** to use the **ssl-context** from Elytron.

**NOTE**

**https-listener** must always have either a **security-realm** or **ssl-context** configured. When changing between the two configurations, the commands must be executed as a single batch, as shown below.

```
batch
/subsystem=undertow/server=default-server/https-listener=https:undefine-attribute(name=security-realm)
/subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=ssl-context, value=httpsSSC)
run-batch
```

6. Reload the server.

```
reload
```

One-way SSL/TLS is now enabled for applications.

**NOTE**

You can disable one-way SSL/TLS for deployed applications using the **disable-ssl-http-server** command.

```
security disable-ssl-http-server
```

This command does not delete the Elytron resources. It configures the system to use the **ApplicationRealm** legacy security realm for its SSL configuration.
Using Management Console
You can enable SSL for applications by configuring the undertow subsystem using an SSL wizard in the management console.

To access the wizard:

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.


3. Click the name of the server to configure.

4. Click View.

5. Navigate to Listener → HTTPS Listener.

6. Select the listener for which SSL is to be enabled, and click Enable SSL to launch the wizard. The wizard guides you through the following scenarios for enabling SSL:

- You want to create a certificate store and generate a self-signed certificate.
- You want to obtain a certificate from Let’s Encrypt Certificate Authority.
- You already have the certificate store on the file system, but no keystore configuration.
- You already have a keystore configuration that uses a valid certificate store.

Using the wizard, you can optionally create a truststore for mutual authentication.

1.4.2.2. Enable Two-way SSL/TLS for Applications Using the Elytron Subsystem

1. Obtain or generate your client keystores:

```
$ keytool -genkeypair -alias client -keyalg RSA -keysize 1024 -validity 365 -keystore client.keystore.jks -dname "CN=client" -keypass secret -storepass secret
```

2. Export the client certificate:

```
keytool -exportcert -keystore client.keystore.jks -alias client -keypass secret -storepass secret -file /path/to/client.cer
```

3. Enable two-way SSL/TLS for deployed applications.

In JBoss EAP, two-way SSL/TLS for deployed applications can be enabled either by using a security command or by using the elytron subsystem commands.

a. Using a security command.

The security enable-ssl-http-server command can be used to enable two-way SSL/TLS for the deployed applications.

**NOTE**

The following example does not validate the certificate as no chain of trust exists. If you are using a trusted certificate, then the client certificate can be validated without issue.
Example: Wizard Usage

```
security enable-ssl-http-server --interactive

Please provide required pieces of information to enable SSL:
Key-store file name (default default-server.keystore): server.keystore.jks
Password (blank generated): secret
What is your first and last name? [Unknown]: localhost
What is the name of your organizational unit? [Unknown]:
What is the name of your organization? [Unknown]:
What is the name of your City or Locality? [Unknown]:
What is the name of your State or Province? [Unknown]:
What is the two-letter country code for this unit? [Unknown]:
Is CN=Unknown, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown correct y/n [y]?
Validity (in days, blank default): 365
Alias (blank generated): localhost
Enable SSL Mutual Authentication y/n (blank n): y
Client certificate (path to pem file): /path/to/client.cer
Validate certificate y/n (blank y): n
Trust-store file name (management.truststore): server.truststore.jks
Password (blank generated): secret

SSL options:
key store file: server.keystore.jks
distinguished name: CN=localhost, OU=Unknown, O=Unknown, L=Unknown, ST=Unknown, C=Unknown
password: secret
validity: 365
alias: localhost
client certificate: /path/to/client.cer
trust store file: server.trustore.jks
trust store password: secret
Server keystore file server.keystore.jks, certificate file server.pem and server.csr file will be generated in server configuration directory.
Server truststore file server.trustore.jks will be generated in server configuration directory.
Do you confirm y/n: y
```

**NOTE**

Once the command is executed, the management CLI will reload the server.

To complete the two-way SSL/TLS authentication, you need to import the server certificate into the client truststore and configure your client to present the client certificate.

- Using elytron subsystem commands.
  - In JBoss EAP, you can also use the elytron subsystem, along with the undertow subsystem, to enable two-way SSL/TLS for deployed applications.
    - Obtain or generate your keystore.
      - Before enabling two-way SSL/TLS in JBoss EAP, you must obtain or generate the keystores, truststores and certificates you plan on using.
A. Create a server keystore:

```
/subsystem=elytron/key-store=twoWayKS:add(path=/PATH/TO/server.keystore.jks,credential-reference={clear-text=secret},type=JKS)
/subsystem=elytron/key-store=twoWayKS:generate-key-pair(alias=localhost,algorithm=RSA,key-size=1024,validity=365,credential-reference={clear-text=secret},distinguished-name="CN=localhost")
/subsystem=elytron/key-store=twoWayKS:store()
```

NOTE

The command above uses an absolute path to the keystore. Alternatively you can use the `relative-to` attribute to specify the base directory variable and `path` specify a relative path.

```
/subsystem=elytron/key-store=twoWayKS:add(path=server.keystore.jks,relative-to=jboss.server.config.dir,credential-reference={clear-text=secret},type=JKS)
```

B. Export the server certificate:

```
/subsystem=elytron/key-store=twoWayKS:export-certificate(alias=localhost,path=/path/to/server.cer,pem=true)
```

ii. Create a keystore for the server truststore and import the client certificate into the server truststore.

NOTE

The following example does not validate the certificate as no chain of trust exists. If you are using a trusted certificate, then the client certificate can be validated without issue.

```
/subsystem=elytron/key-store=twoWayTS:add(path=/path/to/server.truststore.jks,credential-reference={clear-text=secret},type=JKS)
/subsystem=elytron/key-store=twoWayTS:import-certificate(alias=client,path=/path/to/client.cer,credential-reference={clear-text=secret},trust-cacerts=true,validate=false)
/subsystem=elytron/key-store=twoWayTS:store()
```

iii. Configure a `key-manager` that references your keystore `key-store`.

```
/subsystem=elytron/key-manager=twoWayKM:add(key-store=twoWayKS,algorithm="SunX509",credential-reference={clear-text=secret})
```
IMPORTANT

You need to know what key manager algorithms are provided by the JDK you are using. For example, a JDK that uses SunJSSE provides the PKIX and SunX509 algorithms.

The example command below uses SunX509 for the key manager algorithm.

iv. Configure a **trust-manager** that references your truststore **key-store**.

```
/subsystem=elytron/trust-manager=twoWayTM:add(key-store=twoWayTS, algorithm="SunX509")
```

IMPORTANT

You need to know what key manager algorithms are provided by the JDK you are using. For example, a JDK that uses SunJSSE provides the PKIX and SunX509 algorithms.

The example command above uses SunX509 for the key manager algorithm.

v. Configure a **server-ssl-context** that references your **key-manager**, **trust-manager**, and enables client authentication:

```
/subsystem=elytron/server-ssl-context=twoWaySSC:add(key-manager=twoWayKM, protocols=["TLSv1.2"], trust-manager=twoWayTM, need-client-auth=true)
```

IMPORTANT

You need to determine what SSL/TLS protocols you want to support. The example command above uses TLSv1.2. You can use the **cipher-suite-filter** argument to specify which cipher suites are allowed, and the **use-cipher-suites-order** argument to honor server cipher suite order. The **use-cipher-suites-order** attribute by default is set to **true**. This differs from the legacy security subsystem behavior, which defaults to honoring client cipher suite order.

WARNING

Red Hat recommends that SSLv2, SSLv3, and TLSv1.0 be explicitly disabled in favor of TLSv1.1 or TLSv1.2 in all affected packages.

vi. Check and see if the **https-listener** is configured to use a legacy security realm for its SSL configuration.

```
/subsystem=undertow/server=default-server/https-listener=https:read-
```
attribute(name=security-realm)
{
  "outcome" => "success",
  "result" => "ApplicationRealm"
}

The above command shows that the **https-listener** is configured to use the **ApplicationRealm** legacy security realm for its SSL configuration. Undertow cannot reference both a legacy security realm and an **ssl-context** in the **elytron** subsystem at the same time. So you must remove the reference to the legacy security realm.

**NOTE**

If the result is **undefined**, you do not need to remove the reference to the security realm in the next step.

vii. Remove the reference to the legacy security realm, and update the **https-listener** to use the **ssl-context** from Elytron.

**NOTE**

**https-listener** must always have either a **security-realm** or **ssl-context** configured. When changing between the two configurations, the commands must be executed as a single batch, as shown below.

```
batch
/subsystem=undertow/server=default-server/https-listener=https:undefine-
attribute(name=security-realm)
/subsystem=undertow/server=default-server/https-listener=https:write-
attribute(name=ssl-context, value=twoWaySSC)
run-batch
```

viii. Reload the server.

**NOTE**

To complete the two-way SSL/TLS authentication, you need to import the server certificate into the client truststore and configure your client to present the client certificate.

```
$ keytool -importcert -keystore client.truststore.jks -storepass secret -alias localhost -trustcacerts -file /path/to/server.cer
```

ix. Configure your client to use the client certificate.

You need to configure your client to present the trusted client certificate to the server to complete the two-way SSL/TLS authentication. For example, if using a browser, you need to import the trusted certificate into the browser’s trust store.

This procedure forces a two-way SSL/TLS but it does not change the original authentication method of the application.
If you want to change the original authentication method, see Configure Authentication with Certificates in How to Configure Identity Management for JBoss EAP.

Two-way SSL/TLS is now enabled for applications.

**NOTE**

You can disable two-way SSL/TLS for deployed applications using the `disable-ssl-http-server` command.

```
security disable-ssl-http-server
```

This command does not delete the Elytron resources. It configures the system to use the ApplicationRealm legacy security realm for its SSL configuration.

### 1.4.3. Configuring Certificate Revocation Using CRL in Elytron

Configure the trust manager used for enabling two-way SSL/TLS to use Certificate Revocation List (CRL) for certificate revocation in Elytron.

**Prerequisites**

- The trust manager is configured to use two-way SSL/TLS.
- The trust manager contains the certificate chain to be checked for revocation.

**Procedure**

1. Configure the trust manager to use CRLs obtained from distribution points referenced in your certificates.

   ```
   /subsystem=elytron/trust-manager=twoWayTM:write-attribute(name=certificate-revocation-list,value={})
   ```

2. Override the CRL obtained from distribution points referenced in your certificates.

   ```
   /subsystem=elytron/trust-manager=twoWayTM:write-attribute(name=certificate-revocation-list.path, value=intermediate.crl.pem)
   ```

3. Configure `trust-manager` to use CRL for certificate revocation.

   - If an OCSP responder is also configured for certificate revocation, add attribute `ocsp.prefer-crls` with the value `true` in the trust manager to use CRL for certificate revocation:

     ```
     /subsystem=elytron/trust-manager=twoWayTM:write-attribute(name=ocsp.prefer-crls,value="true")
     ```

   - If no OCSP responder is configured for certificate revocation, the configuration is complete.

**Additional Information**

- For a complete list of CRL attributes, see trust-manager Attributes.
1.4.4. Configuring Certification Revocation Using OCSP in Elytron

Configure the trust manager used for enabling two-way SSL/TLS to use an Online Certificate Status Protocol (OCSP) responder for certificate revocation. OCSP is defined in RFC6960.

When both OCSP responder and CRL are configured for certificate revocation, the OCSP responder is invoked by default.

Prerequisites
- The trust manager is configured to use two-way SSL/TLS.

Procedure

1. Configure the trust manager to use the OCSP responder defined in the certificate for certificate revocation.

   /subsystem=elytron/trust-manager=twoWayTM:write-attribute(name=ocsp,value={})

2. Override OCSP responder defined in the certificate.

   /subsystem=elytron/trust-manager=twoWayTM:write-attribute(name=ocsp.responder,value="http://example.com/ocsp-responder")

Additional Information
- For a complete list of attributes, see online-certificate-status Attributes.

1.4.5. Using Legacy Security Realms

**IMPORTANT**

As a prerequisite, an SSL/TLS encryption key and certificate should be created and placed in an accessible directory. Additionally, relevant information, such as keystore aliases and passwords, desired cipher suites, should also be accessible. For examples on generating SSL/TLS Keys and Certificates, see the first two steps in the Setting up Two-way SSL/TLS for the Management Interfaces section. For more information about the HTTPS listener, including cipher suites, see the HTTPS Listener Reference section.

1.4.5.1. Enable One-way SSL/TLS for Applications Using Legacy Security Realms

This example assumes that the keystore, `identity.jks`, has been copied to the server configuration directory and configured with the given properties. Administrators should substitute their own values for the example ones.

**NOTE**

The management CLI commands shown assume that you are running a JBoss EAP standalone server. For more details on using the management CLI for a JBoss EAP managed domain, see the JBoss EAP Management CLI Guide.
1. Add and configure an HTTPS security realm first. Once the HTTPS security realm has been configured, configure an `https-listener` in the `undertow` subsystem that references the security realm:

```bash
batch
/core-service=management/security-realm=HTTPSRealm:add
/core-service=management/security-realm=HTTPSRealm/server-identity=ssl:add(keystore-path=identity.jks, keystore-relative-to=jboss.server.config.dir, keystore-password=password1, alias=appserver)
/subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=security-realm, value=HTTPSRealm)
run-batch
```

**WARNING**

Red Hat recommends that SSLv2, SSLv3, and TLSv1.0 be explicitly disabled in favor of TLSv1.1 or TLSv1.2 in all affected packages.

2. Restart the JBoss EAP instance for the changes to take effect.

### 1.4.5.2. Enable Two-way SSL/TLS for Applications Using Legacy Security Realms

Setting up two-way SSL/TLS for applications follows many of the same procedures outlined in Setting up Two-way SSL/TLS for the Management Interfaces. To set up two-way SSL/TLS for applications, you need to do the following:

1. Generate the stores for both the client and server
2. Export the certificates for both the client and server
3. Import the certificates into the opposing truststores
4. Define a security realm, for example `CertificateRealm`, on the server that uses the server’s keystore and truststore
5. Update the `undertow` subsystem to use the security realm and require client verification

The first four steps are covered in Setting up Two-way SSL/TLS for the Management Interfaces.

**IMPORTANT**

If the server has not been reloaded since the new security realm has been added, you must reload the server before performing the next step.

**Update the Undertow Subsystem**

Once the keystores, certificates, truststores, and security realms have been created and configured, you
Once the keystores, certificates, truststores, and security realms have been created and configured, you need to add an HTTPS listener to the `undertow` subsystem, use the security realm you created, and require client verification:

```
/subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=security-realm, value=CertificateRealm)
/subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=verify-client, value=REQUIRED)
```

**IMPORTANT**

You must reload the server for these changes to take effect.

**IMPORTANT**

Any client connecting to a JBoss EAP instance with two-way SSL/TLS enabled for applications must have access to a client certificate or keystore, in other words a client keystore whose certificate is included in the server’s truststore. If the client is using a browser to connect to the JBoss EAP instance, you need to import that certificate or keystore into the browser’s certificate manager.

**NOTE**

More details on using certificate-based authentication in applications, in addition to two-way SSL/TLS with applications, can be found in the Configuring a Security Domain to Use Certificate-based Authentication section of the JBoss EAP How to Configure Identity Management Guide.

### 1.5. Enable HTTP Authentication for Applications Using the CLI Security Command

In JBoss EAP, HTTP authentication, using an elytron HTTP authentication factory, can be enabled for the undertow security domain with the `security enable-http-auth-http-server` command. By default this command associates the application HTTP factory to the specified security domain.

**Example: Enable HTTP Authentication on the Undertow Security Domain**

```
security enable-http-auth-http-server --security-domain=SECURITY_DOMAIN
```

Server reloaded.
Command success.
Authentication configured for security domain SECURITY_DOMAIN
http authentication-factory=application-http-authentication
security-domain=SECURITY_DOMAIN

**NOTE**

Once the command is executed, the management CLI will reload the server and reconnect to it.
If an HTTP factory already exists, then the factory is updated to use the mechanism defined by the --mechanism argument.

1.5.1. Disabling HTTP authentication for the management interfaces

This procedure describe how to disable HTTP authentication for the management interfaces.

Procedure

- To remove the active HTTP authentication factory use the following command.
  
  \[ \text{security disable-http-auth-http-server} \ --\text{security-domain=SECURITY\_DOMAIN} \]

- Alternatively, you can use the following command to remove specific mechanisms from the active SASL authentication factory.
  
  \[ \text{security disable-http-auth-http-server} \ --\text{mechanism=MECHANISM} \ --\text{security-domain=SECURITY\_DOMAIN} \]

1.6. SASL AUTHENTICATION MECHANISMS

Simple Authentication and Security Layer (SASL) authentication mechanisms are used for defining the mechanisms for authenticating connections to a JBoss EAP server using the elytron subsystem, and for clients connecting to servers. Clients can be other JBoss EAP instances, or Elytron Client. SASL authentication mechanisms in JBoss EAP are also significantly used in Elytron integration with the remoting subsystem.

1.6.1. Choosing SASL Authentication Mechanisms

NOTE

Although JBoss EAP and Elytron Client work with a variety of SASL authentication mechanisms, you must ensure that the mechanisms you use are supported. See this list for the support levels for SASL authentication mechanisms.

The authentication mechanisms you use depends on your environment and desired authentication method. The following list summarizes the use of some of the supported SASL authentication mechanisms:

ANONYMOUS

Unauthenticated guest access.

DIGEST-MD5

Uses HTTP digest authentication as a SASL mechanism.

EXTERNAL

Uses authentication credentials that are implied in the context of the request. For example, IPsec or TLS authentication.

Mechanisms beginning with GS

Authentication using Kerberos.

JBOSS-LOCAL-USER
Provides authentication by testing that the client has the same file access as the local user that is running the JBoss EAP server. This is useful for other JBoss EAP instances running on the same machine.

**OAUTHBEARER**

Uses authentication provided by OAuth as a SASL mechanism.

**PLAIN**

Plain text username and password authentication.

**Mechanisms beginning with SCRAM**

Salted Challenge Response Authentication Mechanism (SCRAM) that uses a specified hashing function.

**Mechanisms ending with -PLUS**

Indicates a channel binding variant of a particular authentication mechanism. You should use these variants when the underlying connection uses SSL/TLS.

For more information on individual SASL authentication mechanisms, see the IANA SASL mechanism list and individual mechanism memos.

### 1.6.2. Configuring SASL Authentication Mechanisms on the Server Side

Configuring SASL authentication mechanisms on the server side is done using SASL authentication factories.

There are two levels of configuration required:

- A **sasl-authentication-factory**, where you specify authentication mechanisms.
- A **configurable-sasl-server-factory** that aggregates one or more of *sasl-authentication-factory*, and configures mechanism properties as well as optionally applying filters to enable or disable certain authentication mechanisms.

The following example demonstrates creating a new **configurable-sasl-server-factory**, and a **sasl-authentication-factory** that uses DIGEST-MD5 as a SASL authentication mechanism for application clients.

```text
/subsystem=elytron/configurable-sasl-server-factory=mySASLServerFactory:add(sasl-server-factory=elytron)
/subsystem=elytron/sasl-authentication-factory=mySASLAuthFactory:add(sasl-server-factory=mySASLServerFactory,security-domain=ApplicationDomain,mechanism-configurations=[{mechanism-name=DIGEST-MD5,mechanism-realm-configurations=[{realm-name=ApplicationRealm}]}])
```

### 1.6.3. Specifying SASL Authentication Mechanisms on the Client Side

SASL authentication mechanisms used by a client are specified using a **sasl-mechanism-selector**. You can specify any supported SASL authentication mechanisms that are exposed by the server that the client is connecting to.

A **sasl-mechanism-selector** is defined in Elytron configurations where authentication is configured:

- In the **elytron** subsystem, this is an attribute of an **authentication-configuration**. For example:
An example of using an `authentication-configuration` with a `sasl-mechanism-selector` can be seen in Configuring SSL/TLS Between Domain and Host Controllers Using Elytron.

- For Elytron Client, it is specified under the `configuration` element of `authentication-configurations` in the client configuration file, usually named `wildfly-config.xml`. For example:

```
<configuration>
  <authentication-client xmlns="urn:elytron:client:1.2">
    <authentication-rules>
      <rule use-configuration="default" />
    </authentication-rules>
    <authentication-configurations>
      <configuration name="default">
        <sasl-mechanism-selector selector="#ALL" />
      </configuration>
      ... 
      <configuration>
        <sasl-mechanism-selector selector="#ALL" />
      </configuration>
    </authentication-configurations>
  </authentication-client>
</configuration>
```

See How to Configure Identity Management for more information on configuring client authentication with Elytron Client.

`sasl-mechanism-selector` Grammar

The selector string for `sasl-mechanism-selector` has a specific grammar.

In a simple form, individual mechanisms are specified by listing their names in order, separated by a spaces. For example, to specify DIGEST-MD5, SCRAM-SHA-1, and SCRAM-SHA-256 as allowed authentication mechanisms, use the following string: `DIGEST-MD5 SCRAM-SHA-1 SCRAM-SHA-256`.

More advanced usage of the grammar can use the following special tokens:

- `#ALL`: All mechanisms.
- `#FAMILY(NAME)`: Mechanisms belonging to the specified mechanism family. For example, the family could be DIGEST, EAP, GS2, SCRAM, or IEC-ISO-9798.
- `#PLUS`: Mechanisms that use channel binding. For example, `SCRAM-SHA-XXX-PLUS` or `GS2-XXX-PLUS`.
- `#MUTUAL`: Mechanisms that authenticate the server in some way, for example making the server prove that the server knows the password. `#MUTUAL` includes families such as `#FAMILY(SCRAM)` and `#FAMILY(GS2)`.
- `#HASH(ALGORITHM)`: Mechanisms that use the specified hash algorithm. For example, the algorithm could be MD5, SHA-1, SHA-256, SHA-384, or SHA-512.

The above tokens and names can also be used with the following operations and predicates:

- `-`: Forbids
- `!`: Inverts
& &: And

||: Or

==: Equals

?: If

#TLS: Is true when TLS is active, otherwise false.

Below are some examples of `sasl-mechanism-selector` strings and their meaning:

- #TLS & & !#MUTUAL: When TLS is active, all mechanisms without mutual authentication.
- #ALL -ANONYMOUS: All mechanisms, except for ANONYMOUS.
- SCRAM-SHA-1 SCRAM-SHA-256: Adds those two mechanisms in that order.
- (SCRAM-SHA-1 || SCRAM-SHA-256): Adds the two mechanisms in the order that the provider or server presents them.
- !#HASH(MD5): Any mechanism that does not use the MD5 hashing algorithm.
- #FAMILY(DIGEST): Any digest mechanism.

1.6.4. Configuring SASL Authentication Mechanism Properties

You can configure authentication mechanism properties on both the server side and on the client side.

- On the server side, you define authentication mechanism properties in the `configurable-sasl-server-factory`. The following example defines the `com.sun.security.sasl.digest.utf8` property with a value of `false`.

```
/subsystem=elytron/configurable-sasl-server-factory=mySASLServerFactory:map-put(name=properties,key=com.sun.security.sasl.digest.utf8,value=false)
```

- On the client side, you define authentication mechanisms properties in the client’s authentication configuration:

  - In the `elytron` subsystem, define the authentication mechanism properties in your `authentication-configuration`. The following example defines the `wildfly.sasl.local-user.quiet-auth` property with a value of `true`.

```
/subsystem=elytron/authentication-configuration=myAuthConfig:map-put(name=mechanism-properties,key=wildfly.sasl.local-user.quiet-auth,value=true)
```

  - For Elytron Client, authentication mechanism properties are specified under the `configuration` element of `authentication-configurations` in the client configuration file, usually named `wildfly-config.xml`. For example:

```
...<authentication-configurations>
  <configuration name="default">
    <sasl-mechanism-selector selector="#ALL"/>
    <set-mechanism-properties>
      <property key="wildfly.sasl.local-user.quiet-auth" value="true"/>
    </set-mechanism-properties>
  </configuration>
</authentication-configurations>
```
You can see a list of standard Java SASL authentication mechanism properties in the Java documentation. Other JBoss EAP-specific SASL authentication mechanism properties are listed in the Authentication Mechanisms Reference.

1.7. ELYTRON INTEGRATION WITH THE MODCLUSTER SUBSYSTEM

One of the security capabilities exposed by elytron subsystem is a client ssl-context that can be used to configure the modcluster subsystem to communicate with a load balancer using SSL/TLS.

When protecting the communication between the application server and the load balancer, you need to define a client ssl-context in order to:

- Define a truststore holding the certificate chain that will be used to validate load balancer’s certificate.
- Define a trust manager to perform validations against the load balancer’s certificate.

1.7.1. Defining a Client SSL Context and Configuring ModCluster Subsystem

The following procedure requires that a truststore and trust manager be configured. For information on creating these see Create an Elytron Truststore and Create an Elytron Trust Manager.

1. Create the client SSL context.
   This SSL context is going to be used by the modcluster subsystem when connecting to the load balancer using SSL/TLS:

   ```
   /subsystem=elytron/client-ssl-context=modcluster-client-ssl-context:add(trust-manager=default-trust-manager)
   ```

2. Reference the newly created client SSL context using one of the following options.

   - Configure the modcluster subsystem by setting the ssl-context.
     ```
     /subsystem=modcluster/mod-cluster-config=configuration:write-attribute(name=ssl-context, value=modcluster-client-ssl-context)
     ```

   - Configure the undertow subsystem by defining the ssl-context attribute of the modcluster filter.
     ```
     /subsystem=undertow/configuration=filter/mod-cluster=modcluster:write-attribute(name=ssl-context,value=modcluster-client-ssl-context)
     ```

3. Reload the server.

   ```
   reload
   ```

For configuring the modcluster subsystem and using two-way authentication, along with the trust manager, the key manager also needs to be configured.
1. Create the keystore.

```
/subsystem=elytron/key-store=twoWayKS:add(path=/path/to/client.keystore.jks, credential-reference={clear-text=secret}, type=JKS)
```

2. Configure the key manager.

```
/subsystem=elytron/key-manager=twoWayKM:add(key-store=twoWayKS, algorithm="SunX509", credential-reference={clear-text=secret})
```

3. Create the client SSL context.

```
/subsystem=elytron/client-ssl-context=modcluster-client-ssl-context:add(trust-manager=default-trust-manager, key-manager=twoWayKM)
```

**NOTE**

If you already have an existing client SSL context, you can add the `key-manager` to it as follows:

```
/subsystem=elytron/client-ssl-context=modcluster-client-ssl-context:write-attribute(name=key-manager, value=twoWayKM)
```

4. Reload the server.

```
reload
```

### 1.8. ELYTRON INTEGRATION WITH THE JGROUPS SUBSYSTEM

Components in the `elytron` subsystem may be referenced when defining authorization or encryption protocols in the `jgroups` subsystem. Full instructions on configuring these protocols are found in the Securing a Cluster section of the Configuration Guide.

### 1.9. ELYTRON INTEGRATION WITH THE REMOTING SUBSYSTEM

#### 1.9.1. Elytron integration with remoting connectors

A remoting connector is specified by a SASL authentication factory, a socket binding, and an optional SSL context. In particular, the attributes for a connector are as follows:

- **sasl-authentication-factory**
  A reference to the SASL authentication factory to use for authenticating requests to this connector. For more information on creating this factory, see Create an Elytron Authentication Factory.

- **socket-binding**
  A reference to the socket binding, detailing the interface and port where the connector should listen for incoming requests.

- **ssl-context**
  A reference to the server-side SSL Context to use for this connector. The SSL Context
An optional reference to the server-side SSL Context to use for this connector. The SSL Context contains the server key manager and trust manager to be used, and should be defined in instances where SSL is desired.

For example, a connector can be added as follows, where `SASL_FACTORY_NAME` is an already defined authentication factory and `SOCKET_BINDING_NAME` is an existing socket binding.

```
/subsystem=remoting/connector=CONNECTOR_NAME:add(sasl-authentication-factory=SASL_FACTORY_NAME,socket-binding=SOCKET_BINDING_NAME)
```

If SSL is desired, a preconfigured `server-ssl-context` may be referenced using the `ssl-context` attribute, as seen below.

```
/subsystem=remoting/connector=CONNECTOR_NAME:add(sasl-authentication-factory=SASL_FACTORY_NAME,socket-binding=SOCKET_BINDING_NAME,ssl-context=SSL_CONTEXT_NAME)
```

1.9.1.1. Enabling one-way SSL/TLS for remoting connectors using the elytron subsystem

The following SASL mechanisms support channel binding to external secure channels, such as SSL/TLS:

- GS2-KRB5-PLUS
- SCRAM-SHA-1-PLUS
- SCRAM-SHA-256-PLUS
- SCRAM-SHA-384-PLUS
- SCRAM-SHA-512-PLUS

To use any of these mechanisms, you can configure a custom SASL factory, or modify one of the predefined SASL authentication factories. A SASL mechanism selector can be used on the client to specify the appropriate SASL mechanism.

**Prerequisites**

- A key-store is configured.
- A key-manager is configured.
- A `server-ssl-context` is configured that references the defined key-manager

**Procedure**

1. Create a socket-binding for the connector. The following command defines the `oneWayBinding` binding that listens on port 11199.

```
/socket-binding-group=standard-sockets/socket-binding=oneWayBinding:add(port=11199)
```

2. Create a connector that references the SASL authentication factory, the previously created socket binding, and the SSL context.

```
/subsystem=remoting/connector=oneWayConnector:add(sasl-authentication-factory=SASL_FACTORY,socket-binding=oneWayBinding,ssl-context=SSL_CONTEXT)
```
IMPORTANT

In cases where you have both a **security-realm** and **ssl-context** defined, JBoss EAP will use the SSL/TLS configuration provided by **ssl-context**.

3. Configure the client to trust the server certificate. A generic example client is found at Elytron Client Side One Way Example. This example configures an **ssl-context** using the client **trust-store**.

Additional resources

- **key-store**
- **key-manager**
- **server-ssl-context**

1.9.1.2. Enabling two-way SSL/TLS for remoting connectors using the elytron subsystem

The following SASL mechanisms support channel binding to external secure channels, such as SSL/TLS:

- GS2-KRB5-PLUS
- SCRAM-SHA-1-PLUS
- SCRAM-SHA-256-PLUS
- SCRAM-SHA-384-PLUS
- SCRAM-SHA-512-PLUS

To use any of these mechanisms, you can configure a custom SASL factory, or modify one of the predefined SASL authentication factories to offer any of these mechanisms. A SASL mechanism selector can be used on the client to specify the appropriate SASL mechanism.

**Prerequisites**

- Separate **key-store** components for the client and server certificates are configured.
- A **key-manager** for the server **key-store** is configured.
- A **trust-manager** for the server **trust-store** is configured.
- A **server-ssl-context** that references the defined **key-manager** and **trust-manager** is configured.

**Procedure**

1. Create a **socket-binding** for the connector. The following command defines the **twoWayBinding** binding that listens on port **11199**.

   ```
   /socket-binding-group=standard-sockets/socket-binding=twoWayBinding:add(port=11199)
   ```
2. Create a connector that references the SASL authentication factory, the previously created socket binding, and the SSL context.

```
$subsystem=remoting/connector=twoWayConnector:add(sasl-authentication-factory=\SASL\_FACTORY\,socket-binding=twoWayBinding,ssl-context=\SSL\_CONTEXT)
```

**IMPORTANT**

In cases where you have both a security-realm and ssl-context defined, JBoss EAP will use the SSL/TLS configuration provided by ssl-context.

3. Configure your client to trust the server certificate, and to present its certificate to the server. You need to configure your client to present the trusted client certificate to the server to complete the two-way SSL/TLS authentication. For example, if using a browser, you need to import the trusted certificate into the browser’s truststore. A generic example client is found at Elytron Client Side Two Way Example. This example configures an ssl-context using the client trust-store and key-store.

Two-way SSL/TLS is now enabled on the remoting connector.

**Additional resources**

- key-store
- key-manager
- trust-manager
- trust-store
- server-ssl-context
- SASL mechanism selector

### 1.9.2. Elytron integration with remoting HTTP connectors

A remote HTTP connection is specified by referencing a connector in the undertow subsystem and a SASL authentication factory defined in the elytron subsystem. The HTTP connector provides the configuration for the HTTP upgrade-based remoting connector, and connects to an HTTP listener specified by the connector-ref attribute.

The attributes for a connector are as follows:

**connector-ref**

A reference to a predefined undertow listener.

**sasl-authentication-factory**

A reference to the SASL authentication factory to use for authenticating requests to this connector. For more information on creating this factory, see Create an Elytron Authentication Factory.

For example, a http-connector can be added as follows, where CONNECTOR_NAME references the undertow listener, and SASL_FACTORY_NAME is an already defined authentication factory in the elytron subsystem.
1.9.2.1. Enabling one-way SSL on the remoting HTTP connector

The following SASL mechanisms support channel binding to external secure channels, such as SSL/TLS:

- GS2-KRB5-PLUS
- SCRAM-SHA-1-PLUS
- SCRAM-SHA-256-PLUS
- SCRAM-SHA-384-PLUS
- SCRAM-SHA-512-PLUS

To use any of the above mechanisms, a custom SASL factory can be configured, or one of the predefined SASL authentication factories can be modified to offer any of these mechanisms. A SASL mechanism selector can be used on the client to specify the appropriate SASL mechanism.

Prerequisites

- A key-store is configured.
- A key-manager is configured.
- A server-ssl-context is configured that references the defined key-manager.

Procedure

1. Check whether the https-listener is configured to use a legacy security realm for its SSL configuration.

```
/subsystem=undertow/server=default-server/https-listener=https:read-attribute(name=security-realm)
{
  "outcome" => "success",
  "result" => "ApplicationRealm"
}
```

The above command shows that the https-listener is configured to use the ApplicationRealm legacy security realm for its SSL configuration. Undertow cannot reference both a legacy security realm and an ssl-context in Elytron at the same time so you must remove the reference to the legacy security realm.

**NOTE**

If the result is undefined, you do not need to remove the reference to the security realm in the next step.

2. Remove the reference to the legacy security realm, and update the https-listener to use the ssl-context from Elytron.
NOTE

**https-listener** must always have either a **security-realm** or **ssl-context** configured. When changing between the two configurations, the commands must be executed as a single batch, as shown below.

```
batch
/subsystem=undertow/server=default-server/https-listener=https:undefine-attribute(name=security-realm)
/subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=ssl-context, value=SERVER_SSL_CONTEXT)
run-batch
```

3. Create an HTTP connector that references the HTTPS listener and the SASL authentication factory.

```
/subsystem=remoting/http-connector=ssl-http-connector:add(connector-ref=https,sasl-authentication-factory=SASL_FACTORY)
```

4. Reload the server.

```
reload
```

5. Configure the client to trust the server certificate. For example, if using a browser, you need to import the trusted certificate into the browser’s truststore.

Additional resources

- **key-store**
- **key-manager**
- **server-ssl-context**
- **custom SASL factory**

1.9.2.2. Enabling two-way SSL/TLS on the remoting HTTP connectors

The following SASL mechanisms support channel binding to external secure channels, such as SSL/TLS:

- GS2-KRB5-PLUS
- SCRAM-SHA-1-PLUS
- SCRAM-SHA-256-PLUS
- SCRAM-SHA-384-PLUS
- SCRAM-SHA-512-PLUS

To use any of the above mechanisms, a custom SASL factory can be configured, or one of the predefined SASL authentication factories can be modified to offer any of these mechanisms. A **SASL mechanism selector** can be used on the client to specify the appropriate SASL mechanism.
Prerequisites

- Separate key-store components for the client and server certificates are configured.
- A key-manager for the server key-store is configured.
- A trust-manager for the server trust-store is configured.
- A server-ssl-context that references the defined key-manager and trust-manager is configured.

Procedure

1. Check whether the https-listener is configured to use a legacy security realm for its SSL configuration.

    ```
    /subsystem=undertow/server=default-server/https-listener=https:read-attribute(name=security-realm)
    {
    "outcome" => "success",
    "result" => "ApplicationRealm"
    }
    ```

    The above command shows that the https-listener is configured to use the ApplicationRealm legacy security realm for its SSL configuration. Undertow cannot reference both a legacy security realm and an ssl-context in Elytron at the same time so you must remove the reference to the legacy security realm.

    **NOTE**

    If the result is undefined, you do not need to remove the reference to the security realm in the next step.

2. Remove the reference to the legacy security realm, and update the https-listener to use the ssl-context from Elytron.

    **NOTE**

    https-listener must always have either a security-realm or ssl-context configured. When changing between the two configurations, the commands must be executed as a single batch, as shown below.

    ```
    batch
    /subsystem=undertow/server=default-server/https-listener=https:define-attribute(name=security-realm)
    /subsystem=undertow/server=default-server/https-listener=https:write-attribute(name=ssl-context, value=SERVER_SSL_CONTEXT)
    run-batch
    ```

3. Create an HTTP connector that references the HTTPS listener and the SASL authentication factory.

    ```
    /subsystem=remoting/http-connector=ssl-http-connector:add(connector-ref=https, sasl-authentication-factory=SASL_FACTORY)
    ```
4. Reload the server.

```
reload
```

5. Configure your client to trust the server certificate, and to present its certificate to the server. You need to configure your client to present the trusted client certificate to the server to complete the two-way SSL/TLS authentication. For example, if using a browser, you need to import the trusted certificate into the browser’s truststore.

Two-way SSL/TLS is now enabled on the remoting HTTP connector.

**IMPORTANT**

In cases where you have *both* a `security-realm` and `ssl-context` defined, JBoss EAP will use the SSL/TLS configuration provided by `ssl-context`.

Additional resources

- `key-store`
- `key-manager`
- `trust-manager`
- `trust-store`
- `server-ssl-context`
- custom SASL factory

1.9.3. Elytron integration with remoting outbound connectors

A remote outbound connection is specified by an outbound socket binding and an authentication context. The authentication context provides all of the security information that is needed for the connection. In particular, the attributes for a `remote-outbound-connection` are as follows:

- `outbound-socket-binding-ref` - The name of the outbound socket binding, which is used to determine the destination address and port for the connection.

- `authentication-context` - A reference to the authentication context, which contains the authentication configuration and the defined SSL context, if one exists, required for the connection. For information on defining an authentication context, see Creating an Authentication Context.

For example, a `remote-outbound-connection` can be added as follows, where `OUTBOUND_SOCKET_BINDING_NAME` is an already defined `outbound-socket-binding` and `AUTHENTICATION_CONTEXT_NAME` is an `authentication-context` that has already been defined in the `elytron` subsystem configuration.

```
/subsystem=remoting/remote-outbound-connection=OUTBOUND_CONNECTION_NAME:add(authentication-context=AUTHENTICATION_CONTEXT_NAME, outbound-socket-binding-ref=OUTBOUND_SOCKET_BINDING_NAME)
```
1.10. SECURING A MANAGED DOMAIN

In addition to securing the management interfaces, you can also secure communication between JBoss EAP instances in a managed domain.

For information on concepts and general configuration for the managed domain operating mode, see the Domain Management section of the JBoss EAP Configuration Guide.

1.10.1. Configure Password Authentication Between Slaves and the Domain Controller Using Elytron

1. Add a user on the master domain controller.
   A user needs to be added on the master domain controller for the slave controller to use for authentication. If you are using the default file based user and group authentication mechanism, this can be done by running `EAP_HOME/bin/adduser.sh`. Add the username, password and other configurations when prompted.

   The `add-user` utility can be used to manage both the users in the ManagementRealm and the users in the ApplicationRealm.

   **NOTE**

   The server caches the contents of the properties files in memory. However, the server does check the modified time of the properties files on each authentication request and reloads if the time has been updated. This means that all changes made by the `add-user` utility are immediately applied to any running server.

   The slave controller attempts to authenticate using the HTTP interface. If the HTTP interface has been secured with the ManagementRealm Elytron security realm, then you would need to add a user to ManagementRealm for the slave controller to use.

   **NOTE**

   The default name of the realm for management users is ManagementRealm. When the `add-user` utility prompts for the realm name, just accept the default unless you have switched to a different realm.

   The following example assumes the user slave with the password password1! has been added to ManagementRealm.

2. Add an authentication-configuration to the slave controller.

   ```
   /host=slave/subsystem=elytron/authentication-configuration=slave:add(authentication-name=slave, credential-reference={clear-text=password1!})
   ```

3. Add an authentication-context to the slave controller.
4. Specify the domain controller location and authentication-context in the slave controller.

```
<domain-controller>
 <remote protocol="remote" host="localhost" port="9990" authentication-context="slave-context"/>
</domain-controller>
```

1.10.2. Configure Password Authentication Between Slaves and the Domain Controller Using Legacy Core Management Authentication

When configuring a managed domain, by default, the master domain controller is configured to require authentication for each slave controller that connects to it. To configure slave controllers with the proper credentials, you must do the following:

1. Add a user to the master domain controller
   You need to add a user to the master domain controller using the `add-user` script. Specifically, you will need to ensure that the user is added to the same realm the master uses to secure its management interface, which by default is ManagementRealm. You also need to ensure you answer yes to the Is this new user going to be used for one AS process to connect to another AS process? question.

   **IMPORTANT**

   After adding the user, the script will output a <secret> element, which will be used in the next step. You must keep this value for use in the next step.

   Example: Adding a Slave User

   ```
   $ EAP_HOME/bin/add-user.sh
   What type of user do you wish to add?
   a) Management User (mgmt-users.properties)
   b) Application User (application-users.properties)
   (a): a
   Enter the details of the new user to add.
   Using realm 'ManagementRealm' as discovered from the existing property files.
   Username : slave-user
   Password recommendations are listed below. To modify these restrictions edit the add-user.properties configuration file.
   - The password should be different from the username
   - The password should not be one of the following restricted values {root, admin, administrator}
   - The password should contain at least 8 characters, 1 alphabetic character(s), 1 digit(s), 1 non-alphanumeric symbol(s)
   Password :
   Re-enter Password :
   What groups do you want this user to belong to? (Please enter a comma separated list, or leave blank for none)[]: 
   About to add user 'slave-user' for realm 'ManagementRealm'
   ```
Is this correct yes/no? yes
Added user ‘slave-user’ to file ‘/home/user/EAP-7.4.0/standalone/configuration/mgmt-users.properties’
Added user ‘slave-user’ to file ‘/home/user/EAP-7.4.0/domain/configuration/mgmt-users.properties’
Added user ‘slave-user’ with groups  to file ‘/home/user/EAP-7.4.0/standalone/configuration/mgmt-groups.properties’
Added user ‘slave-user’ with groups  to file ‘/home/user/EAP-7.4.0/domain/configuration/mgmt-groups.properties’
Is this new user going to be used for one AS process to connect to another AS process?
e.g. for a slave host controller connecting to the master or for a Remoting connection for server to server EJB calls.
yes/no? yes
To represent the user add the following to the server-identities definition <secret value="ABCzc3dv11Qx"/>

2. Configure the slave controllers to use the credential.
   Once you have created the user on the master domain controller, you will need to update each
   slave controller to use that credential in the host configuration file, for example host.xml or
   host-slave.xml. To do so, you need to add the user name to the \(<remote>\) element in the
   domain controller configuration. You will also need to add the \(<secret>\) to the server identities
   of the realm used to secure the \(<remote>\) element. Both the user name and \(<secret>\) were
   obtained when adding the user to the master domain controller in the previous step.

Example: Configuring Slave Controllers

   ...  
   \(<security-realm name="ManagementRealm">\)
   \(<server-identities>\)
   \(<!-- Replace this with either a base64 password of your own, or use a vault with a vault
   expression -->\)
   \(<secret value="ABCzc3dv11Qx"/>\)
   \</server-identities>\)
   \(<domain-controller>\)
   \(<remote security-realm="ManagementRealm" username="slave-user">\)
   \(<discovery-options>\)
   \(<static-discovery name="primary" protocol="${jboss.domain.master.protocol:remote}" host="${jboss.domain.master.address}" port="${jboss.domain.master.port:9990}"/>\)
   \</discovery-options>\)
   \</remote>\)
   \</domain-controller>\)

1.10.3. Configuring SSL/TLS Between Domain and Host Controllers Using Elytron

IMPORTANT

When you configure SSL/TLS to be used between JBoss EAP instances in a managed
domain, each instance can have a client or server role depending on the interaction. This
includes all host controllers as well as domain controllers. As a result, it is recommended
that you set up two-way SSL/TLS between endpoints.
You can configure JBoss EAP instances in a managed domain to use SSL/TLS when communicating with each other, in other words, between the master domain controller and host controllers. To do so using Elytron, use the following procedure.

1. Generate and configure all necessary certificates and keystores.
   In order to set up two-way SSL/TLS between endpoints, you need to generate and configure certificates and keystores for the master domain controller as well as each host controller. You also need to import the certificate of the master domain controller into each host controller’s keystore as well as import each host controller’s certificate into the master domain controller’s keystore. The specifics of this process is covered in Enable Two-way SSL/TLS for the Management Interfaces Using the Elytron Subsystem.

2. Add a user on the master domain controller.
   A user needs to be added on the master domain controller for the slave controller to use for authentication. If you are using the default file based user and group authentication mechanism, this can be done by running `EAP_HOME/bin/adduser.sh`. Add the username, password and other configurations when prompted.

   The `add-user` utility can be used to manage both the users in the `ManagementRealm` and the users in the `ApplicationRealm`.

   **NOTE**
   The server caches the contents of the properties files in memory. However, the server does check the modified time of the properties files on each authentication request and reloads if the time has been updated. This means that all changes made by the `add-user` utility are immediately applied to any running server.

   The slave controller attempts to authenticate using the HTTP interface. If the HTTP interface has been secured with the `ManagementRealm` Elytron security realm, then you would need to add a user to `ManagementRealm` for the slave controller to use.

   **NOTE**
   The default name of the realm for management users is `ManagementRealm`. When the `add-user` utility prompts for the realm name, just accept the default unless you have switched to a different realm.

   The following example assumes the user `slave` with the password `password1!` has been added to `ManagementRealm`.

3. Configure the master domain controller to use SSL/TLS.
   The commands below configure the domain controller’s `key-store`, `key-manager`, `trust-manager`, and `server-ssl-context` for the server keystore and truststore.

   ```
   /host=master/subsystem=elytron/key-store=twoWayKS:add(path=/path/to/server.keystore.jks,credential-reference={clear-text=secret},type=JKS)
   
   /host=master/subsystem=elytron/key-store=twoWayTS:add(path=/path/to/server.truststore.jks,credential-reference={clear-text=secret},type=JKS)
   ```
You need to know what key manager algorithms are provided by the JDK you are using. For example, a JDK that uses SunJSSE provides the PKIX and SunX509 algorithms. You also need to determine what HTTPS protocols you want to support. The example commands above use TLSv1.2. You can use the cipher-suite-filter argument to specify which cipher suites are allowed, and the use-cipher-suites-order argument to honor server cipher suite order. The use-cipher-suites-order attribute by default is set to true. This differs from the legacy security subsystem behavior, which defaults to honoring client cipher suite order.

4. Configure an authentication context and domain controller location on each slave host controller.

The following example configuration assumes the domain controller exists on localhost. Ensure you specify the correct management user, password, and domain controller location for your environment.
5. Configure each slave host controller to use SSL/TLS. The commands below configure a slave host controller’s **key-store, key-manager, trust-manager, client-ssl-context** for the server keystore and truststore, as well as the **authentication-context**.

The following example configuration assumes the domain controller exists on **localhost**. Ensure you specify the correct domain controller location for your environment.

```
/host=slave1/subsystem=elytron/key-store=twoWayKS:add(path=/path/to/client.keystore.jks,credential-reference={clear-text=secret},type=JKS)
/host=slave1/subsystem=elytron/key-store=twoWayTS:add(path=/path/to/client.truststore.jks,credential-reference={clear-text=secret},type=JKS)
/host=slave1/subsystem=elytron/key-manager=twoWayKM:add(key-store=twoWayKS,algorithm="SunX509",credential-reference={clear-text=secret})
/host=slave1/subsystem=elytron/trust-manager=twoWayTM:add(key-store=twoWayTS,algorithm="SunX509")
/host=slave1/subsystem=elytron/client-ssl-context=twoWayCSC:add(key-manager=twoWayKM,protocols=["TLSv1.2"],trust-manager=twoWayTM)
/host=slave1/subsystem=elytron/authentication-context=slaveHostSSLContext:write-attribute(name=match-rules,value=[[match-host=localhost,authentication-configuration=slaveHostSSLConfiguration,ssl-context=twoWayCSC]])
```

6. Reload all the JBoss EAP hosts in your managed domain.

### 1.10.4. Configuring SSL/TLS Between Domain and Host Controllers Using Legacy Core Management Authentication

**IMPORTANT**

When you configure SSL/TLS to be used between JBoss EAP instances in a managed domain, each instance can have a client or server role depending on the interaction. This includes all host controllers as well as domain controllers. As a result, it is recommended that you set up two-way SSL/TLS between endpoints.

You can configure JBoss EAP instances in a managed domain to use SSL/TLS when communicating with each other, in other words, between the master domain controller and host controllers. To do so using legacy core management authentication, use the following procedure.

1. Generate and configure all necessary certificates and keystores.

   In order to set up two-way SSL/TLS between endpoints, you need to generate and configure certificates and keystores for the master domain controller as well as each host controller. You also need to import the certificate of the master domain controller into each host controller’s
keystore as well as import each host controller’s certificate into the master domain controller’s keystore. The specifics of this process is covered in Setting up Two-way SSL/TLS for the Management Interfaces with Legacy Core Management Authentication.

2. Configure the master domain controller to use SSL/TLS.
   Once you have configured all certificates and keystores, you need to configure a security realm to use two-way SSL/TLS. This is done by configuring a security realm to use SSL/TLS and to require it for authentication. That security realm is then used to secure the management interface used for connecting between host controllers and the master domain controller.

   **NOTE**
   
   The following commands below must either be run in batch mode, or the server must be reloaded after adding the ssl server identity. The example below is shown using batch mode.

   ```
   batch
   /host=master/core-service=management/security-realm=CertificateRealm:add()
   /host=master/core-service=management/security-realm=CertificateRealm/authentication=truststore:add(keystore-relative-to=jboss.domain.config.dir,keystore-path=domaincontroller.jks,keystore-password=secret)
   /host=master/core-service=management/security-realm=CertificateRealm/authentication=local:add(default-user=$local)
   /host=master/core-service=management/security-realm=CertificateRealm/authentication=properties:add(relative-to=jboss.domain.config.dir,path=mgmt-users.properties)
   /host=master/core-service=management/management-interface=http-interface:write-attribute(name=security-realm,value=CertificateRealm)
   run-batch
   ```

3. Configure all host controllers to use SSL/TLS.
   Once you have the master domain controller configured to use two-way SSL/TLS, you need to configure each host controller to use it as well. The process is very much the same as the master domain controller configuration, except you will need to use the keystore specific to each host.

   **NOTE**
   
   The following commands below must either be run in batch mode, or the server must be reloaded after adding the ssl server identity. The example below is shown using batch mode.

   ```
   batch
   ```
Additionally, you will need to update the security realm used when connecting the master domain controller. This change must be done directly in the host controller's configuration file, for example `host.xml` or `host-slave.xml`, while the server is not running.

**Example: Host Controller Configuration File**

```xml
<domain-controller>
  <remote security-realm="CertificateRealm" username="slave-user">
    <discovery-options>
      <static-discovery name="primary" protocol="${jboss.domain.master.protocol:remote}" host="${jboss.domain.master.address}" port="${jboss.domain.master.port:9990}"/>
    </discovery-options>
  </remote>
</domain-controller>
```

**WARNING**

Red Hat recommends that SSLv2, SSLv3, and TLSv1.0 be explicitly disabled in favor of TLSv1.1 or TLSv1.2 in all affected packages.

### 1.11. ADDITIONAL ELYTRON COMPONENTS FOR SSL/TLS

The basic concepts behind configuring one-way SSL/TLS and two-way SSL/TLS are covered in the following:

- Enable One-way SSL/TLS for Applications Using the Elytron Subsystem
• Enable Two-way SSL/TLS for Applications Using the Elytron Subsystem
• Enable One-way SSL/TLS for the Management Interfaces Using the Elytron Subsystem
• Enable Two-way SSL/TLS for the Management Interfaces Using the Elytron Subsystem

Elytron also offers some additional components for configuring SSL/TLS.

1.11.1. Using an ldap-key-store

An ldap-key-store allows you to use a keystore stored in an LDAP server. You can use an ldap-key-store in the same way as you use a key-store.

NOTE
It is not possible to use a Jakarta Management ObjectName to decrypt the LDAP credentials. Instead, credentials can be secured by using a credential store.

To create and use an ldap-key-store:

1. Configure a dir-context.
   To connect to the LDAP server from JBoss EAP, you need to configure a dir-context that provides the URL as well as the principal used to connect to the server.

   Example: dir-context
   ```
   /subsystem=elytron/dir-context=exampleDC:add(url="ldap://127.0.0.1:10389",
       principal="uid=admin,ou=system", credential-reference={clear-text="secret"})
   ```

2. Configure an ldap-key-store.
   When you configure an ldap-key-store, you need to specify both the dir-context used to connect to the LDAP server as well as how to locate the keystore stored in the LDAP server. At a minimum, this requires you to specify a search-path.

   Example: ldap-key-store
   ```
   /subsystem=elytron/ldap-key-store=ldapKS:add(dir-context=exampleDC, search-path="ou=Keystores,dc=wildfly,dc=org")
   ```

3. Use the ldap-key-store.
   Once you have defined your ldap-key-store, you can use it in the same places where a key-store could be used. For example, you could use an ldap-key-store when configuring One-way SSL/TLS and Two-way SSL/TLS for applications.

For the full list of attributes for ldap-key-store as well as other Elytron components, see Elytron Subsystem Components Reference.

1.11.2. Using a filtering-key-store

A filtering-key-store allows you to expose a subset of aliases from an existing key-store, and use it in the same places you could use a key-store. For example, if a keystore contained alias1, alias2, and alias3, but you only wanted to expose alias1 and alias3, a filtering-key-store provides you several ways to do that.
To create a **filtering-key-store**:

1. Configure a **key-store**.

   ```
   /subsystem=elytron/key-store=myKS:add(path=keystore.jks, relative-to=jboss.server.config.dir, credential-reference={clear-text=secret}, type=JKS)
   ```

2. Configure a **filtering-key-store**.

   When you configure a **filtering-key-store**, you specify which **key-store** you want to filter and the **alias-filter** for filtering aliases from the **key-store**. The filter can be specified in one of the following formats:

   - **alias1,alias3**, which is a comma-delimited list of aliases to expose.
   - **ALL:-alias2**, which exposes all aliases in the keystore except the ones listed.
   - **NONE:+alias1:+alias3**, which exposes no aliases in the keystore except the ones listed.

   This example uses a comma-delimited list to expose `alias1` and `alias3`.

   ```
   /subsystem=elytron/filtering-key-store=filterKS:add(key-store=myKS, alias-filter="alias1,alias3")
   ```

   **NOTE**

   The **alias-filter** attribute is case sensitive. Because the use of mixed-case or uppercase aliases, such as `elytronAppServer`, might not be recognized by some keystore providers, it is recommended to use lowercase aliases, such as `elytronappserver`.

3. Use the **filtering-key-store**.

   Once you have defined your **filtering-key-store**, you can use it in the same places where a **key-store** could be used. For example, you could use a **filtering-key-store** when configuring **One-way SSL/TLS** and **Two-way SSL/TLS** for applications.

   For the full list of attributes for **filtering-key-store** as well as other Elytron components, see [Elytron Subsystem Components Reference](#).

### 1.11.3. Reload a Keystore

You can reload a keystore configured in JBoss EAP from the management CLI. This is useful in cases where you have made changes to certificates referenced by a keystore.

To reload a keystore:

```
/subsystem=elytron/key-store=httpsKS:load
```

### 1.11.4. Reinitialize a Key Manager

You can reinitialize a **key-manager** configured in JBoss EAP from the management CLI. This is useful in cases where you have made changes in certificates provided by keystore resource and you want to apply this change to new SSL connections without restarting the server.
1.11.5. Reinitialize a Trust Manager

You can reinitialize a trust-manager configured in JBoss EAP from the management CLI or the management console. This is useful when you have made changes to certificates provided by a keystore resource and want to apply the changes to the new SSL connections without restarting the server.

Reinitializing a Trust Manager from the management CLI

To reinitialize a trust-manager:

/subsystem=elytron/trust-manager=httpsTM:init()

Reinitializing a Trust Manager from the management console

1. Navigate to the management console and click the Runtime tab.
2. In the Monitor column, click Security (Elytron).
3. In the Security column, click SSL → View.
4. On the navigation pane, click Trust Manager.
5. Click Initialize on the top right corner of the screen to reinitialize a trust-manager.

1.11.6. Keystore Alias

The alias denotes the stored secret or credential in the store. If you add a keystore to the elytron subsystem using the key-store component, you can check the keystore’s contents using the alias related key-store operations.

The different operations for alias manipulation are:

- read-alias - Read an alias from a keystore.
- read-aliases - Read aliases from a keystore.
- remove-alias - Remove an alias from a keystore.
For example, to read an alias:

/subsystem=elytron/key-store=httpsKS/:read-alias(alias=localhost)

1.11.7. Using a client-ssl-context

A client-ssl-context is used for providing an SSL context when the JBoss EAP instance creates an SSL connection as a client, such as using SSL in remoting.

To create a client-ssl-context:

1. Create key-store, key-manager, and trust-manager components as needed. If establishing a two-way SSL/TLS connection, you need to create separate key-store components for the client and server certificates, a key-manager for the client key-store, and a trust-manager for the server key-store. Alternatively, if you are doing a one-way SSL/TLS connection, you need to create a key-store for the server certificate and a trust-manager that references it. Examples on creating keystores and truststores are available in the Enable Two-way SSL/TLS for Applications using the Elytron Subsystem section.

2. Create a client-ssl-context. Create a client-ssl-context referencing keystores, truststores, as well as any other necessary configuration options.

Example: client-ssl-context

/subsystem=elytron/client-ssl-context=exampleCSC:add(key-manager=clientKM, trust-manager=clientTM, protocols=["TLSv1.2"])

3. Reference the client-ssl-context.

For the full list of attributes for client-ssl-context as well as other Elytron components, see Elytron Subsystem Components Reference.

1.11.8. Using a server-ssl-context

A server-ssl-context is used for providing a server-side SSL context. In addition to the usual configuration for an SSL context, it is possible to configure additional items such as cipher suites and protocols. The SSL context will wrap any additional items that are configured.

1. Create key-store, key-manager, and trust-manager components as needed. If establishing a two-way SSL/TLS connection, you need to create separate key-store components for the client and server certificates, a key-manager for the server key-store, and a trust-manager for the server trust-store. Alternatively, if you are doing a one-way SSL/TLS connection, you need to create a key-store for the server certificate and a key-manager that references it. Examples on creating keystores and truststores are available in the Enable Two-way SSL/TLS for Applications Using the Elytron Subsystem section.

2. Create a server-ssl-context. Create a server-ssl-context that references the key manager, trust manager, or any other desired configuration options using one of the options outlined below.

Add a Server SSL Context Using the Management CLI
IMPORTANT

You need to determine what HTTPS protocols will be supported. The example commands above use TLSv1.2. You can use the `cipher-suite-filter` argument to specify which cipher suites are allowed, and the `use-cipher-suites-order` argument to honor server cipher suite order. The `use-cipher-suites-order` attribute by default is set to `true`. This differs from the legacy `security` subsystem behavior, which defaults to honoring client cipher suite order.

Add a Server SSL Context Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.

2. Navigate to Configuration → Subsystems → Security (Elytron) → Other Settings and click View.

3. Click on SSL → Server SSL Context and click Add to configure a new server SSL context.

For the full list of attributes for `server-ssl-context` as well as other Elytron components, see Elytron Subsystem Components Reference.

1.11.9. Using a server-ssl-sni-context

A `server-ssl-sni-context` is used for providing a server-side SNI matching. It provides matching rules to correlate host names to SSL contexts, along with a default in case none of the provided host names are matched. The SSL SNI contexts can be used in place of a standard server SSL context, such as when defining a context in the `undertow` subsystem.

1. Create `key-store`, `key-manager`, `trust-manager`, and `server-ssl-context` components as needed. There must be a server SSL context defined to create the `server-ssl-sni-context`.

2. Create a `server-ssl-sni-context` that provides matching information for the `server-ssl-context` elements. A default SSL context must be specified, using the `default-ssl-context` attribute, which will be used if no matching host names are found. The `host-context-map` accepts a comma-separated list of host names to match to the various SSL contexts.

   ```
   /subsystem=elytron/server-ssl-sni-context=SERVER_SSL_SNI_CONTEXT:add(default-ssl-context=DEFAULT_SERVER_SSL_CONTEXT,host-context-map={HOSTNAME=SERVER_SSL_CONTEXT,...})
   ```

   The following would be used to define a `server-ssl-sni-context` that defaults to the `serverSSL` SSL context, and matches incoming requests for `www.example.com` to the `exampleSSL` context.

   ```
   /subsystem=elytron/server-ssl-sni-context=exampleSNIContext:add(default-ssl-context=serverSSL,host-context-map={www\.example\.com=exampleSSL})
   ```
NOTE

The attribute value for host matching works as a regular expression, so be sure to escape any periods (.) used to delimit the domain name.

Configure server-ssl-sni-context Using the Management Console

1. Access the management console. For more information, see the Management Console section in the JBoss EAP Configuration Guide.

2. Navigate to Configuration → Subsystems → Security (Elytron) → Other Settings and click View.

3. Click SSL → Server SSL SNI Context to configure the required ssl-sni-context.

For the complete list of attributes for Elytron components, see Elytron Subsystem Components Reference.

1.11.10. Custom SSL Components

When configuring SSL/TLS in the elytron subsystem, you can provide and use custom implementations of the following components:

- key-store
- key-manager
- trust-manager
- client-ssl-context
- server-ssl-context

WARNING

It is not recommended to provide custom implementations of any component outside of the trust-manager without an intimate knowledge of the Java Secure Socket Extension (JSSE).

IMPORTANT

When using FIPS it is not possible to utilize a custom trust manager or key manager, as FIPS requires these managers be embedded in the JDK for security reasons. Similar behavior can be accomplished by implementing a SecurityRealm that validates X509 evidences.

When creating custom implementations of Elytron components, they must present the appropriate capabilities and requirements. For more details on capabilities and requirements, see the Capabilities and Requirements section of the JBoss EAP Security Architecture guide. Implementation details for each component are provided by the JDK vendor.
1.11.10.1. Add a Custom Component to Elytron

The following steps describe adding a custom component within Elytron.

1. Add the JAR containing the provider for the custom component as a module into JBoss EAP, declaring any required dependencies, such as `javax.api`:

   ```shell
   module add --name=MODULE_NAME --resources=FACTORY_JAR --dependencies=javax.api,DEPENDENCY_LIST
   ```

   **IMPORTANT**

   Using the `module` management CLI command to add and remove modules is provided as Technology Preview only. This command is not appropriate for use in a managed domain or when connecting to the management CLI remotely. Modules should be added and removed manually in a production environment. For more information, see the Create a Custom Module Manually and Remove a Custom Module Manually sections of the JBoss EAP Configuration Guide.

   Technology Preview features are not supported with Red Hat production service level agreements (SLAs), might not be functionally complete, and Red Hat does not recommend to use them for production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process.

   See Technology Preview Features Support Scope on the Red Hat Customer Portal for information about the support scope for Technology Preview features.

2. When the component is added to the `elytron` subsystem the `java.util.ServiceLoader` will be used to discover the provider. Alternatively, a reference to the provider can be provided by defining a `provider-loader`. There are two methods of creating the loader, and only one should be implemented for each component.

   - Reference the provider directly when defining the `provider-loader`:
     ```
     /subsystem=elytron/provider-loader=LOADER_NAME:add(class-names=[CLASS_NAME],module=MODULE_NAME)
     ```

   - Include a reference to the provider in `META-INF/services/java.security.Provider`. This reference is automatically created when using the `@MetaInfServices` annotation in `org.kohsuke.metainf-services`. When using this method only the module needs to be referenced by the `provider-loader`, as seen below:
     ```
     /subsystem=elytron/provider-loader=LOADER_NAME:add(module=MODULE_NAME)
     ```

3. Add the custom component into Elytron’s configuration, using the appropriate element for the type to be added and referencing any defined providers.

   ```
   /subsystem=elytron/COMPONENT_NAME=NEW_COMPONENT:add(providers=LOADER_NAME,...)
   ```

   For instance, to define a trust manager, the `trust-manager` element would be used, as seen in the following command:
Example: Adding a Custom Trust Manager

```
/subsystem=elytron/trust-manager=newTrustManager:add(algorithm=MyX509,providers=customProvider,key-store=sampleKeystore)
```

4. Once defined, the component can be referenced from other elements.

Additional resources

- For more information see modules and dependencies.

1.11.10.2. Including Arguments in a Custom Elytron Component

You can include arguments within a custom component if your class implements the `initialize` method, as seen below.

```java
void initialize(final Map<String, String> configuration);
```

This method allows the custom class to receive a set of configuration strings when defined. These are passed in using the `configuration` attribute when defining the component. For instance, the following example defines an attribute named `myAttribute` with a value of `myValue`.

```
/subsystem=elytron/COMPONENT_NAME=NEW_COMPONENT:add(class-name=CLASS_NAME,module=MODULE_NAME,configuration={myAttribute="myValue"})
```

1.11.10.3. Using Custom Trust Managers with Elytron

By implementing a custom trust manager, it is possible to extend the validation of certificates when using HTTPS in Undertow, LDAPS in a `dir-context`, or any place where Elytron is used for SSL connections. This component is responsible for making trust decisions for the server, and it is strongly recommended that these be implemented if a custom trust manager is used.

**IMPORTANT**

When using FIPS it is not possible to utilize a custom trust manager, as FIPS requires this manager be embedded in the JDK for security reasons. Similar behavior can be accomplished by implementing a `SecurityRealm` that validates X509 evidences.

**Requirements for Implementing a Custom Trust Manager**

When using a custom trust manager, the following must be implemented:

- A trust manager that implements the `X509ExtendedTrustManager` interface.
- A trust manager factory that extends `TrustManagerFactorySpi`.
- The provider of the trust manager factory.

The provider must be included in the JAR file to be added into JBoss EAP. Any implemented classes must be included in JBoss EAP as a module. Classes are not required to be in one module, and can be loaded from module dependencies.

**Example Implementations**
The following example demonstrates a provider that registers the custom trust manager factory as a service.

Example: Provider

```java
import org.kohsuke.MetaInfServices;
import javax.net.ssl.TrustManagerFactory;
import java.security.Provider;
import java.util.Collections;
import java.util.List;
import java.util.Map;

@MetaInfServices(Provider.class)
public class CustomProvider extends Provider {
    public CustomProvider() {
        super("CustomProvider", 1.0, "Demo provider");
        System.out.println("CustomProvider initialization.");
        final List<String> emptyList = Collections.emptyList();
        final Map<String, String> emptyMap = Collections.emptyMap();
        putService(new Service(this, TrustManagerFactory.class.getSimpleName(), "CustomAlgorithm", CustomTrustManagerFactorySpi.class.getName(), emptyList, emptyMap));
    }
}
```

The following example demonstrates a custom trust manager. This trust manager contains overloaded methods on checking if a client or server is trusted.

Example: TrustManager

```java
import javax.net.ssl.SSLEngine;
import javax.net.ssl.X509ExtendedTrustManager;
import java.net.Socket;
import java.security.cert.CertificateException;
import java.security.cert.X509Certificate;

public class CustomTrustManager extends X509ExtendedTrustManager {
    public void checkClientTrusted(X509Certificate[] x509Certificates, String s, Socket socket) throws CertificateException {
        // Insert your code here
    }
    public void checkServerTrusted(X509Certificate[] x509Certificates, String s, Socket socket) throws CertificateException {
        // Insert your code here
    }
    public void checkClientTrusted(X509Certificate[] x509Certificates, String s, SSLEngine sslEngine) throws CertificateException {
        // Insert your code here
    }
}
```
The following example is a factory used to return instances of the trust manager.

**Example: TrustManagerFactorySpi**

```java
import javax.net.ssl.ManagerFactoryParameters;
import javax.net.ssl.TrustManager;
import javax.net.ssl.TrustManagerFactorySpi;
import java.security.InvalidAlgorithmParameterException;
import java.security.KeyStore;
import java.security.KeyStoreException;

public class CustomTrustManagerFactorySpi extends TrustManagerFactorySpi {
    protected void.engineInit(KeyStore keyStore) throws KeyStoreException {
        // Insert your code here
    }

    protected void.engineInit(ManagerFactoryParameters managerFactoryParameters) throws InvalidAlgorithmParameterException {
        // Insert your code here
    }

    protected CustomTrustManager[] engineGetTrustManagers() {
        // Insert your code here
    }
}
```

Adding the Custom Trust Manager

Once the provider and trust manager have been created, add them to the elytron subsystem by using the steps outlined in Add a Custom Component to Elytron.
1.11.11. Default SSLContext

Many libraries used within deployments might require SSL configuration for connections they establish. These libraries tend to be configurable by the caller. If no configuration is provided, they use the default SSLContext for the process.

The default SSLContext is available using the following method call:

```java
javax.net.ssl.SSLContext.getDefault();
```

By default this SSLContext is configured using system properties. However, within the elytron subsystem, it is possible to specify which one of the configured contexts should be associated and used as the default.

To make use of this feature, configure your SSLContext as normal. The following command can then be used to specify which SSLContext should be used as the default.

```subsystem=elytron:write-attribute(name=default-ssl-context, value=client-context)
```

As existing services and deployments could have cached the default SSLContext prior to this being set, a reload is required to ensure that the default gets set before the deployments are activated.

```:reload
```

If the default-ssl-context attribute is subsequently undefined, the standard APIs do not provide any mechanism to revert the default. In this situation, the Java process would need be restarted.

```subsystem=elytron:undefine-attribute(name=default-ssl-context)
```

```json
{
   "outcome" => "success",
   "response-headers" => {
      "operation-requires-restart" => true,
      "process-state" => "restart-required"
   }
}
```

1.11.12. Using a Certificate Revocation List

If you want to validate a certificate against a certificate revocation list (CRL), you can configure this using the certificate-revocation-list attribute for a trust manager in the elytron subsystem. For example:

```subsystem=elytron/trust-manager=TRUST_MANAGER:write-attribute(name=certificate-revocation-list, value={path=/path/to/CRL_FILE.crl.pem})
```

For more information on the available attributes for a trust manager, see the trust-manager Attributes table.

**NOTE**

Your truststore must contain the certificate chain in order to check the validity of both the certification revocation list and the certificate. The truststore should not contain end-entity certificates, just certificate authority and intermediate certificates.
You can instruct the trust manager to reload the certificate revocation list by using the `reload-certificate-revocation-list` operation.

`/subsystem=elytron/trust-manager=TRUST_MANAGER:reload-certificate-revocation-list`

1.11.13. Using a Certificate Authority to Manage Signed Certificates

You can obtain and manage signed certificates using the JBoss EAP management CLI and the management console. This allows you to create a signed certificate directly from the CLI or the console and then import it into the required keystore.

**NOTE**

Many of the commands in this section have an optional staging parameter that indicates whether the certificate authority’s staging URL should be used. This value defaults to `false`, and is designed to assist in testing purposes. This parameter should never be enabled in a production environment.

Configure a Let’s Encrypt Account

As of JBoss EAP 7.4, Let’s Encrypt is the only supported certificate authority. To manage signed certificates an account must be created with the certificate authority, and the following information provided:

- A keystore to contain the alias of the certificate authority account key.
- The alias of the certificate authority. If the provided alias does not exist in the given keystore, then one will be created and stored as a private key entry.
- An optional list of URLs, such as email addresses, that the certificate authority can contact in the result of any issues.

`/subsystem=elytron/certificate-authority-account=CERTIFICATE_ACCOUNT:add(key-store=KEYSTORE,alias=ALIAS,contact-urls=[mailto:EMAIL_ADDRESS])`

Create an Account with the Certificate Authority

Once an account has been configured it may be created with the certificate authority by agreeing to their terms of service.

`/subsystem=elytron/certificate-authority-account=CERTIFICATE_ACCOUNT:create-account(agree-to-terms-of-service=true)`

Update an Account with the Certificate Authority

The certificate authority account options can be updated using the `update-account` command.

`/subsystem=elytron/certificate-authority-account=CERTIFICATE_ACCOUNT:update-account(agree-to-terms-of-service=true)`

Change the Account Key Associated with the Certificate Authority

The key associated with the certificate authority account can be changed by using the `change-account-key` command.

`/subsystem=elytron/certificate-authority-account=CERTIFICATE_ACCOUNT:change-account-key()`
Deactivate the Account with the Certificate Authority
If the account is no longer desired, then it may be deactivated by using the `deactivate-account` command.

```bash
/subsystem=elytron/certificate-authority-account=CERTIFICATE_ACCOUNT:deactivate-account()
```

Get the Metadata Associated with the Certificate Authority
The metadata for the account can be queried with the `get-metadata` command. This provides the following information:

- A URL to the terms of service.
- A URL to the certificate authority website.
- A list of the certificate authority accounts.
- Whether or not an external account is required.

```bash
/subsystem=elytron/certificate-authority-account=CERTIFICATE_ACCOUNT:get-metadata()
```

Configure a Let’s Encrypt Account Using Management Console
To configure a Let’s Encrypt account using the management console:

1. Access the management console.
   For more information, see the Management Console section in the JBoss EAP Configuration Guide.

2. Navigate to Runtime → Host → Security (Elytron) → SSL and click View.

3. Click Certificate Auth… to open the Certificate Authority Account page.

4. You can perform the following configurations for the selected alias by clicking the buttons with the labels:
   - **Create**
     Create an account with a certificate authority.
   - **Deactivate**
     Deactivate the selected certificate authority account.
   - **Update**
     Update the selected account with the certificate authority.
   - **Get Metadata**
     View the following information about the certificate authority account:
     - Associated alias
     - Certificate authority name
     - Contact details
     - Keystore name
     - Certificate authority details
1. Change Account Key
   - Change the associated key with the certificate authority.


You can perform various keystore manipulation operations on an Elytron key-store resource using the management CLI and the management console.

Keystore Manipulation Operations Using the Management CLI

Using the management CLI, you can perform the following keystore manipulation operations:

- Generate a key pair.
  The `generate-key-pair` command generates a key pair and wraps the resulting public key in a self-signed X.509 certificate. The generated private key and self-signed certificate will be added to the keystore.

  ```
  /subsystem=elytron/key-store=httpsKS:generate-key-pair(alias=example,algorithm=RSA,key-size=1024,validity=365,credential-reference={clear-text=secret},distinguished-name="CN=www.example.com")
  ```

- Generate a certificate signing request.
  The `generate-certificate-signing-request` command generates a PKCS #10 certificate signing request using a PrivateKeyEntry from the keystore. The generated certificate signing request will be written to a file.

  ```
  /subsystem=elytron/key-store=httpsKS:generate-certificate-signing-request(alias=example,path=server.csr,relative-to=jboss.server.config.dir,distinguished-name="CN=www.example.com",extensions=[[critical=false,name=KeyUsage,value=digitalSignature]],credential-reference={clear-text=secret})
  ```

- Import a certificate or certificate chain.
  The `import-certificate` command imports a certificate or certificate chain from a file into an entry in the keystore.

  ```
  /subsystem=elytron/key-store=httpsKS:import-certificate(alias=example,path=/path/to/certificate_or_chain/file,relative-to=jboss.server.config.dir,credential-reference={clear-text=secret},trust-cacerts=true)
  ```

- Export a certificate.
  The `export-certificate` command exports a certificate from an entry in the keystore to a file.

  ```
  /subsystem=elytron/key-store=httpsKS:export-certificate(alias=example,path=serverCert.cer,relative-to=jboss.server.config.dir,pem=true)
  ```

- Change an alias.
  The `change-alias` command moves an existing keystore entry to a new alias.
Keystore Manipulation Operations Using the Management Console

To perform the operations using the management console:

1. Access the management console.
   For more information, see the Management Console section in the JBoss EAP Configuration Guide.


3. Click Key Store to open the keystore definitions page.

4. Click the required keystore name.
   You can perform the following operations for the selected keystore by clicking the buttons with the labels:

   - **Load**
     Load or reload the keystore.

   - **Store**
     Persist changes made to the file backing the keystore.

   - **Generate Key Pair**
     Generate a key pair, wrap the public key in a self-signed X.509 certificate, and add the private key and the certificate to the keystore.

   - **Import Certificate**
     Import a certificate chain to the keystore from a file.

   - **Obtain**
     Obtain a signed certificate from a Certificate Authority and store it in the keystore.


You can perform the following operations on the keystore after you Configure a Let’s Encrypt Account.

**NOTE**

Many of the commands in this section have an optional staging parameter that indicates whether the certificate authority’s staging URL should be used. This value defaults to false, and is designed to assist in testing purposes. This parameter should never be enabled in a production environment.

Keystore Certificate Authority Operations Using the Management CLI

Using the management CLI, you can perform the following keystore certificate authority operations:
Obtain a Signed Certificate.
Once a certificate authority account has been defined for the keystore, you can use the `obtain-certificate` command to obtain a signed certificate and store it in the keystore. If an account with the certificate authority does not exist, then it will be automatically created.

```
/subsystem=elytron/key-store=KEYSTORE:obtain-certificate(alias=ALIAS,domain-names=[DOMAIN_NAME],certificate-authority-account=CERTIFICATE_ACCOUNT,agree-to-terms-of-service=true,algorithm=RSA,credential-reference={clear-text=secret})
```

Revoke a signed certificate.
The `revoke-certificate` command revokes a certificate that was issued by the certificate authority.

```
/subsystem=elytron/key-store=KEYSTORE:revoke-certificate(alias=ALIAS,certificate-authority-account=CERTIFICATE_ACCOUNT)
```

Check if a signed certificate is due for renewal.
The `should-renew-certificate` command determines if a certificate is due for renewal. The command returns `true` if the certificate expires in less than the given number of days, and `false` otherwise.

The following command determines if the certificate expires in the next 7 days.

```
/subsystem=elytron/key-store=KEYSTORE:should-renew-certificate(alias=ALIAS,expiration=7)
```

Keystore Certificate Authority Operations Using the Management Console
To perform the operations using the management console:

1. Access the management console.
   For more information, see the Management Console section in the JBoss EAP Configuration Guide.


3. Click Key Store to open the keystore definitions page.

4. Click Aliases next to the required keystore name.

5. Click the required alias name.
   You can perform the following operations for the selected alias by clicking on the buttons with the labels:

   - **Change Alias**
     Change the alias for the entry.

   - **Export Certificate**
     Export a certificate from a keystore entry to a file.

   - **Generate CSR**
     Generate a certificate signing request.

   - **Remove Alias**
     Remove the selected alias from the keystore.
Details
View the details of the certificate associated with the alias.

Revoke
Revoke the certificate associated with the alias.

Verify Renew
Determine if the associated certificate is due for renewal.

1.11.15. Configuring Evidence Decoder for X.509 Certificate with Subject Alternative Name Extension

By default, the principal associated with an X.509 certificate in Elytron is the subject name in the certificate and the principal associated with an X.509 certificate chain is the subject name in the first certificate in a certificate chain. You can configure an X509-subject-alt-name-evidence-decoder to use subject alternative name extension in an X.509 certificate as the principal.

The subject alternative name extension specification for an X.509 certificate and an X.509 certificate chain is defined in RFC 5280.

Prerequisites
- You know the expected format of a client certificate, or you have a client certificate available locally.

Procedure

1. Identify which subject alternative name extension to use.
   If you have the client certificate locally, the subject alternative name extension can be viewed using the keytool command:

   ```
   keytool -printcert -file /path/to/certificate/certificate.cert
   ```

   The subject alternative name extension is listed as:

   ```
   SubjectAlternativeName [ 
   DNS:one.example.org  
   IP Address:127.0.0.1  
   ]
   ```

   2. Create an x509-subject-alt-name-evidence-decoder to use the identified subject alternative name:

   ```
   /subsystem=elytron/x509-subject-alt-name-evidence-decoder=exampleDnsDecoder:add(alt-name-type=__EXTENSION_TO_USE__)
   ```

   - To use the evidence decoder, reference it in a security-domain:

   ```
   /subsystem=elytron/security-domain=__Security_Domain_Name__:write-attribute(name="evidence-decoder",value="exampleDnsDecoder")
   ```

Additional resources
1.11.16. Configuring an Aggregate Evidence Decoder

You can configure an aggregate evidence decoder to combine two or more evidence decoders. The evidence decoders are applied in the configured order until an evidence decoder returns a non-null principal or until there are no more evidence decoders left to try.

Prerequisites

- The evidence decoders to be aggregated are configured.
  For information about configuring evidence decoder, see Configuring Evidence Decoder for X.509 Certificate with Subject Alternative Name Extension.

Procedure

1. Create an aggregate evidence decoder from existing the evidence decoders:

   /subsystem=elytron/aggregate-evidence-decoder=aggregateDecoder:add(evidence-decoders=[__DECODER_1__,__DECODER_2__,...,__DECODER_N__])

- To use the evidence decoder, reference it in a security domain:

   /subsystem=elytron/security-domain=__SECURITY_DOMAIN__/write-attribute(name="evidence-decoder",value="aggregateDecoder")

1.11.17. Configuring X.500 Subject Evidence Decoder

Configure x500-subject-evidence-decoder to extract the subject from the first certificate in a certificate chain.

Procedure

- Create an x.500 subject evidence decoder:

   /subsystem=elytron/x500-subject-evidence-decoder=exampleSubjectDecoder:add()

1.11.18. Using Custom Evidence Decoder Implementation

You can use a custom org.wildfly.security.auth.server.EvidenceDecoder implementation in Elytron by adding it as a module to JBoss EAP.

Procedure

1. Package the custom implementation class as a Java Archive (JAR).

2. Add a module to JBoss EAP containing the JAR.
   For information about adding modules to JBoss EAP, see Create a Custom Module section in the Configuration Guide.

3. Add the custom evidence decoder to Elytron:
CHAPTER 2. SECURING USERS OF THE SERVER AND ITS MANAGEMENT INTERFACES

2.1. USER AUTHENTICATION WITH ELYTRON

2.1.1. Default Configuration

By default, the JBoss EAP management interfaces are secured by the legacy core management authentication.

Example: Default Configuration

```
/core-service=management/management-interface=http-interface:read-resource()
{
  "outcome" => "success",
  "result" => {
    "allowed-origins" => undefined,
    "console-enabled" => true,
    "http-authentication-factory" => undefined,
    "http-upgrade" => {"enabled" => true},
    "http-upgrade-enabled" => true,
    "sasl-protocol" => "remote",
    "secure-socket-binding" => undefined,
    "security-realm" => "ManagementRealm",
    "server-name" => undefined,
    "socket-binding" => "management-http",
    "ssl-context" => undefined
  }
}
```

JBoss EAP does provide management-http-authentication and management-sasl-authentication in the elytron subsystem for securing the management interfaces as well.

To update JBoss EAP to use the default Elytron components:

1. Set http-authentication-factory to use management-http-authentication:

2. Set sasl-authentication-factory to use management-sasl-authentication:
   `/core-service=management/management-interface=http-interface:write-attribute(name=http-upgrade.sasl-authentication-factory, value=management-sasl-authentication)`

3. Undefine security-realm:
   `/core-service=management/management-interface=http-interface:undefined-attribute(name=security-realm)`

4. Reload JBoss EAP for the changes to take affect:
   `reload`
The management interfaces are now secured using the default components provided by the elytron subsystem.

2.1.1.1. Default Elytron HTTP Authentication Configuration

When you access the management interface over http, for example when using the web-based management console, JBoss EAP will use the management-http-authentication http-authentication-factory.

```json
/subsystem=elytron/http-authentication-factory=management-http-authentication:read-resource()
{
  "outcome" => "success",
  "result" => {
    "http-server-mechanism-factory" => "global",
    "mechanism-configurations" => [{
      "mechanism-name" => "DIGEST",
      "mechanism-realm-configurations" => [{"realm-name" => "ManagementRealm"}]
    }],
    "security-domain" => "ManagementDomain"
  }
}
```

The management-http-authentication http-authentication-factory, is configured to use the ManagementDomain security domain.

```json
/subsystem=elytron/security-domain=ManagementDomain:read-resource()
{
  "outcome" => "success",
  "result" => {
    "default-realm" => "ManagementRealm",
    "permission-mapper" => "default-permission-mapper",
    "post-realm-principal-transformer" => undefined,
    "pre-realm-principal-transformer" => undefined,
    "principal-decoder" => undefined,
    "realm-mapper" => undefined,
    "realms" => [  
      {  
        "realm" => "ManagementRealm",
        "role-decoder" => "groups-to-roles"
      },
      {  
        "realm" => "local",
        "role-mapper" => "super-user-mapper"
      }
    ],
    "role-mapper" => undefined,
    "trusted-security-domains" => undefined
  }
}
```

The ManagementDomain security domain is backed by the ManagementRealm Elytron security realm, which is a properties-based realm.
IMPORTANT

A properties-based realm is only read when the server starts. Any users added after server start, either manually or by using an `add-user` script, will require a server reload. This reload is accomplished by running the `reload` command from the management CLI.

```
reload
```

```
/subsystem=elytron/properties-realm=ManagementRealm:read-resource()
{
  "outcome" => "success",
  "result" => {
    "groups-attribute" => "groups",
    "groups-properties" => {
      "path" => "mgmt-groups.properties",
      "relative-to" => "jboss.server.config.dir"
    },
    "plain-text" => false,
    "users-properties" => {
      "path" => "mgmt-users.properties",
      "relative-to" => "jboss.server.config.dir"
    }
  }
}
```

2.1.1.2. Default Elytron Management CLI Authentication

By default, the management CLI (`jboss-cli.sh`) is configured to connect over `remote+http`.

Example: Default `jboss-cli.xml`

```
<jboss-xmlns="urn:jboss:cli:3.1">
  <default-protocol use-legacy-override="true">remote+http</default-protocol>
  <!-- The default controller to connect to when 'connect' command is executed w/o arguments -->
  <default-controller>
    <protocol>remote+http</protocol>
    <host=localhost</host>
    <port>9990</port>
  </default-controller>
</jboss-xmlns>
```

This will establish a connection over HTTP and use HTTP upgrade to change the communication protocol to Remoting. The HTTP upgrade connection is secured in the `http-upgrade` section of the `http-interface` using a `sasl-authentication-factory`.

Example: Configuration with Default Components

```
/core-service=management/management-interface=http-interface:read-resource()
{
  "outcome" => "success",
  "result" => {
    "allowed-origins" => undefined,
```

120
The default sasl-authentication-factory is **management-sasl-authentication**.

The **management-sasl-authentication** sasl-authentication-factory specifies **JBoss-Local-User** and **DIGEST-MD5** mechanisms.

The **ManagementRealm** Elytron security realm, used in **DIGEST-MD5**, is the same realm used in the **management-http-authentication** http-authentication-factory.

**Example: JBOSS-LOCAL-USER Realm**
The local Elytron security realm is for handling silent authentication for local users.

2.1.2. Secure the Management Interfaces with a New Identity Store

1. Create a security domain and any supporting security realms, decoders, or mappers for your identity store. This process is covered in the Elytron Subsystem section of JBoss EAP How to Configure Identity Management Guide. For example, if you wanted to secure the management interfaces using a filesystem-based identity store, you would follow the steps in Configure Authentication with a Filesystem-based Identity Store.

2. Create an http-authentication-factory or sasl-authentication-factory.

Example: http-authentication-factory

```xml
/subsystem=elytron/http-authentication-factory=example-http-auth:add(http-server-mechanism-factory=global, security-domain=exampleSD, mechanism-configurations=[{mechanism-name=DIGEST, mechanism-realm-configurations=[{realm-name=exampleManagementRealm}]}])
```

Example: sasl-authentication-factory

```xml
/subsystem=elytron/sasl-authentication-factory=example-sasl-auth:add(sasl-server-factory=configured, security-domain=exampleSD, mechanism-configurations=[{mechanism-name=DIGEST-MD5, mechanism-realm-configurations=[{realm-name=exampleManagementRealm}]}])
```

3. Add pattern-filter to the configured configurable-sasl-server-factory.

Example: Add GSSAPI to the Configured configurable-sasl-server-factory

```xml
/subsystem=elytron/configurable-sasl-server-factory=configured:list-add(name=filters, value= {pattern-filter=GSSAPI})
```

This is an optional step. When a client attempts to connect to the HTTP management interfaces, JBoss EAP sends back an HTTP response with a status code of 401 Unauthorized, and a set of headers that list the supported authentication mechanisms, for example, Digest, GSSAPI, and so on. For more information, see the Local and Remote Client Authentication with the HTTP Interface section in the JBoss EAP Security Architecture guide.

4. Update the management interfaces to use your http-authentication-factory or sasl-authentication-factory.

Example: Update http-authentication-factory

```xml
/core-service=management/management-interface=http-interface:write-attribute(name=http-authentication-factory, value=example-http-auth)
```

Example: Update sasl-authentication-factory

```xml
/core-service=management/management-interface=http-interface:write-attribute(name=http-
NOTE

When using legacy core management authentication, you can only secure the http management interface with a single legacy security realm. This forces the HTTP and SASL configuration to appear in a single legacy security realm. When using the `elytron` subsystem, you can configure the `http-authentication-factory` and `sasl-authentication-factory` separately, allowing you to use distinct security domains for securing the HTTP and SASL mechanisms of the http management interface.

NOTE

If two different attributes with similar implementation in legacy security and Elytron, respectively, are configured in the management interface, only the Elytron related configurations are used. For example, if `security-realm` for legacy security and `http-authentication-factory` for Elytron are configured, then authentication is handled by `http-authentication-factory` configuration.

NOTE

When the management interface includes both `http-authentication-factory`, or `sasl-authentication-factory` for the HTTP interface, as well as the `security-realm`, and the `ssl-context` attribute is not used, the authentication is handled by Elytron and the SSL is handled by the legacy security realm.

When the management interface includes both the `security-realm` and the `ssl-context`, and the `http-authentication-factory` or `sasl-authentication-factory` for the HTTP interface is not used, then authentication is handled by the legacy security realm and SSL is handled by Elytron.

2.1.3. Adding Silent Authentication

By default, JBoss EAP provides an authentication mechanism for local users, also know as silent authentication, through the `local` security realm. You can find more details on silent authentication in the Silent Authentication section.

Silent authentication must be added to a `sasl-authentication-factory`.

To add silent authentication to an existing `sasl-authentication-factory`:

```
/subsystem=elytron/sasl-authentication-factory=example-sasl-auth:list-add(name=mechanism-configurations, value={mechanism-name=JBOSS-LOCAL-USER, realm-mapper=local})
```

```
reload
```

To create a new `sasl-server-factory` with silent authentication:

```
/subsystem=elytron/sasl-authentication-factory=example-sasl-auth:add(sasl-server-factory=configured,security-domain=ManagementDomain,mechanism-configurations=[[mechanism-name=DIGEST-MD5,mechanism-realm-configurations=[[realm-name=exampleManagementRealm]]]])
```

{mechanism-name=JBOSS-LOCAL-USER, realm-mapper=local})

reload

NOTE

The above example uses the existing ManagementDomain security domain, but you can also create and use other security domains. You can find more examples of creating security domains in the Elytron Subsystem section of the JBoss EAP How to Configure Identity Management Guide.

IMPORTANT

If the Elytron security is used and an authentication attempt comes in using the JBOSS-LOCAL-USER SASL mechanism with an authentication name that does not correspond to a real identity, authentication fails.

Choosing a custom user name for JBOSS-LOCAL-USER is possible with legacy security subsystem. There the authentication proceeds by mapping the user name to a special identity.

2.1.4. Mapping Identity for Authenticated Management Users

When using the elytron subsystem to secure the management interfaces, you can provide a security domain to the management interfaces for identity mapping of authenticated users. This allows authenticated users to appear with the appropriate identity when logged into the management interfaces.

The application server exposes more than one kind of management interface. Each type of interface can be associated with an independent authentication-factory to handle the authentication requirements of that interface.

To make the authorization decision, the current security identity is obtained from the security domain. The returned security identity has the role mapping and permission assignment, based on the rules defined within that security domain.

NOTE

In most cases, a common security domain is used for all management; for authentication of the management interfaces as well as for obtaining the security identity used for the authorization decisions. In these cases, the security domain is associated with the authentication factory of the management interface and no special access=identity needs to be defined.

In some cases, a different security domain is used to obtain the identity for the authorization decisions. Here, the access=identity resource is defined. It contains a reference to a security domain to obtain the identity for authorization.

The below example assumes you have secured the management interfaces with the exampleSD Elytron security domain and have it exposed as exampleManagementRealm.

To define the identity mapping, add the identity resource to the management interfaces.

Example: Add the identity Resource
Once you have added the `identity` resource, the identity of an authenticated user will appear when accessing the management interfaces. When the `identity` resource is not added, then the identity of the security domain used for authentication is used.

For example, if you logged into the management CLI as `user1`, your identity will properly appear.

**Example: Display the Identity of an Authenticated User from the Management CLI**

```
:whoami
{
    "outcome" => "success",
    "result" => {"identity" => {"username" => "user1"}}
}
```

**IMPORTANT**

If the `identity` resource is added and legacy security realms are used to secure the management interfaces, authenticated users will always have the `anonymous` identity. Once the `identity` resource is removed, users authenticated from the legacy security realms will appear with the appropriate identity.

Authorization for management operation always uses the security domain, which is the domain specified on `access=identity`. If not specified, it is the domain used for authentication. Any role mapping is always in the context of the security domain.

The `identity` resource for the current request will return a set of roles as mapped using the Elytron configuration. When an RBAC based role mapping definition is in use, the roles from the `identity` resource will be taken as groups and fed into the management `RoleMapping` to obtain the management roles for the current request.

**Table 2.1. Identity to be Used for Different Scenarios**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>No access=identity definition</th>
<th>access=identity referencing an Elytron security-domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTP management interface using legacy security-realm</td>
<td>Identity from connection.</td>
<td>Unsupported or anonymous identity.</td>
</tr>
<tr>
<td>HTTP management interface using elytron HTTP authentication factory backed by security-domain</td>
<td>Identity from connection.</td>
<td>Identity from referenced security-domain if it was successfully inflowed.</td>
</tr>
<tr>
<td>Native management, including over HTTP Upgrade, interface using legacy security-realm</td>
<td>Identity from connection.</td>
<td>Unsupported or anonymous identity.</td>
</tr>
</tbody>
</table>
Native management, including over HTTP Upgrade, interface using elytron SASL authentication factory backed by security-domain identity from connection. Identity from referenced security-domain if it was successfully inflowed.

**NOTE**

If security domain used in the identity resource does not trust the security domain from authentication, anonymous identity is used.

The security domain used in the identity resource does not need to trust the security domain from authentication, when both are using an identical security realm.

The trusted security domains is not transitive.

Where no access=identity resource is defined, then the identity established during authentication against the management interface will be used. Identities established using connections, through the remoting subsystem or using applications, will not be usable in this case.

Where an access=identity resource is defined but the security domain used by the management interfaces is different and not listed in the list of domains to inflow from, no identity will be established. An inflow will be attempted using the identity established during authentication. Identities established using connections through the remoting subsystem or using applications will not be inflowed in this way.

**IMPORTANT**

Where the management interfaces are secured using the legacy security realms, the identity will not be sharable across different security domains. In that case no access=identity resource should be defined. So the identity established during authentication can be used directly. Thus, applications secured using PicketBox are not supported for the identity resource.

**2.1.5. Using Elytron Client with the Management CLI**

You can configure the management CLI to use Elytron Client for providing security information when connecting to JBoss EAP.

1. Secure the management interfaces with Elytron.
   In order to use Elytron Client with the management CLI, you must secure the management interfaces with Elytron. You can find more details on securing the management interfaces with Elytron in User Authentication with Elytron.

2. Create an Elytron Client configuration file.
   You need to create an Elytron Client configuration file that houses your authentication configuration as well as rules for using that configuration. You can find more details on creating an authentication configuration in the The Configuration File Approach section of the JBoss EAP How to Configure Identity Management Guide.

   **Example:** custom-config.xml
3. Use the Elytron Client configuration file with management CLI script.

   $ ./jboss-cli.sh -c -Dwildfly.config.url=/path/to/custom-config.xml

### 2.2. IDENTITY PROPAGATION AND FORWARDING WITH ELYTRON

#### 2.2.1. Propagating Security Identities for Remote Calls

JBoss EAP 7.1 introduced the ability to easily configure the server and your applications to propagate a security identity from a client to the server for remoting calls. You can also configure server components to run within the security identity of a given user.

The example in this section demonstrates how to forward security identity credentials. It propagates the security identity of a client and an Jakarta Enterprise Beans to a remote Jakarta Enterprise Beans. It returns a string containing the name of the Principal that called the remote Jakarta Enterprise Beans along with the user’s authorized role information. The example consists of the following components.

- A secured Jakarta Enterprise Beans that contains a single method, accessible by all users, that returns authorization information about the caller.
- An intermediate Jakarta Enterprise Beans that contains a single method. It makes use of a remote connection and invokes the method on the secured Jakarta Enterprise Beans.
- A remote standalone client application that invokes the intermediate Jakarta Enterprise Beans.
- A META-INF/wildfly-config.xml file that contains the identity information used for authentication.

You must first enable security identity propagation by configuring the server. Next review the example application code that uses the WildFlyInitialContextFactory to look up and invoke the remote Jakarta Enterprise Beans.
Configure the Server for Security Propagation

1. Configure the **ejb3** subsystem to use the Elytron **ApplicationDomain**.

   ```xml
   /subsystem=ejb3/application-security-domain=quickstart-domain:add(security-domain=ApplicationDomain)
   ``

   This adds the following **application-security-domain** configuration to the **ejb3** subsystem.

   ```xml
   <subsystem xmlns="urn:jboss:domain:ejb3:5.0">
     ....
     <application-security-domains>
       <application-security-domain name="quickstart-domain" security-domain="ApplicationDomain"/>
     </application-security-domains>
   </subsystem>
   ``

2. Add the **PLAIN** authentication configuration to send plain text user names and passwords, and the authentication context that is to be used for outbound connections. See [Mechanisms That Support Security Identity Propagation](#) for the list of mechanisms that support identity propagation.

   ```xml
   /subsystem=elytron/authentication-configuration=ejb-outbound-configuration:add(security-domain=ApplicationDomain,sasl-mechanism-selector="PLAIN")
   /subsystem=elytron/authentication-context=ejb-outbound-context:add(match-rules=[[authentication-configuration=ejb-outbound-configuration]])
   ``

   This adds the following **authentication-client** configuration to the **elytron** subsystem.

   ```xml
   <subsystem xmlns="urn:wildfly:elytron:4.0" final-providers="combined-providers" disallowed-providers="OracleUcrypto">
     <authentication-client>
       <authentication-configuration name="ejb-outbound-configuration" security-domain="ApplicationDomain" sasl-mechanism-selector="PLAIN"/>
       <authentication-context name="ejb-outbound-context"/>
     </authentication-client>
     ....
   </subsystem>
   ``

3. Add the remote destination outbound socket binding to the **standard-sockets** socket binding group.

   ```xml
   /socket-binding-group=standard-sockets/remote-destination-outbound-socket-binding=ejb-outbound:add(host=localhost,port=8080)
   ``

   This adds the following **ejb-outbound** outbound socket binding to the **standard-sockets** socket binding group.

   ```xml
   <socket-binding-group name="standard-sockets" default-interface="public" port-offset="${jboss.socket.binding.port-offset:0}">
     ....
     <outbound-socket-binding name="ejb-outbound"/>
   </socket-binding-group>
   ```
4. Add the remote outbound connection and set the SASL authentication factory in the HTTP connector.

```
/subsystem=remoting/remote-outbound-connection=ejb-outbound-connection:add(outbound-socket-binding-ref=ejb-outbound, authentication-context=ejb-outbound-context)
/subsystem=remoting/http-connector=http-remoting-connector:write-attribute(name=sasl-authentication-factory,value=application-sasl-authentication)
```

This adds the following `http-remoting-connector` and `ejb-outbound-connection` configuration to the `remoting` subsystem.

```
<subsystem xmlns="urn:jboss:domain:remoting:4.0">
  ....
  <http-connector name="http-remoting-connector" connector-ref="default" security-realm="ApplicationRealm" sasl-authentication-factory="application-sasl-authentication"/>
  <outbound-connections>
    <remote-outbound-connection name="ejb-outbound-connection" outbound-socket-binding-ref="ejb-outbound" authentication-context="ejb-outbound-context"/>
  </outbound-connections>
</subsystem>
```

5. Configure the Elytron SASL authentication to use the PLAIN mechanism.

```
/subsystem=elytron/sasl-authentication-factory=application-sasl-authentication:write-attribute(name=mechanism-configurations,value=:{mechanism-name=PLAIN},{mechanism-name=JBOSS-LOCAL-USER,realm-mapper=local},{mechanism-name=DIGEST-MD5,mechanism-realm-configurations=:[{realm-name=ApplicationRealm}]})
```

This adds the following `application-sasl-authentication` configuration to the `elytron` subsystem.

```
<subsystem xmlns="urn:wildfly:elytron:4.0" final-providers="combined-providers" disallowed-providers="OracleUcrypto">
  ....
  <sasl>
    ....
    <sasl-authentication-factory name="application-sasl-authentication" sasl-server-factory="configured" security-domain="ApplicationDomain">
      <mechanism-configuration>
        <mechanism mechanism-name="PLAIN"/>
        <mechanism mechanism-name="JBOSS-LOCAL-USER" realm-mapper="local"/>
        <mechanism mechanism-name="DIGEST-MD5">
          <mechanism realm-name="ApplicationRealm"/>
        </mechanism>
      </mechanism-configuration>
    </sasl-authentication-factory>
  </sasl>
  ....
</subsystem>
```
The server is now configured to enable security propagation for the following example application.

**Review the Example Application Code That Propagates a Security Identity**

Once security identity propagation is enabled in the server configuration, the Jakarta Enterprise Beans client application can use the `WildFlyInitialContextFactory` to look up and invoke the Jakarta Enterprise Beans proxy. The Jakarta Enterprise Beans is invoked as the user that authenticated in the client example shown below. The following abbreviated code examples are taken from the `ejb-security-context-propagation` quickstart that ships with JBoss EAP 7.4. See that quickstart for a complete working example of security identity propagation.

To invoke the Jakarta Enterprise Beans as a different user, you can set the `Context.SECURITY_PRINCIPAL` and `Context.SECURITY_CREDENTIALS` in the context properties.

### Example: Remote Client

```java
public class RemoteClient {

    public static void main(String[] args) throws Exception {
        // invoke the intermediate bean using the identity configured in wildfly-config.xml
        invokeIntermediateBean();

        // now lets programmatically setup an authentication context to switch users before invoking the intermediate bean
        AuthenticationConfiguration superUser = AuthenticationConfiguration.empty().setSaslMechanismSelector(SaslMechanismSelector.NONE.addMechanism("PLAIN"));
        superUser.useName("superUser").usePassword("superPwd1!");
        final AuthenticationContext authCtx = AuthenticationContext.empty().with(MatchRule.ALL, superUser);

        AuthenticationContext.getContextManager().setThreadDefault(authCtx);
        invokeIntermediateBean();
    }

    private static void invokeIntermediateBean() throws Exception {
        final Hashtable<String, String> jndiProperties = new Hashtable<>();
        jndiProperties.put(Context.INITIAL_CONTEXT_FACTORY, "org.wildfly.naming.client.WildFlyInitialContextFactory");
        jndiProperties.put(Context.PROVIDER_URL, "remote+http://localhost:8080");
        final Context context = new InitialContext(jndiProperties);
        + IntermediateEJBRemote.class.getName());
        // Call the intermediate EJB
        System.out.println(intermediate.makeRemoteCalls());
    }
}
```

### Example: Intermediate Jakarta Enterprise Beans

```java
@Stateless
@Remote(IntermediateEJBRemote.class)
@SecurityDomain("quickstart-domain")
@PermitAll
public class IntermediateEJB implements IntermediateEJBRemote {
```
Example: Secured Jakarta Enterprise Beans

@Stateless
@Remote(SecuredEJBRemote.class)
@SecurityDomain("quickstart-domain")
public class SecuredEJB implements SecuredEJBRemote {

@Resource
private SessionContext context;

@PermitAll
public String getSecurityInformation() {
    StringBuilder sb = new StringBuilder("[");
    sb.append("Principal=").append(context.getCallerPrincipal().getName()).append("], ");
    userInRole("guest", sb).append(" ", ");
    userInRole("user", sb).append(" ", ");
    userInRole("admin", sb).append(""");
    return sb.toString();
}

Example: wildfly-config.xml File

<?xml version="1.0" encoding="UTF-8"?>
<configuration>
2.2.2. Utilizing Authorization Forwarding Mode

In addition to credential forwarding, Elytron supports the trusted use of identities between peers. This can be useful in the following cases.

- Requirements are such that you cannot send passwords over the wire.
- The authentication type is one that does not support credential forwarding.
- The environment requires a need to limit which systems are allowed to receive the propagated requests.

To utilize authorization forwarding, you first configure an authentication client on the forwarding server and then configure the receiving server to accept and handle the authorization.

Configure the Authentication Client on the Forwarding Server
To enable authorization forwarding, you must configure an authentication client configuration in the forwarding server configuration.

The following management CLI commands create a default authentication client configuration to enable authentication forwarding. You can configure a more advanced rule based selection if you need one.

Example: Management CLI Command to Create the Authentication Client Configuration

```
/subsystem=elytron/authentication-configuration=forwardit:add(authentication-name=theserver1,security-domain=ApplicationDomain,realm=ApplicationRealm,forwarding-mode=authorization,credential-reference={clear-text=thereallysecretpassword})
/subsystem=elytron/authentication-context=forwardctx:add(match-rules=[{authentication-configuration=forwardit,match-no-user=true}])
```

These commands add the following `authentication-configuration` and `authentication-context` configuration to the `elytron` subsystem.

Example: Authentication Client Configuration
When the forwarding server contacts the receiving server, instead of using the default authentication-based user name and credentials, it uses the predefined server login name `theserver1` to establish the trust relationship.

**Configure the Authorization Forwarding on the Receiving Server**

For the forwarding to complete successfully, the receiving server configuration needs to be configured with the identity matching the one passed by the forwarding server. In this case, you must configure a user named `theserver1` on the receiving server with the correct credentials.

You must also configure a "RunAs" permission mapping in the `elytron` subsystem to allow the identity switch for the `theserver1` identity that is passed from the forwarding server. For more information about permission mapping, see Create an Elytron Permission Mapper in How to Configure Server Security for JBoss EAP.

The command below adds a `simple-permission-mapper` named `auth-forwarding-permission-mapper` that includes the following configurations.

- A permission mapping for the user `anonymous`. This user has no permissions, which prevents an anonymous user from being able to log in.

- A permission mapping for the user `theserver1`. This user is assigned the `RunAsPrincipalPermission` permission of `*`, which gives this user global permissions to run as any identity. You can restrict the permission to a specific identity if you prefer.

- A permission mapping for all other users.

**Example: Management CLI Command to the Create Simple Permission Mapper**

```
$subsystem=elytron/permission-set=run-as-principal-permission:add(permissions=[{class-name="org.wildfly.security.auth.permission.RunAsPrincipalPermission",target-name="*"}])
```

```
$subsystem=elytron/simple-permission-mapper=auth-forwarding-permission-mapper:add(permission-mappings=[{principals=["anonymous"],permission-sets=[{permission-set=login-permission},{permission-set=default-permissions},{permission-set=run-as-principal-permission}],match-all=true,permission-sets=[{permission-set=login-permission},{permission-set=default-permissions}]}])
```

This command adds the following `simple-permission-mapper` configuration to the `elytron` subsystem.

**Example: Simple Permission Mapper Configuration**

```
<mappers>
  <simple-permission-mapper name="auth-forwarding-permission-mapper">
    <permission-mapping>
      <principal name="anonymous"/>
  </permission-mapping>
</simple-permission-mapper>
```
NOTE

The login-permission and default-permissions permission sets are already present in the default configuration.

In cases where principal transformers are used after forwarding authorization, then those transformers are applied on both the authentication and the authorization principals.

2.2.3. Creating a case-principal-transformer to change the case characters of your principal username

The elytron subsystem includes the case-principal-transformer principal transformer. You can use this principal transformer to change a principal’s username to either uppercase or lowercase characters.

The case-principal-transformer principal transformer includes the upper-case attribute that is set as true by default.

To demonstrate a use case for case-principal-transformer, consider that you are using an authentication mechanism to map a principal to a security realm. A realm mapper manipulates the mapped principal to identify a security realm and load one of its identities. The authentication mechanism passes the identity to a post-realm mapping stage and to a final principal transformation.
stage. Subsequently, the authentication mechanism verifies the identity for authentication purposes. You can use a **case-principal-transformer** principal transformer to convert the character case format of your mapped principal.

The example in the procedure uses the **case-principal-transformer** in the context of a security domain. You can also use the principal transformer inline with the following authentication policies:

- http-authentication-factory
- sasl-authentication-factory
- ssl-context
- aggregate-realm

**Procedure**

1. Add the **case-principal-transformer** to the **elytron** subsystem, and choose the character case for the username.

   a. To change the username of a transformer to uppercase characters, do not change the default **upper-case** attribute value.

      Example showing `<transformer_name>` added to the **elytron** subsystem with the default **upper-case** attribute setting defined:

      ```
      /subsystem=elytron/case-principal-transformer=<transformer_name>:add(upper-case="true")
      ```

      Alternatively, you can truncate the command syntax to use the default **upper-case** attribute value:

      ```
      /subsystem=elytron/case-principal-transformer=<transformer_name>:add()
      ```

   b. To change the username of a transformer to lowercase characters, set the **upper-case** attribute to **false**.

      Example showing `<transformer_name>` added to the **elytron** subsystem with the **upper-case** attribute set to **false**:

      ```
      /subsystem=elytron/case-principal-transformer=<transformer_name>:add(upper-case="false")
      ```

2. **Optional**: Use the **elytron** subsystem to configure your principal transformer. The following example configured a principal transformer to the default **ApplicationDomain** configuration that was provided by the **elytron** subsystem. Elytron applies the default **ApplicationDomain** configuration to a **pre-realm-principal-transformer**:

   ```
   /subsystem=elytron/security-domain=ApplicationDomain:write-attribute(name=pre-realm-principal-transformer,value=<transformer_name>)
   ```
NOTE

You can configure a `post-realm-principal-transformer` to use the `ApplicationDomain` configuration after a security realm has been identified by a realm mapper.

Additional resources

- For information about the `upper-case` attribute, see Table A.26 `case-principal-transformer` attributes.

2.2.4. Retrieving Security Identity Credentials

There might be situations where you need to retrieve identity credentials for use in outgoing calls, for example, by an HTTP client. The following example demonstrates how to retrieve security credentials programmatically.

```java
import org.wildfly.security.auth.server.IdentityCredentials;
import org.wildfly.security.auth.server.SecurityDomain;
import org.wildfly.security.auth.server.SecurityIdentity;
import org.wildfly.security.credential.PasswordCredential;
import org.wildfly.security.password.interfaces.ClearPassword;

SecurityIdentity securityIdentity = null;
ClearPassword password = null;

// Obtain the SecurityDomain for the current deployment.
// The calling code requires the
// org.wildfly.security.permission.ElytronPermission("getSecurityDomain") permission
// if running with a security manager.
SecurityDomain securityDomain = SecurityDomain.getCurrent();
if (securityDomain != null) {
    // Obtain the current security identity from the security domain.
    // This always returns an identity, but it could be the representation
    // of the anonymous identity if no authenticated identity is available.
    securityIdentity = securityDomain.getCurrentSecurityIdentity();
    // The private credentials can be accessed to obtain any credentials delegated to the identity.
    // The calling code requires the
    // org.wildfly.security.permission.ElytronPermission("getPrivateCredentials")
    // permission if running with a security manager.
    IdentityCredentials credentials = securityIdentity.getPrivateCredentials();
    if (credentials.contains(PasswordCredential.class)) {
        password = credentials.getCredential(PasswordCredential.class).getPassword(ClearPassword.class);
    }
}
```

2.2.5. Mechanisms That Support Security Identity Propagation

The following SASL mechanisms support propagation of security identities:

- **PLAIN**
- **OAUTHBEARER**
The following HTTP mechanisms support propagation of security identities:

- **FORM**
- **BASIC**
- **BEARER_TOKEN**
- **SPNEGO**

1 **FORM** authentication is not automatically handled by the web browser. For this reason, you cannot use identity propagation with web applications that use **FORM** authentication when running in an HA cluster. Other mechanisms, such as **BASIC** and **SPNEGO**, support identity propagation in an HA cluster environment.

### 2.3. IDENTITY SWITCHING WITH ELYTRON

#### 2.3.1. Switching Identities in Server-to-server Jakarta Enterprise Beans Calls

By default, when you make a remote call to a Jakarta Enterprise Beans deployed to an application server, the identity used for authentication on the remote server is the same one that was used on the source server. In some cases, you might want to run the remote secured Jakarta Enterprise Beans within the security context of a different identity.

You can use the Elytron API to switch identities in server-to-server Jakarta Enterprise Beans calls. When you do that, the request received over the connection is executed as a new request, using the identity specified programmatically in the API call.

The following code example demonstrates how to switch the identity that is used for authentication on a remote Jakarta Enterprise Beans. The **remoteUsername** and **remotePassword** arguments passed in the **securityDomain.authenticate()** method are the identity credentials that are to be used for authentication on the target server.

**Example: Switching Identities in Server-to-server Jakarta Enterprise Beans Calls**

```java
SecurityDomain securityDomain = SecurityDomain.getCurrent();
Callable<T> forwardIdentityCallable = () -> {
    return AuthenticationContext.empty()
        .with(MatchRule.ALL,
            AuthenticationConfiguration.empty()
                .setSaslMechanismSelector(SaslMechanismSelector.ALL)
                .useForwardedIdentity(securityDomain))
        .runCallable(callable);
};
securityDomain.authenticate(remoteUsername, new PasswordGuessEvidence(remotePassword.toCharArray())).runAs(forwardIdentityCallable);
```
2.4. USER AUTHENTICATION WITH LEGACY CORE MANAGEMENT AUTHENTICATION

2.4.1. Default User Configuration

All management interfaces in JBoss EAP are secured by default and users can access them in two different ways: local interfaces and remote interfaces. The basics of both of these authentication mechanisms are covered in the Default Security and JBoss EAP Out of the Box sections of the JBoss EAP Security Architecture guide. By default, access to these interfaces is configured in the Management Realm security realm. Initially, the local interface is enabled and requires access to the host machine running the JBoss EAP instance. Remote access is also enabled and is configured to use a file-based identity store. By default it uses mgmt-users.properties file to store user names and passwords, and mgmt-groups.properties to store user group information.

User information is added to these files by using the included adduser script located in the EAP_HOME/bin/ directory.

To add a user via the adduser script:

1. Run the add-user.sh or add-user.bat command.
2. Choose whether to add a management user or application user.
3. Choose the realm the user will be added to. By default, the only available realms are ManagementRealm and ApplicationRealm. If a custom realm has been added, its name can be manually entered instead.
4. Type the desired user name, password, and optional roles when prompted. The changes are written to each of the properties files for the security realm.

2.4.2. Adding Authentication via LDAP

JBoss EAP also supports using LDAP authentication for securing the management interfaces. The basics of LDAP and how it works with JBoss EAP are covered in the LDAP, Using LDAP with the Management Interfaces, and Using LDAP with the ManagementRealm sections of the Red Hat JBoss Enterprise Application Platform 7 Security Architecture guide. For more specifics on how to secure the management interfaces using LDAP authentication, see the Securing the Management Interfaces with LDAP section of the JBoss EAP How to Configure Identity Management Guide.

2.4.3. Using JAAS for Securing the Management Interfaces

JAAS is a declarative security API used by JBoss EAP to manage security. For more details and background regarding JAAS and declarative security, see the Declarative Security and JAAS section of the Red Hat JBoss Enterprise Application Platform Security Architecture guide.

NOTE

When JBoss EAP instances are configured to run in ADMIN_ONLY mode, using JAAS to secure the management interfaces is not supported. For more information on ADMIN_ONLY mode, see the Running JBoss EAP in ADMIN_ONLY Mode section of the JBoss EAP Configuration Guide.

To use JAAS to authenticate to the management interfaces, the following steps must be performed:
1. Create a security domain.
   In this example, a security domain is created with the **UserRoles** login module, but other login modules may be used as well:

   ```
   /subsystem=security/security-domain=UsersLMDomain:add(cache-type=default)
   /subsystem=security/security-domain=UsersLMDomain/authentication=classic:add
   /subsystem=security/security-domain=UsersLMDomain/authentication=classic/login-module=UsersRoles:add(code=UsersRoles, flag=required,module-options= ["usersProperties"=>"users.properties"],"rolesProperties"=>"roles.properties")
   ```

2. Create a security realm with JAAS authentication.

   ```
   /core-service=management/security-realm=SecurityDomainAuthnRealm:add
   /core-service=management/security-realm=SecurityDomainAuthnRealm/authentication=jaas:add(name=UsersLMDomain)
   ```

3. Update the **http-interface** management interface to use new security realm.

   ```
   /core-service=management/management-interface=http-interface/:write-attribute(name=security-realm,value=SecurityDomainAuthnRealm)
   ```

4. **Optional**: Assign group membership.
   The attribute **assign-groups** determines whether loaded user membership information from the security domain is used for group assignment in the security realm. When set to **true**, this group assignment is used for Role-Based Access Control (RBAC).

   ```
   /core-service=management/security-realm=SecurityDomainAuthnRealm/authentication=jaas:write-attribute(name=assign-groups,value=true)
   ```

### 2.5. ROLE-BASED ACCESS CONTROL

The basics of Role-Based Access Control are covered in the Role-Based Access Control and Adding RBAC to the Management Interfaces sections of the JBoss EAP Security Architecture guide.

#### 2.5.1. Enabling Role-Based Access Control

By default the Role-Based Access Control (RBAC) system is disabled. It is enabled by changing the **provider** attribute from **simple** to **rbac**. **provider** is an attribute of the **access-control** element of the **management** element. This can be done using the management CLI or by editing the server configuration XML file if the server is offline. When RBAC is disabled or enabled on a running server, the server configuration must be reloaded before it takes effect.
WARNING

Before changing the provider to rbac, be sure your configuration has a user who will be mapped to one of the RBAC roles, preferably with at least one in the Administrator or SuperUser role. Otherwise your installation will not be manageable except by shutting it down and editing the XML configuration. If you have started with one of the standard XML configurations shipped with JBoss EAP, the $local user will be mapped to the SuperUser role and the local authentication scheme will be enabled. This will allow a user, running the CLI on the same system as the JBoss EAP process, to have full administrative permissions. Remote CLI users and web-based management console users will have no permissions.

It is recommended to map at least one user, besides $local, before switching the provider to rbac. You can do all of the configuration associated with the rbac provider even when the provider is set to simple.

Once enabled it can only be disabled by a user of the Administrator or SuperUser roles. By default the management CLI runs as the SuperUser role if it is run on the same machine as the server.

CLI to Enable RBAC

To enable RBAC with the management CLI, use the write-attribute operation of the access authorization resource to set the provider attribute to rbac.

```
/core-service=management/access=authorization:write-attribute(name=provider, value=rbac)
{
    "outcome" => "success",
    "response-headers" => {
        "operation-requires-reload" => true,
        "process-state" => "reload-required"
    }
}
```

reload

In a managed domain, the access control configuration is part of the domain wide configuration, so the resource address is the same as above, but the management CLI is connected to the master domain controller.

```
/core-service=management/access=authorization:write-attribute(name=provider, value=rbac)
{
    "outcome" => "success",
    "response-headers" => {
        "operation-requires-reload" => true,
        "process-state" => "reload-required"
    },
    "result" => undefined,
    "server-groups" => {"main-server-group" => {"host" => {"master" => {
        "server-one" => {"response" => {
            "outcome" => "success",
            "response-headers" => {
                "operation-requires-reload" => true,
            }},
        }
    }
```
NOTE

As with a standalone server, a reload or restart is required for the change to take effect. In a managed domain, all hosts and servers in the domain will need to be reloaded or restarted, starting with the master domain controller.

Management CLI Command to Disable RBAC

To disable RBAC with the management CLI, use the write-attribute operation of the access authorization resource to set the provider attribute to simple.

```
/core-service=management/access=authorization:write-attribute(name=provider, value=simple)
```

XML Configuration to Enable or Disable RBAC

If the server is offline the XML configuration can be edited to enable or disable RBAC. To do this, edit the provider attribute of the access-control element of the management element. Set the value to rbac to enable, and simple to disable.

Example: XML Configuration to Enable or Disable RBAC

```
<management>
  <access-control provider="rbac">
    <role-mapping>
      <role name="SuperUser">
        <include>
          <user name="$local"/>
        </include>
      </role>
    </role-mapping>
  </access-control>
</management>
```

2.5.2. Changing the Permission Combination Policy

The Permission Combination Policy determines how permissions are determined if a user is assigned more than one role. This can be set to permissive or rejecting. The default is permissive.

When set to permissive, if any role is assigned to the user that permits an action, then the action is allowed.
When set to **rejecting**, if multiple roles are assigned to a user, then no action is allowed. This means that when the policy is set to rejecting each user should only be assigned one role. Users with multiple roles will not be able to use the management console or the management CLI when the policy is set to rejecting.

The Permission Combination Policy is configured by setting the `permission-combination-policy` attribute to either **permissive** or **rejecting**. This can be done using the management CLI or by editing the server configuration XML file if the server is offline. The `permission-combination-policy` attribute is part of the `access-control` element and the `access-control` element can be found in the `management` element.

### Setting the Permission Combination Policy

Use the write-attribute operation of the access authorization resource to set the permission-combination-policy attribute to the required policy name.

```
/core-service=management/access=authorization:write-attribute(name=permission-combination-policy, value=POLICYNAME)
```

The valid policy names are **rejecting** and **permissive**.

#### Example: Management CLI Command for Rejecting Permission Combination Policy

```
/core-service=management/access=authorization:write-attribute(name=permission-combination-policy, value=rejecting)
```

If the server is offline the XML configuration can be edited to change the permission combination policy value. To do this, edit the `permission-combination-policy` attribute of the `access-control` element.

#### Example: XML Configuration for Rejecting Permission Combination Policy

```
<access-control provider="rbac" permission-combination-policy="rejecting">
  <role-mapping>
    <role name="SuperUser">
      <include>
        <user name="$local"/>
      </include>
    </role>
  </role-mapping>
</access-control>
```

### 2.5.3. Managing Roles

When Role-Based Access Control (RBAC) is enabled, what a management user is permitted to do is determined by the roles to which the user is assigned. JBoss EAP 7 uses a system of includes and excludes based on both the user and group membership to determine to which role a user belongs.

A user is considered to be assigned to a role if the user is:

- listed as a user to be included in the role, or
- a member of a group that is listed to be included in the role.

A user is also considered to be assigned to a role if the user is not:

- listed as a user to exclude from the role, or
• a member of a group that is listed to be excluded from the role.

Exclusions take priority over inclusions.

Role include and exclude settings for users and groups can be configured using both the management console and the management CLI.

Only users of the **SuperUser** or **Administrator** roles can perform this configuration.

### 2.5.3.1. Configure User Role Assignment Using the Management CLI

The configuration of mapping users and groups to roles is located at: `/core-service=management/access=authorization` as **role-mapping** elements.

Only users of the **SuperUser** or **Administrator** roles can perform this configuration.

#### Viewing Role Assignment Configuration

Use the **:read-children-names** operation to get a complete list of the configured roles:

```json
/core-service=management/access=authorization:read-children-names(child-type=role-mapping)
{
    "outcome" => "success",
    "result" => [
        "Administrator",
        "Deployer",
        "Maintainer",
        "Monitor",
        "Operator",
        "SuperUser"
    ]
}
```

Use the **read-resource** operation of a specified role-mapping to get the full details of a specific role:

```json
/core-service=management/access=authorization/role-mapping=ROLENAME:read-resource(recursive=true)
{
    "outcome" => "success",
    "result" => {
        "include-all" => false,
        "exclude" => undefined,
        "include" => {
            "user-theboss" => {
                "name" => "theboss",
                "realm" => undefined,
                "type" => "USER"
            },
            "user-harold" => {
                "name" => "harold",
                "realm" => undefined,
                "type" => "USER"
            },
            "group-SysOps" => {
                "name" => "SysOps",
                "realm" => undefined,
```
Add a New Role
This procedure shows how to add a role-mapping entry for a role. This must be done before the role can be configured.

Use the **add** operation to add a new role configuration.

```
/core-service=management/access=authorization/role-mapping=ROLENAME:add
```

**ROLENAME** is the name of the role that the new mapping is for, such as **Auditor**.

**Example: Management CLI Command for New Role Configuration**

```
/core-service=management/access=authorization/role-mapping=Auditor:add
```

Add a User as Included in a Role
This procedure shows how to add a user to the included list of a role.

If no configuration for a role has been done, then a role-mapping entry for it must be done first.

Use the **add** operation to add a user entry to the includes list of the role.

```
/core-service=management/access=authorization/role-mapping=ROLENAME/include=ALIAS:add(name=USERNAME, type=USER)
```

- **ROLENAME** is the name of the role being configured, such as **Auditor**.
- **ALIAS** is a unique name for this mapping. Red Hat recommends the use of a naming convention for aliases, such as **user-USERNAME** (for example, **user-max**).
- **USERNAME** is the name of the user being added to the include list, such as **max**.

**Example: Management CLI Command for User Included in a Role**

```
/core-service=management/access=authorization/role-mapping=Auditor/include=user-max:add(name=max, type=USER)
```

Add a User as Excluded in a Role
This procedure shows how to add a user to the excluded list of a role.

If no configuration for a role has been done, then a role-mapping entry for it must be done first.

Use the **add** operation to add a user entry to the excludes list of the role.

```
/core-service=management/access=authorization/role-mapping=ROLENAME/exclude=ALIAS:add(name=USERNAME, type=USER)
```

- **ROLENAME** is the name of the role being configured, for example **Auditor**.
• **USERNAME** is the name of the user being added to the exclude list, for example **max**.

• **ALIAS** is a unique name for this mapping. Red Hat recommends that the use of a naming convention for aliases, such as **user-USERNAME** (for example, **user-max**).

### Example: Management CLI Command User Excluded in a Role

```
/core-service=management/access=authorization/role-mapping=Auditor/exclude=user-max:add(name=max, type=USER)
```

### Remove User Role Include Configuration

This procedure shows how to remove a user include entry from a role mapping.

Use the **remove** operation to remove the entry.

```
/core-service=management/access=authorization/role-mapping=ROLENAME/include=ALIAS:remove
```

• **ROLENAME** is the name of the role being configured, such as **Auditor**.

• **ALIAS** is a unique name for this mapping. Red Hat recommends that the use of a naming convention for aliases, such as **user-USERNAME** (for example, **user-max**).

### Example: Management CLI Command for Removing User Role Include Configuration

```
/core-service=management/access=authorization/role-mapping=Auditor/include=user-max:remove
```

**NOTE**

Removing the user from the list of includes does not remove the user from the system, nor does it guarantee that the role will not be assigned to the user. The role might still be assigned based on group membership.

### Remove User Role Exclude Configuration

This procedure shows how to remove an user exclude entry from a role mapping.

Use the remove operation to remove the entry.

```
/core-service=management/access=authorization/role-mapping=ROLENAME/exclude=ALIAS:remove
```

• **ROLENAME** is the name of the role being configured, such as **Auditor**.

• **ALIAS** is a unique name for this mapping. Red Hat recommends that the use of a naming convention for aliases, such as **user-USERNAME** (for example, **user-max**).

```
/core-service=management/access=authorization/role-mapping=Auditor/exclude=user-max:remove
```

**NOTE**

Removing the user from the list of excludes does not remove the user from the system, nor does it guarantee the role will be assigned to the user. Roles might still be excluded based on group membership.
2.5.4. Configure User Role Assignment with the Elytron Subsystem

In addition to adding role mappings for users directly, as covered in Managing Roles section, you can also configure RBAC roles to be directly taken from the identity provided by the elytron subsystem.

To configure the RBAC system to use roles provided by the elytron subsystem:

```
/core-service=management/access=authorization:write-attribute(name=use-identity-roles,value=true)
```

**IMPORTANT**

RBAC must be enabled to use this functionality, and the principal must have RBAC roles.

2.5.5. Roles and User Groups

A user group is an arbitrary label that can be assigned to one or more users. When authenticating using the management interfaces, users are assigned groups from either the elytron subsystem or core management authentication, depending on how the management interfaces are secured. The RBAC system can be configured to automatically assign roles to users depending on what user groups they are members of. It can also exclude users from roles based on group membership.

2.5.6. Configure Group Role Assignment Using the Management CLI

Groups to be included or excluded from a role can be configured in the management console and the management CLI. This topic only shows using the management CLI.

The configuration of mapping users and groups to roles is located in the management API at: /core-service=management/access=authorization as role-mapping elements.

Only users in the SuperUser or Administrator roles can perform this configuration.

**Viewing Group Role Assignment Configuration**

Use the read-children-names operation to get a complete list of the configured roles:

```
/core-service=management/access=authorization:read-children-names(child-type=role-mapping)

{
  "outcome" => "success",
  "result" => [
    "Administrator",
    "Deployer",
    "Maintainer",
    "Monitor",
    "Operator",
    "SuperUser"
  ]
}
```

Use the read-resource operation of a specified role-mapping to get the full details of a specific role:

```
/core-service=management/access=authorization/role-mapping=ROLENAME:read-resource(recursive=true)

{
  "outcome" => "success",
  "result" => {
```

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Add a New Role
This procedure shows how to add a role-mapping entry for a role. This must be done before the role can be configured.

Use the `add` operation to add a new role configuration.

```
/core-service=management/access=authorization/role-mapping=ROLENAME:add
```

Add a Group as Included in a Role
This procedure shows how to add a group to the included list of a role.

If no configuration for a role has been done, then a role-mapping entry for it must be done first.

Use the `add` operation to add a group entry to the includes list of the role.

```
/core-service=management/access=authorization/role-mapping=ROLENAME/include=ALIAS:add(name=GROUPNAME, type=GROUP)
```

- `ROLENAME` is the name of the role being configured, such as `Auditor`.
- `GROUPNAME` is the name of the group being added to the include list, such as `investigators`.
- `ALIAS` is a unique name for this mapping. Red Hat recommends that you use a naming convention for your aliases, such as `group-GROUPNAME` (for example, `group-investigators`).

Example: Management CLI Command for Adding a Group as Included in a Role

```
/core-service=management/access=authorization/role-mapping=Auditor/include=group-investigators:add(name=investigators, type=GROUP)
```

Add a Group as Excluded in a Role
This procedure shows how to add a group to the excluded list of a role.
If no configuration for a role has been done, then a role-mapping entry for it must be created first.

Use the add operation to add a group entry to the excludes list of the role.

```
/core-service=management/access=authorization/role-mapping=ROLENAME/exclude=ALIAS:add(name=GROUPNAME, type=GROUP)
```

- **ROLENAME** is the name of the role being configured, such as Auditor.
- **GROUPNAME** is the name of the group being added to the include list, such as supervisors.
- **ALIAS** is a unique name for this mapping. Red Hat recommends that you use a naming convention for your aliases, such as group-GROUPNAME (for example, group-supervisors).

**Example: Management CLI Command for Adding a Group as Excluded in a Role**

```
/core-service=management/access=authorization/role-mapping=Auditor/exclude=group-supervisors:add(name=supervisors, type=GROUP)
```

**Remove Group Role Include Configuration**

This procedure shows how to remove a group include entry from a role mapping.

Use the remove operation to remove the entry.

```
/core-service=management/access=authorization/role-mapping=ROLENAME/include=ALIAS:remove
```

- **ROLENAME** is the name of the role being configured, such as Auditor.
- **ALIAS** is a unique name for this mapping. Red Hat recommends that you use a naming convention for your aliases, such as group-GROUPNAME (for example, group-investigators).

**Example: Management CLI Command for Removing Group Role Include Configuration**

```
/core-service=management/access=authorization/role-mapping=Auditor/include=group-investigators:remove
```

**NOTE**

Removing the group from the list of includes does not remove the group from the system, nor does it guarantee that the role will not be assigned to users in this group. The role might still be assigned to users in the group individually.

**Remove a User Group Exclude Entry**

This procedure shows how to remove a group exclude entry from a role mapping.

Use the remove operation to remove the entry.

```
/core-service=management/access=authorization/role-mapping=ROLENAME/exclude=ALIAS:remove
```

- **ROLENAME** is the name of the role being configured, such as Auditor.
ALIAS is a unique name for this mapping. Red Hat recommends that you use a naming convention for your aliases, such as group-GROUPNAME (for example, group-supervisors).

```
/core-service=management/access=authorization/role-mapping=Auditor/exclude=group-supervisors:remove
```

**NOTE**

Removing the group from the list of excludes does not remove the group from the system. It also does not guarantee the role will be assigned to members of the group. Roles might still be excluded based on group membership.

### 2.5.7. Using RBAC with LDAP

The basics of using RBAC with LDAP as well as how to configure JBoss EAP to use RBAC with LDAP are covered in the LDAP and RBAC section of the JBoss EAP How to Configure Identity Management Guide.

### 2.5.8. Scoped Roles

Scoped roles are user-defined roles that grant the permissions of one of the standard roles but only for one or more specified server groups or hosts in a JBoss EAP managed domain. Scoped roles allow for management users to be granted permissions that are limited to only those server groups or hosts that are required.

**IMPORTANT**

Scoped roles can be created by users assigned the Administrator or SuperUser roles.

They are defined by five characteristics:

- A unique name.
- The standard roles which it is based on.
- If it applies to server groups or hosts.
- The list of server groups or hosts that it is restricted to.
- If all users are automatically included. This defaults to false.

Once created a scoped role can be assigned to users and groups the same way that the standard roles are.

Creating a scoped role does not allow for defining new permissions. Scoped roles can only be used to apply the permissions of an existing role in a limited scope. For example, a scoped role could be created based on the Deployer role which is restricted to a single server group.

There are only two scopes that roles can be limited to:

**Host-scoped roles**

A role that is host-scoped restricts the permissions of that role to one or more hosts. This means access is provided to the relevant /host=* resource trees but resources that are specific to other hosts are hidden.
Server-group-scoped roles

A role that is server-group-scoped restricts the permissions of that role to one or more server groups. Additionally, the role permissions will also apply to the profile, socket binding group, server configuration, and server resources that are associated with the specified server-groups. Any sub-resources within any of those that are not logically related to the server-group will not be visible to the user.

IMPORTANT

Some resources are non-addressable to server-group and host scoped roles in order to provide a simplified view of the management model to improve usability. This is distinct from resources that are non-addressable to protect sensitive data.

For host scoped roles this means that resources in the /host=* portion of the management model will not be visible if they are not related to the server groups specified for the role.

For server-group scoped roles, this means that resources in the profile, socket-binding-group, deployment, deployment-overlay, server-group, server-config and server portions of the management model will not be visible if they are not related to the server groups specified for the role.

2.5.8.1. Configuring Scoped Roles from the Management CLI

IMPORTANT

Only users in the SuperUser or Administrator roles can perform this configuration.

Add a New Scoped Role
To add a new scoped role, the following operations must be done:

```
/core-service=management/access=authorization/role-mapping=NEW-SCOPED-ROLE:add
```

```
/core-service=management/access=authorization/server-group-scoped-role=NEW-SCOPED-ROLE:add(base-role=BASE-ROLE, server-groups=[SERVER-GROUP-NAME])
```

Replace NEW-SCOPED-ROLE, BASE-ROLE, and SERVER-GROUP-NAME with the proper information.

Viewing and Editing a Scoped Role Mapping
A scoped role’s details, including members, can be viewed by using the following command:

```
/core-service=management/access=authorization/role-mapping=NEW-SCOPED-ROLE:read-resource(recursive=true)
```

Replace NEW-SCOPED-ROLE with the proper information.

To edit a scoped role’s details, the write-attribute command may be used. For example:

```
/core-service=management/access=authorization/role-mapping=NEW-SCOPED-ROLE:write-attribute(name=include-all, value=true)
```

Replace NEW-SCOPED-ROLE with the proper information.
Delete a Scoped Role

/core-service=management/access=authorization/role-mapping=NEW-SCOPED-ROLE:remove

/core-service=management/access=authorization/server-group-scoped-role=NEW-SCOPED-ROLE:remove

Replace NEW-SCOPED-ROLE with the proper information.

**IMPORTANT**

A scoped role cannot be deleted if users or groups are assigned to it. Remove the role assignments first, and then delete it.

Adding and Removing Users

Adding and removing users to and from scoped roles follows the same process as adding and removing standard roles.

2.5.8.2. Configuring Scoped Roles from the Management Console

**IMPORTANT**

Only users in the **SuperUser** or **Administrator** roles can perform this configuration.

Scoped role configuration in the management console can be found by following these steps:

1. Log in to the management console.
2. Click on the **Access Control** tab.
3. Click on **Roles** to view all roles, including scoped roles.

The following procedures show how to perform configuration tasks for scoped roles.

**Add a New Scoped Role**

1. Log in to the management console.
2. Click on the **Access Control** tab.
3. Select **Roles** and click the Add (+) button.
4. Choose **Host Scoped Role** or **Server Group Scoped Role**.
5. Specify the following details:
   - **Name**: The unique name for the new scoped role.
   - **Base Role**: The role which this role will base its permissions on.
   - **Hosts** or **Server Groups**: The list of hosts or server groups that the role is restricted to, depending on the type of scoped role being added. Multiple entries can be selected.
   - **Include All**: Whether this role should automatically include all users. Defaults to **OFF**.
6. Click Add to create the new role.

**Edit a Scoped Role**

1. Log in to the management console.
2. Click on the Access Control tab.
3. Click on the Roles menu on the left.
4. Click on the desired scoped role to edit and click Edit.
5. Update the desired details to change and click the Save button.

**View Scoped Role Members**

1. Log in to the management console.
2. Click on the Access Control tab.
3. Click on the Roles menu on the left.
4. Click on the desired scoped role to view the included and excluded members.

**Delete a Scoped Role**

1. Log in to the management console.
2. Click on the Access Control tab.
3. Click on the Roles menu on the left.
4. Click on the desired scoped role and click Remove from the drop down.
5. Click Yes to remove the role and all of its assignments.

**Adding and Removing Users**
Adding and removing users to and from scoped roles follows the same process as adding and removing standard roles. To update a user’s scoped roles:

1. Log in to the management console.
2. Click on the Access Control tab.
3. Click on the Roles menu on the left and click on the desired scoped role.
4. Select the Plus (+) button to include a member or the Minus (-) button to exclude a member.

2.5.9. Configuring Constraints

2.5.9.1. Configure Sensitivity Constraints

Each sensitivity constraint defines a set of resources that are considered sensitive. A sensitive resource is generally one that either should be secret, like passwords, or one that will have serious impact on the server, like networking, JVM configuration, or system properties. The access control system itself is also considered sensitive. Resource sensitivity limits which roles are able to read, write or address a specific resource.
Sensitivity constraint configuration is at /core-service=management/access=authorization/constraint=sensitivity-classification.

Within the management model each sensitivity constraint is identified as a classification. The classifications are then grouped into types. Each classification has an applies-to element which is a list of path patterns to which the classifications configuration applies.

To configure a sensitivity constraint, use the write-attribute operation to set the configured-requires-read, configured-requires-write, or configured-requires-addressable attribute. To make that type of operation sensitive set the value of the attribute to true, otherwise to make it nonsensitive set it to false. By default these attributes are not set and the values of default-requires-read, default-requires-write, and default-requires-addressable are used. Once the configured attribute is set it is that value that is used instead of the default. The default values cannot be changed.

**Example: Make Reading System Properties a Sensitive Operation**

```
/core-service=management/access=authorization/constraint=sensitivity-classification/type=core/classification=system-property:write-attribute(name=configured-requires-read,value=true)
```

**Example: Result**

```
/core-service=management/access=authorization/constraint=sensitivity-classification/type=core/classification=system-property:read-resource

{
    "outcome" => "success",
    "result" => {
        "configured-requires-addressable" => undefined,
        "configured-requires-read" => true,
        "configured-requires-write" => undefined,
        "default-requires-addressable" => false,
        "default-requires-read" => false,
        "default-requires-write" => true,
        "applies-to" => {
            "/core-service=platform-mbean/type=runtime" => undefined,
            "/system-property=" => undefined,
            "/*" => undefined
        }
    }
}
```

The roles, and the respective operations that they are able to perform, depend on the configuration of the attributes. This is summarized in the following table:

**Table 2.2. Sensitivity Constraint Configuration Outcomes**

<table>
<thead>
<tr>
<th>Value</th>
<th>requires-read</th>
<th>requires-write</th>
<th>requires-addressable</th>
</tr>
</thead>
<tbody>
<tr>
<td>true</td>
<td>Read is sensitive. Only <strong>Auditor</strong>, <strong>Administrator</strong>, <strong>SuperUser</strong> can read.</td>
<td>Write is sensitive. Only <strong>Administrator</strong> and <strong>SuperUser</strong> can write.</td>
<td>Addressing is sensitive. Only <strong>Auditor</strong>, <strong>Administrator</strong>, <strong>SuperUser</strong> can address.</td>
</tr>
</tbody>
</table>
### 2.5.9.2. List Sensitivity Constraints

You can see a list of the available sensitivity constraints directly from the JBoss EAP management model using the following management CLI command:

```
/core-service=management/access=authorization/constraint=sensitivity-classification:read-resource(include-runtime=true,recursive=true)
```

### 2.5.9.3. Configure Application Resource Constraints

Each application resource constraint defines a set of resources, attributes and operations that are usually associated with the deployment of applications and services. When an application resource constraint is enabled management users of the **Deployer** role are granted access to the resources that it applies to.

Application constraint configuration is at `/core-service=management/access=authorization/constraint=application-classification/`.

Each application resource constraint is identified as a classification. The classifications are then grouped into types. Each classification has an **applies-to** element which is a list of path patterns to which the classifications configuration applies.

By default the only application resource classification that is enabled is core. Core includes deployments, deployment overlays, and the deployment operations.

To enable an application resource, use the **write-attribute** operation to set the **configured-application** attribute of the classification to **true**. To disable an application resource, set this attribute to **false**. By default these attributes are not set and the value of **default-application** attribute is used. The default value cannot be changed.

#### Example: Enabling the logger-profile Application Resource Classification

```
/core-service=management/access=authorization/constraint=application-classification/type= logging/classification=logging-profile:write-attribute(name=configured-application,value=true)
```
Example: Result

```
/core-service=management/access=authorization/constraint=application-classification/type=logging/classification=logging-profile:read-resource
```

{  
  "outcome" => "success",
  "result" => {  
    "configured-application" => true,
    "default-application" => false,
    "applies-to" => {"/subsystem=logging/logging-profile=" => undefined}
  }
}

**IMPORTANT**

Application resource constraints apply to all resources that match its configuration. For example, it is not possible to grant a **Deployer** user access to one datasource resource but not another. If this level of separation is required then it is recommended to configure the resources in different server groups and create different scoped **Deployer** roles for each group.

### 2.5.9.4. List Application Resource Constraints

You can see a list of the available application resource constraints directly from the JBoss EAP management model using the following management CLI command:

```
/core-service=management/access=authorization/constraint=application-classification:read-resource(include-runtime=true,recursive=true)
```

### 2.5.9.5. Configure the Vault Expression Constraint

By default, reading and writing vault expressions are sensitive operations. Configuring the vault expression constraint allows either or both of those operations to be set to nonsensitive. Changing this constraint allows a greater number of roles to read and write vault expressions.

The vault expression constraint is found at `/core-service=management/access=authorization/constraint=vault-expression`.

To configure the vault expression constraint, use the **write-attribute** operation to set the attributes of `configured-requires-write` and `configured-requires-read` to `true` or `false`. By default these are not set and the values of `default-requires-read` and `default-requires-write` are used. The default values cannot be changed.

**Example: Making Writing to Vault Expressions a Nonsensitive Operation**

```
/core-service=management/access=authorization/constraint=vault-expression:write-attribute(name=configured-requires-write,value=false)
```

**Example: Result**

```
/core-service=management/access=authorization/constraint=vault-expression:read-resource
```
The roles, and the respective vault expressions that they will be able to read and write, depend on the configuration of the attributes. This is summarized in the following table:

Table 2.3. Vault Expression Constraint Configuration Outcomes

<table>
<thead>
<tr>
<th>Value</th>
<th>requires-read</th>
<th>requires-write</th>
</tr>
</thead>
<tbody>
<tr>
<td>true</td>
<td>Read operation is sensitive. Only Auditor, Administrator, and SuperUser can read.</td>
<td>Write operation is sensitive. Only Administrator and SuperUser can write.</td>
</tr>
<tr>
<td>false</td>
<td>Read operation is not sensitive. All management users can read.</td>
<td>Write operation is not sensitive. Monitor, Administrator, and SuperUser can write. Deployer can also write if the vault expression is in an application resource.</td>
</tr>
</tbody>
</table>
CHAPTER 3. SECURELY STORING CREDENTIALS

JBoss EAP allows the encryption of sensitive strings outside of configuration files. These strings can be stored in a keystore, and subsequently decrypted for applications and verifications systems. Sensitive strings can be stored in either of the following:

- **Credential Store** - Introduced in JBoss EAP 7.1, a credential store can safely secure sensitive and plain text strings by encrypting them in a storage file. Each JBoss EAP server can contain multiple credential stores.

- **Password Vault** - Primarily used in legacy configurations, a password vault uses a Java Keystore to store sensitive strings outside of the configuration files. Each JBoss EAP server can only contain a single password vault.

All of the configuration files in `EAP_HOME/standalone/configuration/` and `EAP_HOME/domain/configuration/` are world readable by default. It is strongly recommended to not store plaintext passwords in the configuration files, and instead place these credentials in either a credential store or password vault.

If you decide to place plaintext passwords in the configuration files, then these files should only be accessible by limited users. At a minimum, the user account under which JBoss EAP 7 is running requires read-write access.

### 3.1. CREDENTIAL STORE

Introduced with the elytron subsystem, credential stores allow for secure storage and usage of credentials. You can find more background information on credential stores as well as other Elytron components in the Core Concepts and Components section of the Security Architecture guide.

Using a credential store is preferred to using a password vault to store passwords and other sensitive strings. Credential stores allow for easier credential management within the JBoss EAP management CLI, without having to use an external tool. You can also use multiple credential stores within a JBoss EAP server, compared to the limitation of only one password vault per JBoss EAP server.

The default credential store implementation uses a JCEKS keystore file to store credentials. When creating a new credential store, the default implementation also allows you to reference an existing keystore file or have JBoss EAP automatically create one for you. Currently, the default implementation only allows you to store clear text passwords.

**IMPORTANT**

The elytron subsystem does not provide any checks for using the same file as storage to multiple credential stores. It is strongly advised not to use the same file for multiple credential stores or even to share the storage file using remote file systems.

If you need to use shared storage file, be sure to set the read-only flag on the credential stores accessing it. This will prevent the file from being modified. After the file is updated from outside, each credential store has to be reloaded to reflect the changed values. A similar process needs to be followed when using credential stores in a managed domain.

Since a credential store contains sensitive information, the directory containing the store should be accessible to only limited users. At a minimum the user account under which JBoss EAP is running requires read-write access.
IMPORTANT

JBoss EAP reads the credential store file into memory and writes changes to it at varying times. You must ensure that the user running the JBoss EAP process has permissions to the store file, and that you do not externally modify the store file while JBoss EAP is running.

If the file is modified externally, you can use the `reload()` operation on the credential store to make JBoss EAP reload the content of the store file.

### 3.1.1. Creating a Credential Store

To create a credential store, you must define a path to the new credential store file, and provide a master password that is used to encrypt the credential store. The directory containing the store should be accessible to only limited users. At a minimum the user account under which JBoss EAP is running requires read-write access.

IMPORTANT

JCEKS keystore implementations differ between Java vendors, so the JBoss EAP instance must run a JDK from the same vendor that generated the JCEKS keystore.

Like providing paths in other JBoss EAP configuration, you can also use the `relative-to` attribute to provide a path relative to another.

### Creating a Credential Store for a Standalone Server

Use the following management CLI command to create a credential store:

```
/subsystem=elytron/credential-store=<store_name>:add(location="<path_to_store_file>", credential-reference={clear-text=<store_password>},create=true)
```

For example, the following command creates a new store named `my_store`, and creates the file `jboss.server.data.dir/cred_stores/my_store.jceks`:

```
/subsystem=elytron/credential-store=my_store:add(location="cred_stores/my_store.jceks", relative-to=jboss.server.data.dir, credential-reference={clear-text=<secret_store_password>},create=true)
```

NOTE

If you want to use an implementation other than `default`, you can explicitly define the type of a credential store. For more information, see the section on [using a custom credential store implementation](#).

### Creating a Credential Store in a Managed Domain

You can create a credential store in a managed domain, but you must first prepare the resource with credentials by using the WildFly Elytron Tool. If multiple host controllers exist in the managed domain, you must choose one of the following options:

- Create a credential store in each host controller.
- Copy a credential store from one host controller to all the other host controllers.
- Place the storage file in Network File System (NFS), and use the file for all the created credential store resources.
Alternatively, you can create a credential store file with credentials on a host controller without using the WildFly Elytron Tool.

**NOTE**

You do not need to define a credential store resource on each server. Each server that is running the same profile, for which the resource is created, contains your credential store file. You can locate the storage file at the server data directory, `relative-to=jboss.server.data.dir`.

**Procedure**

1. Use the WildFly Elytron Tool to create a credential store storage file. For more information on this, see [Create and Modify Credential Stores Offline with the WildFly Elytron Tool](#).

2. Distribute the storage file. For example, distribute the file to each host controller, for example by using `scp`, or store it in NFS and use it for all the created credential store resources.

   **NOTE**

   For a credential store file that was stored in NFS and is used by resources from multiple host controllers, you must use the credential store in read-only mode to maintain consistency. Additionally, provide an absolute path for the credential store file.

   ```
   /profile=<profile_name>/subsystem=elytron/credential-store=<store_name>:add(location=<absolute_path_to_store_keystore>,credential-reference={clear-text="<store_password>"},create=false,modifiable=false)
   ```

3. **Optional:** If you need to define the credential store resource in a profile, use the storage file to create the resource.

   **Example of creating a credential store resource from a storage file.**

   ```
   /profile=<profile_name>/subsystem=elytron/credential-store=<store_name>:add(location=<path_to_store_file>,credential-reference={clear-text="<store_password>"})
   ```

4. **Optional:** Create the credential store resource for a host controller.

   **Example of creating a credential store resource for a host controller.**

   ```
   /host=<host_controller_name>/subsystem=elytron/credential-store=<store_name>:add(location=<path_to_store_file>,credential-reference={clear-text="<store_password>"})
   ```

### 3.1.2. Add a Credential to the Credential Store

To add a new credential to a credential store, you associate an alias to the sensitive string that you are wanting to store.
NOTE

Credential store aliases are case insensitive by default. Any stored alias is displayed in lowercase, and may be referenced using any combination of uppercase and lowercase letters.

If a custom credential store is used, then case sensitivity will be determined by the custom implementation.

The following management CLI command adds a credential to a credential store:

```
/subsystem=elytron/credential-store=STORE_NAME:add-alias(alias=ALIAS, secret-value="SENSITIVE_STRING")
```

For example, to add a password with the alias `database-pw` to the store created in the previous section:

```
/subsystem=elytron/credential-store=my_store:add-alias(alias=database-pw, secret-value="speci@l_db_pa$$_01")
```

For information about adding a credential to a credential store in a managed domain, see Add a Credential to a Credential Store Using the WildFly Elytron Tool.

Editing Credential Store Aliases Using the Management Console

1. Log in to the management console and click on the Runtime tab.
2. Select the server and select Security (Elytron) → Stores and click View.
3. Select the credential store and click Aliases to edit the aliases.

3.1.3. Use a Stored Credential in a Configuration

To refer to a password or sensitive string stored in a credential store, use the credential-reference attribute in your JBoss EAP configuration. You can use credential-reference as an alternative to providing a password or other sensitive string in most places throughout the JBoss EAP configuration.

```
credential-reference={store=STORE_NAME, alias=ALIAS}
```

For example, to create a new datasource using the password that was added to the credential store in the previous example, you can use credential-reference like the following:

```
data-source add --name=my_DS --jndi-name=java:/my_DS --driver-name=h2 --connection-url=jdbc:h2:mem:test;DB_CLOSE_DELAY=-1;DB_CLOSE_ON_EXIT=FALSE --user-name=db_user --credential-reference={store=my_store, alias=database-pw}
```

In the above example, instead of providing a password using --password, a credential-reference including a store name and alias is provided. If you check the resulting datasource configuration, note that password is undefined and the credential-reference attribute is defined instead.

```
/subsystem=datasources/data-source=my_DS:read-resource()
{
  "outcome" => "success",
  "result" => {
    ...
  }
}
"credential-reference" => { 
    "store" => "my_store",
    "alias" => "database-pw"
},
...
"password" => undefined,
...
}

3.1.4. Automatic update of credentials in credential store

If you have a credential store, you are not required to add credentials or update existing credentials before you can reference them from a credential reference. Elytron automates this process.

When configuring a credential reference, specify both the store and clear-text attributes. Elytron automatically adds or updates a credential in the credential store specified by the store attribute. Optionally, you can specify the alias attribute.

Elytron updates the credential store as follows:

- If you specify an alias:
  - If an entry for the alias exists, the existing credential is replaced with the specified clear text password.
  - If an entry for the alias does not exist, a new entry is added to the credential store with the specified alias and the clear text password.

- If you do not specify an alias, Elytron generates an alias and adds a new entry to the credential store with the generated alias and the specified clear text password.

The clear-text attribute is removed from the management model when the credential store is updated.

The following example illustrates how to create a credential reference that specifies the store, clear-text, and alias attributes:

```
/subsystem=elytron/key-store=exampleKS:add(relative-to=jboss.server.config.dir,
    path=example.keystore, type=JCEKS, credential-reference={
        store=mycredstore, alias=myNewAlias,
        clear-text=myNewPassword} )
{
    "outcome" => "success",
    "result" => {"credential-store-update" => {
        "status" => "new-entry-added",
        "new-alias" => "myNewAlias"
    }}
}
```

You can update the credential for the myNewAlias entry that was added to the previously defined credential store with the following command:

```
/subsystem=elytron/key-store=exampleKS:write-attribute(name=credential-reference.clear-text,value=myUpdatedPassword)
{
    "outcome" => "success",
}
NOTE

If an operation that includes a **credential-reference** parameter fails, no automatic credential store update occurs. The credential store that was specified by the **credential-reference** attribute does not change.

3.1.5. List the Credentials in the Credential Store

You can list the aliases of all the credentials contained in a credential store using the following management CLI command:

```
/subsystem=elytron/credential-store=STORE_NAME:read-aliases()
```

For example:

```
/subsystem=elytron/credential-store=my_store:read-aliases()
{
   "outcome" => "success",
   "result" => [ 
      "database-pw"
   ]
}
```

3.1.6. Remove a Credential from the Credential Store

You can remove a credential from a credential store using the following command:

```
/subsystem=elytron/credential-store=STORE_NAME:remove-alias(alias=ALIAS)
```

For example:

```
/subsystem=elytron/credential-store=my_store:remove-alias(alias=database-pw)
```

3.1.7. Obtain the Master Password for the Credential Store from an External Source

Instead of providing your credential store’s master password in the clear, you can choose to provide that password using a pseudo credential store. You have the following options:

**EXT**

External command using `java.lang.Runtime#exec(java.lang.String)`. If parameters are needed, they are supplied using a space-separated list of strings. An external command refers to any executable from the operation system, for example a shell script or an executable binary. The password is read from the standard output of the executed command.
Example

{EXT}/usr/bin/getTheMasterPasswordScript.sh par1 par2

CMD

External command using java.lang.ProcessBuilder. If parameters are needed, they are supplied using a comma-separated list of strings. An external command refers to any executable from the operation system, for example a shell script or an executable binary. The password is read from the standard output of the executed command.

Example

{CMD}/usr/bin/getTheMasterPasswordScript.sh par1,par2

MASK

Masked password using PBE, or Password Based Encryption. It must be in the following format, which includes the SALT and ITERATION values:

MASK-MASKED_VALUE:SALT;ITERATION

Example

MASK-NqMznhSbL3lwRpDmyuqLBW==;12345678;123

IMPORTANT

EXT, CMD, and MASK provide backward compatibility with the legacy security vault style of supplying an external password. For MASK you must use the above format that includes the SALT and ITERATION values.

You can also use a password located in another credential store as the master password for a new credential store.

Example Credential Store Created with a Password from Another Credential Store

/subsystem=elytron/credential-store=exampleCS:add(location="cred_stores/exampleCS.jceks", relative-to=jboss.server.data.dir, create=true, credential-reference={store=master-cred-store, alias=master-pw})

3.1.8. Define a FIPS 140-2 Compliant Credential Store

A FIPS 140-2 compliant credential store may be defined using either of the following methods.

- Using an NSS Database
- Using the BouncyCastle Providers

3.1.8.1. Define a FIPS 140-2 Compliant Credential Store Using an NSS Database
To obtain a FIPS compliant keystore, use a Sun PKCS#11 provider accessing an NSS database. Instructions on defining the database are found at Configuring the NSS Database.

1. Create a secret key to be used in the credential store.

   **NOTE**
   
   For the `keytool` command to work, `nssDbMode` attribute must be assigned `readWrite` value in `nss_pkcs11_fips.cfg` file.

   ```bash
   $ keytool -keystore NONE -storetype PKCS11 -storepass STORE_PASSWORD -genseckey -alias ALIAS -keyalg AES -keysize 256
   ```

2. Create an external credential store. An external credential store holds a secret key in a PKCS#11 keystore, and accesses this keystore using the alias defined in the previous step. This keystore is then used to decrypt the credentials in a JCEKS keystore. In addition to the `credential-store` attributes, the `credential-store KeyStoreCredentialStore` implementation properties are used to configure external credential stores.

   ```xml
   /subsystem=elytron/credential-store=STORE_NAME:add(modifiable=true, implementation-properties="\n   "keyStoreType"=>"PKCS11","external"=>"true","keyAlias"=>"ALIAS",
   "externalPath"="/path/to/EXTERNAL_STORAGE"),credential-reference={clear-text="STORE_PASSWORD"}, create=true)
   ```

3. Once created, the credential store can be used to store aliases as normal.

   ```xml
   /subsystem=elytron/credential-store=STORE_NAME:add-alias(alias="ALIAS", secret-value="SENSITIVE_STRING")
   ```

4. Confirm that the alias has been added successfully by reading from the credential store.

   ```xml
   /subsystem=elytron/credential-store=STORE_NAME:read-aliases()
   ```

3.1.8.2. Define a FIPS 140-2 Compliant Credential Store Using the BouncyCastle Providers

The following instructions outline how you can use a BouncyCastle provider to obtain a FIPS compliant keystore.

1. Ensure your environment is configured to use the BouncyCastle provider.

2. Create a secret key to be used in the credential store.

   ```bash
   $ keytool -genseckey -alias KEY_ALIAS -keyalg AES -keysize 128 -keystore KEYSTORE -storetype BCFKS -storepass PASSWORD -keypass PASSWORD
   ```

   **IMPORTANT**
   
   The `keypass` and `storepass` for the keystore must be identical for FIPS credential stores to be defined in the `elytron` subsystem.

3. Create an external credential store. An external credential store holds a secret key in a BCFKS keystore, and accesses this keystore using the alias defined in the previous step. This keystore is
then used to decrypt the credentials in a JCEKS keystore. The `credential-store KeyStoreCredentialStore` implementation properties are used to configure external credential stores.

```text
/subsystem=elytron/credential-store=BCFKS_CREDENTIAL_STORE:add(relative-to=jboss.server.config.dir,credential-reference={clear-text=PASSWORD},implementation-properties={keyAlias=KEY_ALIAS,external=true,externalPath=CREDENTIAL_STORE,keyStoreType=BCFKS},create=true,location=KEYSTORE,modifiable=true)
```

4. Once created, the credential store can be used to store aliases as normal.

```text
/subsystem=elytron/credential-store=BCFKS_CREDENTIAL_STORE:add-alias(alias="ALIAS", secret-value="SENSITIVE_STRING")
```

5. Confirm that the alias has been added successfully by reading from the credential store.

```text
/subsystem=elytron/credential-store=BCFKS_CREDENTIAL_STORE:read-aliases()
```

### 3.1.9. Use a Custom Implementation of the Credential Store

To use a custom implementation of the credential store:

1. Create a class that extends the Service Provider Interface (SPI) `CredentialStoreSpi` abstract class.

2. Create a class that implements the Java Security `Provider`. The provider must add the custom credential store class as a service.

3. Create a module containing your credential store and provider classes, and add it to JBoss EAP with a dependency on `org.wildfly.security.elytron`. For example:

   ```text
   module add --name=org.jboss.customcredstore --resources=/path/to/customcredstoreprovider.jar --dependencies=org.wildfly.security.elytron --slot=main
   ```

4. Create a provider loader for your provider. For example:

   ```text
   /subsystem=elytron/provider-loader=myCustomLoader:add(class-names=[org.wildfly.security.mycustomcredstore.CustomElytronProvider],module=org.jboss.customcreds tore)
   ```

5. Create a credential store using the custom implementation.

   **NOTE**

   Ensure that you specify the correct `providers` and `type` values. The value of `type` is what is used in your provider class where it adds your custom credential store class as a service.

   For example:

   ```text
   /subsystem=elytron/credential-store=BCFKS_CREDENTIAL_STORE:add(relative-to=jboss.server.config.dir,credential-reference={clear-text=PASSWORD},implementation-properties={keyAlias=KEY_ALIAS,external=true,externalPath=CREDENTIAL_STORE,keyStoreType=BCFKS},create=true,location=KEYSTORE,modifiable=true)
   ```
Alternatively, if you have created multiple providers, you can specify the additional providers using another provider loader with `other-providers`. This allows you to have other additional implementations for new types of credentials. These specified other providers are automatically accessible in the custom credential store's `initialize` method as the `Provider[]` argument. For example:

```
/subsystem=elytron/credential-store=my_store:add(providers=myCustomLoader,other-providers=myCustomLoader2,type=CustomKeyStorePasswordStore,location="cred_stores/my_store.jceks",relative-to=jboss.server.data.dir,credential-reference={clear-text=supersecretstorepassword},create=true)
```

### 3.1.10. Create and Modify Credential Stores Offline with the WildFly Elytron Tool

You can use the WildFly Elytron tool, which you access using the `elytron-tool` script located in `EAP_HOME/bin/`, to create and modify a credential store for an offline, or stopped, JBoss EAP server.

**IMPORTANT**

JCEKS keystore implementations differ between Java vendors, so the JBoss EAP instance must run a JDK from the same vendor that generated the JCEKS keystore.

**IMPORTANT**

Using the WildFly Elytron tool to modify a credential store that is in use by a running JBoss EAP server can result in changes to the store being lost. Instead, you should create and modify credential stores for a running server by using the management CLI, as described in the previous sections.

The following commands are shown using `elytron-tool.sh` for Red Hat Enterprise Linux and Solaris systems. For Windows Server systems, use the `elytron-tool.bat` script instead.

### Create a Credential Store Using the WildFly Elytron Tool

Create a credential store using the WildFly Elytron tool with the following command:

```
$ EAP_HOME/bin/elytron-tool.sh credential-store --create --location "path/to/store_file" --password STORE_PASSWORD
```

For example:

```
$ EAP_HOME/bin/elytron-tool.sh credential-store --create --location "/cred_stores/my_store.jceks" --password supersecretstorepassword
```

If you do not want to provide your store password in the command, you can omit that argument and you will be prompted to enter the password manually using standard input. You can also use a masked password generated by the WildFly Elytron tool for the store password.

### Create a Credential Store Using the BouncyCastle Provider with the WildFly Elytron Tool

The following procedure outlines how to create a credential store using the WildFly Elytron tool.
1. Ensure your environment is configured to use the BouncyCastle provider.

2. Define a BCFKS keystore. If this keystore already exists, proceed to the next step.

   ```
   $ keytool -genkeypair -alias ALIAS -keyalg RSA -keysize 2048 -keystore KEYSTORE -keystoretruetype BCFKS -storepass PASSWORD
   
   IMPORTANT
   The keypass and storepass for the keystore must be identical for FIPS credential stores to be defined in the elytron subsystem.
   ```

3. Generate a secret key for the credential store.

   ```
   $ keytool -genseckey -alias KEY_ALIAS -keyalg AES -keysize 128 -keystore KEYSTORE -storetype BCFKS -storepass PASSWORD -keypass PASSWORD
   
   IMPORTANT
   For FIPS credential stores, the keystore must contain at least one secret key for the credential store.
   ```

4. Define the credential store using the WildFly Elytron tool with the following command:

   ```
   $ EAP_HOME/bin/elytron-tool.sh credential-store -c -a ALIAS -x ALIAS_PASSWORD -p PASSWORD -l KEYSTORE -u "keyStoreType=BCFKS;external=true;keyAlias=KEY_ALIAS;externalPath=CREDENTIAL_STORE"
   ```

Add a Credential to a Credential Store Using the WildFly Elytron Tool

Add a credential to a credential store using the WildFly Elytron tool with the following command:

```
$ EAP_HOME/bin/elytron-tool.sh credential-store --location "path/to/store_file" --password STORE_PASSWORD --add ALIAS --secret SENSITIVE_STRING

For example:

$ EAP_HOME/bin/elytron-tool.sh credential-store --location "/path/to/store_file" --password supersecretstorepassword --add database-pw --secret speci@l_db_pa$$_01
```

Similar to providing the credential store password, if you do not want to provide your secret in the command, you can omit that argument and you will be prompted to enter the secret manually using standard input.

List All the Credentials in the Credential Store Using the WildFly Elytron Tool

List the credentials in a credential store using the WildFly Elytron tool with the following command:

```
$ EAP_HOME/bin/elytron-tool.sh credential-store --location "path/to/store_file" --password STORE_PASSWORD --aliases

For example:

$ EAP_HOME/bin/elytron-tool.sh credential-store --location "/path/to/store_file" --password supersecretstorepassword --aliases
```

Check If an Alias Exists in the Credential Store Using the Wildfly Elytron Tool
Check if an alias exists in a credential store using the WildFly Elytron tool with the following command:

```
$ EAP_HOME/bin/elytron-tool.sh credential-store --location "path/to/store_file" --password
STORE_PASSWORD --exists ALIAS
```

For example:

```
$ EAP_HOME/bin/elytron-tool.sh credential-store --location "../cred_stores/my_store.jceks" --password supersecretstorepassword --exists database-pw
```

Remove a Credential from the Credential Store Using the WildFly Elytron Tool

Remove a credential from a credential store using the WildFly Elytron tool with the following command:

```
$ EAP_HOME/bin/elytron-tool.sh credential-store --location "path/to/store_file" --password
STORE_PASSWORD --remove ALIAS
```

For example:

```
$ EAP_HOME/bin/elytron-tool.sh credential-store --location "../cred_stores/my_store.jceks" --password supersecretstorepassword --remove database-pw
```

Add a Credential Store Created with the WildFly Elytron Tool to a JBoss EAP Server

After you have created a credential store with the WildFly Elytron tool, add it to your running JBoss EAP server with the following management CLI command:

```
/subsystem=elytron/credential-store=STORE_NAME:add(location="path/to/store_file",credential-reference={clear-text=STORE_PASSWORD})
```

For example:

```
/subsystem=elytron/credential-store=my_store:add(location="../cred_stores/my_store.jceks",credential-reference={clear-text=supersecretstorepassword})
```

After adding the credential store to the JBoss EAP configuration, you can then refer to a password or sensitive string stored in the credential store using the `credential-reference` attribute.

For more information, use the `EAP_HOME/bin/elytron-tool.sh credential-store --help` command for a detailed listing of available options.

3.1.10.1. Generate Masked Encrypted Strings Using the WildFly Elytron Tool

You can use the WildFly Elytron tool to generate PicketBox-compatible `MASK`-encrypted strings to use instead of a plain text password for a credential store.

To generate a masked string, use the following command and provide values for the salt and the iteration count:

```
$ EAP_HOME/bin/elytron-tool.sh mask --salt SALT --iteration ITERATION_COUNT --secret PASSWORD
```
For example:

```
$ EAP_HOME/bin/elytron-tool.sh mask --salt 12345678 --iteration 123 --secret supersecretstorepassword

MASK-8VzWsSNwBaR676g8ujiIDdFKwSJObHCHgnKf17nun3v;12345678;123
```

If you do not want to provide the secret in the command, you can omit that argument and you will be prompted to enter the secret manually using standard input.

For more information, use the `EAP_HOME/bin/elytron-tool.sh mask --help` command for a detailed listing of available options.

### 3.1.10.2. Convert a Password Vault to a Credential Store Using the WildFly Elytron Tool

You can use the WildFly Elytron tool to convert a password vault to a credential store. To convert a password vault to a credential store, you need the vault’s values used when initializing the vault.

**NOTE**

When converting a password vault, aliases in the new credential store are named in the following format based on their equivalent password vault block and attribute name:

```
VAULT_BLOCK::ATTRIBUTE_NAME
```

#### Convert a Single Password Vault

Convert a single password vault to a credential store using the following command:

```
$ EAP_HOME/bin/elytron-tool.sh vault --keystore "path/to/vault_file" --keystore-password VAULT_PASSWORD --enc-dir "path/to/vault_directory" --salt SALT --iteration ITERATION_COUNT -alias VAULT_ALIAS
```

For example, you can also specify the new credential store’s file name and location with the `--location` argument:

```
$ EAP_HOME/bin/elytron-tool.sh vault --keystore ../vaults/vault.keystore --keystore-password vault22 --enc-dir ../vaults/ --salt 1234abcd --iteration 120 --alias my_vault --location ../cred_stores/my_vault_converted.cred_store
```

**NOTE**

You can also use the `--summary` argument to print a summary of the management CLI commands used to convert it. Note that even if a plain text password is used, it is masked in the summary output. The default `SALT` and `ITERATION` values are used unless they are specified in the command.

#### Bulk Convert Multiple Password Vaults

To bulk convert multiple password vaults:

1. Put the details of the vaults you want to convert into a description file in the following format:

   ```
   keystore: path/to/vault_file
   ```
salt and iteration can be omitted if you are providing a plain text password for the vault.

Specifies the location and file name for the converted credential store.

Optional: Specifies a list of optional parameters separated by semicolons (;). See `EAP_HOME/bin/elytron-tool.sh vault --help` for a list of available parameters.

For example:

```
keystore:/vaults/vault1/vault1.keystore
keystore-password:vault11
enc-dir:/vaults/vault1/
salt:1234abcd
iteration:120
location:/cred_stores/vault1_converted.cred_store
alias:my_vault

keystore:/vaults/vault2/vault2.keystore
keystore-password:vault22
enc-dir:/vaults/vault2/
salt:abcd1234
iteration:130
location:/cred_stores/vault2_converted.cred_store
alias:my_vault2
```

2. Run the bulk convert command with your description file from the previous step:

```
$ EAP_HOME/bin/elytron-tool.sh vault --bulk-convert vaultdescriptions.txt
```

For more information, use the `EAP_HOME/bin/elytron-tool.sh vault --help` command for a detailed listing of available options.

### 3.1.11. Using Credential Stores with Elytron Client

Clients connecting to JBoss EAP, such as Jakarta Enterprise Beans, can authenticate using Elytron Client. Users without access to a running JBoss EAP server can create and modify credential stores using the WildFly Elytron tool, and then clients can use Elytron Client to access sensitive strings inside a credential store.

The following example shows you how to use a credential store in an Elytron Client configuration file.

#### Example custom-config.xml with a Credential Store

```
<configuration>
  <authentication-client xmlns="urn:elytron:client:1.2">
```
3.2. PASSWORD VAULT

Configuration of JBoss EAP and associated applications requires potentially sensitive information, such as user names and passwords. Instead of storing the password as plain text in configuration files, the password vault feature can be used to mask the password information and store it in an encrypted keystore. Once the password is stored, references can be included in management CLI commands or applications deployed to JBoss EAP.

The password vault uses the Java keystore as its storage mechanism. Password vault consists of two parts: storage and key storage. Java keystore is used to store the key, which is used to encrypt or decrypt sensitive strings in Vault storage.

See the JBoss EAP How to Configure Identity Management Guide for more information on configuring client authentication using Elytron Client.
IMPORTANT

The keytool utility, provided by the Java Runtime Environment (JRE), is utilized for this steps. Locate the path for the file, which on Red Hat Enterprise Linux is /usr/bin/keytool.

JCEKS keystore implementations differ between Java vendors so the keystore must be generated using the keytool utility from the same vendor as the JDK used. Using a keystore generated by the keytool from one vendor’s JDK in a JBoss EAP 7 instance running on a JDK from a different vendor results in the following exception:

java.io.IOException: com.sun.crypto.provider.SealedObjectForKeyProtector

3.2.1. Set Up a Password Vault

Follow the steps below to set up and use a Password Vault.

1. Create a directory to store the keystore and other encrypted information.
   The rest of this procedure assumes that the directory is EAP_HOME/vault/. Since this directory will contain sensitive information it should be accessible to only limited users. At a minimum the user account under which JBoss EAP is running requires read-write access.

2. Determine the parameters to use with keytool utility.
   Decide on values for the following parameters:

   **alias**
   The alias is a unique identifier for the vault or other data stored in the keystore. Aliases are case-insensitive.

   **storetype**
   The storetype specifies the keystore type. The value jceks is recommended.

   **keyalg**
   The algorithm to use for encryption. Use the documentation for the JRE and operating system to see which other choices are available.

   **keysize**
   The size of an encryption key impacts how difficult it is to decrypt through brute force. For information on appropriate values, see the documentation distributed with the keytool utility.

   **storepass**
   The value of storepass is the password that is used to authenticate to the keystore so that the key can be read. The password must be at least 6 characters long and must be provided when the keystore is accessed. If this parameter is omitted, the keytool utility will prompt for it to be entered after the command has been executed.

   **keypass**
   The value of keypass is the password used to access the specific key and must match the value of the storepass parameter.

   **validity**
   The value of validity is the period (in days) for which the key will be valid.

   **keystore**
   The value of keystore is the file path and file name in which the keystore’s values are to be stored. The keystore file is created when data is first added to it. Ensure the correct file path separator is used: / (forward slash) for Red Hat Enterprise Linux and similar operating systems, \ (backslash) for Windows Server. The keytool utility has many other options. See the documentation for the JRE or the operating system for more details.
3. Run the keytool command, ensuring `keypass` and `storepass` contain the same value.

```
$ keytool -genseckey -alias vault -storetype jceks -keyalg AES -keysize 128 -storepass vault22 -keypass vault22 -validity 730 -keystore EAP_HOME/vault/vault.keystore
```

This results in a keystore that has been created in the file `EAP_HOME/vault/vault.keystore`. It stores a single key, with the alias `vault`, which will be used to store encrypted strings, such as passwords, for JBoss EAP.

### 3.2.2. Initialize the Password Vault

The password vault can be initialized either interactively, where you are prompted for each parameter’s value, or non-interactively, where all parameter values are provided on the command line. Each method gives the same result, so either may be used.

The following parameters will be needed:

- **keystore URL (KEYSTORE_URL)**
  - The file system path or URI of the keystore file. The examples use `EAP_HOME/vault/vault.keystore`.

- **keystore password (KEYSTORE_PASSWORD)**
  - The password used to access the keystore.

- **Salt (SALT)**
  - The salt value is a random string of eight characters used, together with the iteration count, to encrypt the content of the keystore.

- **keystore Alias (KEYSTORE_ALIAS)**
  - The alias by which the keystore is known.

- **Iteration Count (ITERATION_COUNT)**
  - The number of times the encryption algorithm is run.

- **Directory to store encrypted files (ENC_FILE_DIR)**
  - The path in which the encrypted files are to be stored. This is typically the directory containing the password vault. It is convenient but not mandatory to store all of your encrypted information in the same place as the keystore. This directory should be only accessible to limited users. At a minimum the user account under which JBoss EAP 7 is running requires read-write access. The keystore should be located in the directory you created when you set up the password vault. Note that the trailing backslash or forward slash on the directory name is required. Ensure the correct file path separator is used: / (forward slash) for Red Hat Enterprise Linux and similar operating systems, \ (backslash) for Windows Server.

- **Vault Block (VAULT_BLOCK)**
  - The name to be given to this block in the password vault.

- **Attribute (ATTRIBUTE)**
  - The name to be given to the attribute being stored.

- **Security Attribute (SEC-ATTR)**
  - The password which is being stored in the password vault.

To run the password vault command non-interactively, the `vault` script located in `EAP_HOME/bin` can be invoked with parameters for the relevant information:
To run the password vault command interactively, the following steps are required:

1. Launch the password vault command interactively.
   
   Run `EAP_HOME/bin/vault.sh` on Red Hat Enterprise Linux and similar operating systems or `EAP_HOME/bin/vault.bat` on Windows Server. Start a new interactive session by typing `0` (zero).

2. Complete the prompted parameters.
   
   Follow the prompts to input the required parameters.

```bash
$ vault.sh --keystore KEYSTORE_URL --keystore-password KEYSTORE_PASSWORD --alias KEYSTORE_ALIAS --vault-block VAULT_BLOCK --attribute ATTRIBUTE --sec-attr SEC-ATTR --enc-dir ENC_FILE_DIR --iteration ITERATION_COUNT --salt SALT
```

Example: Initializing Password Vault

```bash
$ vault.sh --keystore EAP_HOME/vault/vault.keystore --keystore-password vault22 --alias vault --vault-block vb --attribute password --sec-attr 0penS3sam3 --enc-dir EAP_HOME/vault/ --iteration 120 --salt 1234abcd
```

Example: Output

```
JBoss Vault

JBOSS_HOME: EAP_HOME

JAVA: java

INFO: PBOX00361: Default Security Vault Implementation Initialized and Ready

WFLYSEC0047: Secured attribute value has been stored in Vault.
Please make note of the following:

**************************
Vault Block: vb
Attribute Name: password
Configuration should be done as follows:
VAULT::vb::password::1
**************************

WFLYSEC0048: Vault Configuration in WildFly configuration file:

```
<extensions>
  <vault>
    <vault-option name="KEYSTORE_URL" value="EAP_HOME/vault/vault.keystore"/>
    <vault-option name="KEYSTORE_PASSWORD" value="MASK-5dOaAVafCSd"/>
    <vault-option name="KEYSTORE_ALIAS" value="vault"/>
    <vault-option name="SALT" value="1234abcd"/>
    <vault-option name="ITERATION_COUNT" value="120"/>
    <vault-option name="ENC_FILE_DIR" value="EAP_HOME/vault/"/>
  </vault>
</extensions>
```

To run the password vault command interactively, the following steps are required:

1. Launch the password vault command interactively.
   
   Run `EAP_HOME/bin/vault.sh` on Red Hat Enterprise Linux and similar operating systems or `EAP_HOME/bin/vault.bat` on Windows Server. Start a new interactive session by typing `0` (zero).

2. Complete the prompted parameters.
   
   Follow the prompts to input the required parameters.
```
3. Make a note of the masked password information.
The masked password, salt, and iteration count are printed to standard output. Make a note of
them in a secure location. They are required to add entries to the Password Vault. Access to the
keystore file and these values could allow an attacker access to obtain access to sensitive
information in the Password Vault.

4. Exit the interactive console
Type 2 (two) to exit the interactive console.

Example: Input and Output

Please enter a Digit:: 0: Start Interactive Session  1: Remove Interactive Session  2: Exit
0
Starting an interactive session
Enter directory to store encrypted files:EAP_HOME/vault/
Enter Keystore URL:EAP_HOME/vault/vault.keystore
Enter Keystore password: vault22
Enter Keystore password again: vault22
Values match
Enter 8 character salt:1234abcd
Enter iteration count as a number (Eg: 44):120
Enter Keystore Alias:vault
Initializing Vault
INFO: PBOX000361: Default Security Vault Implementation Initialized and Ready
Vault Configuration in AS7 config file:
********************************************
... </extensions>
<vault>
  <vault-option name="KEYSTORE_URL" value="EAP_HOME/vault/vault.keystore"/>
  <vault-option name="KEYSTORE_PASSWORD" value="MASK-5dOaAVafCSd"/>
  <vault-option name="KEYSTORE_ALIAS" value="vault"/>
  <vault-option name="SALT" value="1234abcd"/>
  <vault-option name="ITERATION_COUNT" value="120"/>
  <vault-option name="ENC_FILE_DIR" value="EAP_HOME/vault"/>
</vault>
<management> ...
********************************************
Vault is initialized and ready for use
Handshake with Vault complete

+ The keystore password has been masked for use in configuration files and deployments. In addition,
the vault is initialized and ready to use.

3.2.3. Use a Password Vault

Before passwords and other sensitive attributes can be masked and used in configuration files, JBoss
EAP 7 must be made aware of the password vault which stores and decrypts them.

The following command can be used to configure JBoss EAP 7 to use the password vault:

/core-service=vault:add(vault-options=[("KEYSTORE_URL" => PATH_TO_KEYSTORE),
("KEYSTORE_PASSWORD" => MASKED_PASSWORD),("KEYSTORE_ALIAS" => ALIAS),("SALT" => SALT),("ITERATION_COUNT" => ITERATION_COUNT),("ENC_FILE_DIR" => ENC_FILE_DIR)])
NOTE

If Microsoft Windows Server is being used, use two backslashes (\\) in the file path instead using one. For example, C:\data\vault\vault.keystore. This is because a single backslash character (\) is used for character escaping.

3.2.4. Store a Sensitive String in the Password Vault

Including passwords and other sensitive strings in plaintext configuration files is a security risk. Store these strings instead in the Password Vault for improved security, where they can then be referenced in configuration files, management CLI commands and applications in their masked form.

Sensitive strings can be stored in the Password Vault either interactively, where the tool prompts for each parameter's value, or non-interactively, where all the parameters’ values are provided on the command line. Each method gives the same result, so either may be used. Both of these methods are invoked using the vault script.

To run the password vault command non-interactively, the vault script (located in EAP_HOME/bin/) can be invoked with parameters for the relevant information:

```
$ vault.sh --keystore KEYSTORE_URL --keystore-password KEYSTORE_PASSWORD --alias KEYSTORE_ALIAS --vault-block VAULT_BLOCK --attribute ATTRIBUTE --sec-attr SEC-ATTR --enc-dir ENC_FILE_DIR --iteration ITERATION_COUNT --salt SALT
```

NOTE

The keystore password must be given in plaintext form, not masked form.

```
$ vault.sh --keystore EAP_HOME/vault/vault.keystore --keystore-password vault22 --alias vault --vault-block vb --attribute password --sec-attr OpenS3sam3 --enc-dir EAP_HOME/vault/ --iteration 120 --salt 1234abcd
```

Example: Output

```
================================================================================
JBoss Vault

JBOSSE_HOME: EAP_HOME

JAVA: java

================================================================================

INFO: PBOX00361: Default Security Vault Implementation Initialized and Ready
WFLYSEC0047: Secured attribute value has been stored in Vault.
Please make note of the following:

```
Vault Block: vb
Attribute Name: password
Configuration should be done as follows:
VAULT::vb::password::1

WFLYSEC0048: Vault Configuration in WildFly configuration file:

... <extensions>
<vault>
  <vault-option name="KEYSTORE_URL" value="/vault/vault.keystore"/>
  <vault-option name="KEYSTORE_PASSWORD" value="MASK-5dOaAVafCSd"/>
  <vault-option name="KEYSTORE_ALIAS" value="vault"/>
  <vault-option name="SALT" value="1234abcd"/>
  <vault-option name="ITERATION_COUNT" value="120"/>
  <vault-option name="ENC_FILE_DIR" value="/vault/"/>
</vault><management> ...

After invoking the vault script, a message prints to standard output, showing the vault block, attribute name, masked string, and advice about using the string in your configuration. Make note of this information in a secure location. An extract of sample output is as follows:

Vault Block: vb
Attribute Name: password
Configuration should be done as follows:
VAULT::vb::password::1

To run the password vault command interactively, the following steps are required:

1. Launch the Password Vault command interactively.
   Launch the operating system's command line interface and run $EAP_HOME/bin/vault.sh (on Red Hat Enterprise Linux and similar operating systems) or $EAP_HOME\bin\vault.bat (on Microsoft Windows Server). Start a new interactive session by typing 0 (zero).

2. Complete the prompted parameters.
   Follow the prompts to input the required parameters. These values must match those provided when the Password Vault was created.

   NOTE
   The keystore password must be given in plaintext form, not masked form.

3. Complete the prompted parameters about the sensitive string.
   Enter 0 (zero) to start storing the sensitive string. Follow the prompts to input the required parameters.

4. Make note of the information about the masked string.
   A message prints to standard output, showing the vault block, attribute name, masked string, and advice about using the string in the configuration. Make note of this information in a secure location. An extract of sample output is as follows:

   Vault Block: ds_Example1
   Attribute Name: password
Configuration should be done as follows:
VAULT::ds_Example1::password::1

5. Exit the interactive console.
Type 2 (two) to exit the interactive console.

Example: Input and Output

=========================================================================  
JBoss Vault  
JBOSS_HOME: EAP_HOME  
JAVA: java  
=========================================================================  

Please enter a Digit:: 0: Start Interactive Session 1: Remove Interactive Session 2: Exit  

0  
Starting an interactive session  
Enter directory to store encrypted files:EAP_HOME/vault/  
Enter Keystore URL:EAP_HOME/vault/vault.keystore  
Enter Keystore password:  
Enter Keystore password again: Values match  
Enter 8 character salt:1234abcd  
Enter iteration count as a number (Eg: 44):120  
Enter Keystore Alias:vault  
Initializing Vault  
INFO: PBOX000361: Default Security Vault Implementation Initialized and Ready  
Vault Configuration in AS7 config file:  
********************************************  
<extensions>  
<vault>  
<vault-option name="KEYSTORE_URL" value="EAP_HOME/vault/vault.keystore"/>  
<vault-option name="KEYSTORE_PASSWORD" value="MASK-5dOaAVafCSd"/>  
<vault-option name="KEYSTORE_ALIAS" value="vault"/>  
<vault-option name="SALT" value="1234abcd"/>  
<vault-option name="ITERATION_COUNT" value="120"/>  
<vault-option name="ENC_FILE_DIR" value="EAP_HOME/vault"/>  
</vault>  
<management> ...  
********************************************  
Vault is initialized and ready for use  
Handshake with Vault complete  
Please enter a Digit:: 0: Store a secured attribute 1: Check whether a secured attribute exists 2: Remove secured attribute 3: Exit  

0  
Task: Store a secured attribute  
Please enter secured attribute value (such as password):  
Please enter secured attribute value (such as password) again: Values match  
Enter Vault Block:ds_Example1  
Enter Attribute Name:password  
Secured attribute value has been stored in vault.  
Please make note of the following:
3.2.5. Use an Encrypted Sensitive String in Configuration

Any sensitive string which has been encrypted can be used in a configuration file or management CLI command in its masked form, providing expressions are allowed.

To confirm if expressions are allowed within a particular subsystem, run the following management CLI command against that subsystem:

```
/subsystem=SUBSYSTEM:read-resource-description(recursive=true)
```

From the output of running this command, look for the value of the `expressions-allowed` parameter. If this is `true`, then expressions can be used within the configuration of this subsystem.

Use the following syntax to replace any plaintext string with the masked form.

```
${VAULT::VAULT_BLOCK::ATTRIBUTE_NAME::MASKED_STRING}
```

Example: Datasource Definition Using a Password in Masked Form

```
...<subsystem xmlns="urn:jboss:domain:datasources:5.0">
  <datasources>
    <datasource jndi-name="java:jboss/datasources/ExampleDS" enabled="true" use-java-context="true" pool-name="H2DS">
      <connection-url>jdbc:h2:mem:test;DB_CLOSE_DELAY=-1</connection-url>
      <driver>h2</driver>
      <pool></pool>
      <security>
        <user-name>sa</user-name>
        <password>${VAULT::ds_ExampleDS::password::1}</password>
      </security>
    </datasource>
    <drivers>
      <driver name="h2" module="com.h2database.h2">
        <xa-datasource-class>org.h2.jdbcx.JdbcDataSource</xa-datasource-class>
      </driver>
    </drivers>
  </datasources>
</subsystem>
...```

3.2.6. Use an Encrypted Sensitive String in an Application

Encrypted strings stored in the password vault can be used in an application’s source code. The below example is an extract of a servlet’s source code, illustrating the use of a masked password in a
datasource definition, instead of the plaintext password. The plaintext version is commented out so that you can see the difference.

Example: Servlet Using a Vaulted Password

```java
@DataSourceDefinition(
    name = "java:jboss/datasources/LoginDS",
    user = "sa",
    password = "VAULT::DS::thePass::1",
    className = "org.h2.jdbcx.JdbcDataSource",
    url = "jdbc:h2:tcp://localhost/mem:test"
)
/*old (plaintext) definition
@DataSourceDefinition(
    name = "java:jboss/datasources/LoginDS",
    user = "sa",
    password = "sa",
    className = "org.h2.jdbcx.JdbcDataSource",
    url = "jdbc:h2:tcp://localhost/mem:test"
)*/
```

3.2.7. Check if a Sensitive String is in the Password Vault

Before attempting to store or use a sensitive string in the Password Vault it can be useful to first confirm if it is already stored.

This check can be done either interactively, where the user is prompted for each parameter’s value, or non-interactively, where all parameters’ values are provided on the command line. Each method gives the same result, so either may be used. Both of these methods are invoked using the `vault` script.

Use the non-interactive method to provide all parameters’ values at once. For a description of all parameters, see Initialize the Password Vault. To run the password vault command non-interactively, the `vault` script located in `EAP_HOME/bin/` can be invoked with parameters for the relevant information:

```bash
$ vault.sh --keystore KEYSTORE_URL --keystore-password KEYSTORE_PASSWORD --alias KEYSTORE_ALIAS --check-sec-attr --vault-block VAULT_BLOCK --attribute ATTRIBUTE --enc-dir ENC_FILE_DIR --iteration ITERATION_COUNT --salt SALT
```

Substitute the placeholder values with the actual values. The values for parameters `KEYSTORE_URL`, `KEYSTORE_PASSWORD` and `KEYSTORE_ALIAS` must match those provided when the password vault was created.

**NOTE**

The keystore password must be given in plaintext form, not masked form.

If the sensitive string is stored in the vault block specified, the following message will be displayed:

```
Password already exists.
```

If the value is not stored in the specified block, the following message will be displayed:
To run the password vault command interactively, the following steps are required:

1. Launch the password vault command interactively.
   Run `EAP_HOME/bin/vault.sh` (on Red Hat Enterprise Linux and similar operating systems) or `EAP_HOME\bin\vault.bat` (on Windows Server). Start a new interactive session by typing `0` (zero).

2. Complete the prompted parameters. Follow the prompts to input the required authentication parameters. These values must match those provided when the password vault was created.

   **NOTE**
   When prompted for authentication, the keystore password must be given in plaintext form, not masked form.

   - Enter 1 (one) to select **Check whether a secured attribute exists**
   - Enter the name of the vault block in which the sensitive string is stored.
   - Enter the name of the sensitive string to be checked.

If the sensitive string is stored in the vault block specified, a confirmation message like the following will be output:

   **A value exists for** (VAULT_BLOCK, ATTRIBUTE)

If the sensitive string is not stored in the specified block, a message like the following will be output:

   **No value has been store for** (VAULT_BLOCK, ATTRIBUTE)

**Example: Check For a Sensitive String Interactively**

```
JBoss Vault
JBOSS_HOME: EAP_HOME
JAVA: java

 **** JBoss Vault ********

Please enter a Digit::   0: Start Interactive Session  1: Remove Interactive Session  2: Exit
0
Starting an interactive session
Enter directory to store encrypted files:EAP_HOME/vault
Enter Keystore URL:EAP_HOME/vault/vault.keystore
Enter Keystore password:
Enter Keystore password again:
Values match
Enter 8 character salt:1234abcd
Enter iteration count as a number (Eg: 44):120
Enter Keystore Alias:vault
Initializing Vault
```
3.2.8. Remove a Sensitive String from the Password Vault

For security reasons it is best to remove sensitive strings from the Password Vault when they are no longer required. For example, if an application is being decommissioned, any sensitive strings used in datasource definitions should be removed at the same time.

**IMPORTANT**

As a prerequisite, before removing a sensitive string from the Password Vault, confirm if it is used in the configuration of JBoss EAP.

This operation can be done either interactively, where the user is prompted for each parameter’s value, or non-interactively, where all parameters’ values are provided on the command line. Each method gives the same result, so either may be used. Both of these methods are invoked using the `vault` script.

Use the non-interactive method to provide all parameters’ values at once. For a description of all parameters, see *Initialize the Password Vault*. To run the password vault command non-interactively, the `vault` script (located in `EAP_HOME/bin/`) can be invoked with parameters for the relevant information:

```
$ vault.sh --keystore KEystore_URL --keystore-password KEystore_PASSWORD --alias KEystore_ALIAS --remove-sec-attr --vault-block VAULT_BLOCK --attribute ATTRIBUTE --enc-dir ENC_FILE_DIR --iteration ITERATION_COUNT --salt SALT
```

Substitute the placeholder values with the actual values. The values for parameters `KEYSTORE_URL`, `KEYSTORE_PASSWORD` and `KEYSTORE_ALIAS` must match those provided when the password Vault was created.
NOTE

The keystore password must be given in plaintext form, not masked form.

If the sensitive string is successfully removed, a confirmation message like the following will be displayed:

```
Secured attribute [VAULT_BLOCK::ATTRIBUTE] has been successfully removed from vault
```

If the sensitive string is not removed, a message like the following will be displayed:

```
Secured attribute [VAULT_BLOCK::ATTRIBUTE] was not removed from vault, check whether it exist
```

Example: Output

```
$ ./vault.sh --keystore EAP_HOME/vault/vault.keystore --keystore-password vault22 --alias vault --remove-sec-attr --vault-block vb --attribute password --enc-dir EAP_HOME/vault/ --iteration 120 --salt 1234abcd
```

```
Secured attribute [vb::password] has been successfully removed from vault
```

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If the sensitive string is not removed, a message like the following will be displayed:

Secured attribute [VAULT_BLOCK::ATTRIBUTE] was not removed from vault, check whether it exist

**Example: Output**

```
Starting an interactive session
Enter directory to store encrypted files:EAP_HOME/vault/
Enter Keystore URL:EAP_HOME/vault/vault.keystore
Enter Keystore password:
Enter Keystore password again:
Values match
Enter 8 character salt:1234abcd
Enter iteration count as a number (Eg: 44):120
Enter Keystore Alias:vault
```

```
Initializing Vault
```

```
INFO: PBOX000361: Default Security Vault Implementation Initialized and Ready
```

```
Vault Configuration in configuration file:
```

```
<extensions>
<vault>
  <vault-option name="KEYSTORE_URL" value="EAP_HOME/vault/vault.keystore"/>
  <vault-option name="KEYSTORE_PASSWORD" value="MASK-5dOaAVafCSd"/>
  <vault-option name="KEYSTORE_ALIAS" value="vault"/>
  <vault-option name="SALT" value="1234abcd"/>
  <vault-option name="ITERATION_COUNT" value="120"/>
  <vault-option name="ENC_FILE_DIR" value="EAP_HOME/vault"/>
</vault>
</extensions>
```

```
Vault is initialized and ready for use
```

```
Handshake with Vault complete
```

```
Please enter a Digit:: 0: Store a secured attribute 1: Check whether a secured attribute exists 2: Remove secured attribute 3: Exit
2
```

```
Task: Remove secured attribute
Enter Vault Block:vb
Enter Attribute Name:password
Secured attribute [vb::password] has been successfully removed from vault
```

### 3.2.9. Configure Red Hat JBoss Enterprise Application Platform to Use a Custom Implementation of the Password Vault

In addition to using the provided password vault implementation, a custom implementation of SecurityVault can also be used.
IMPORTANT

As a prerequisite, ensure that the password vault has been initialized. For more information, see Initialize the Password Vault.

To use a custom implementation for the password vault:

1. Create a class that implements the interface `SecurityVault`.

2. Create a module containing the class from the previous step, and specify a dependency on `org.picketbox` where the interface is `SecurityVault`.

3. Enable the custom password vault in the JBoss EAP configuration by adding the vault element with the following attributes:
   - `code` - The fully qualified name of class that implements `SecurityVault`.
   - `module` - The name of the module that contains the custom class.

Optionally, the `vault-options` parameters can be used to initialize the custom class for a password vault.

Example: Use `vault-options` Parameters to Initialize the Custom Class

```
/core-service=vault:add(code="custom.vault.implementation.CustomSecurityVault", module="custom.vault.module", vault-options=[("KEYSTORE_URL" => PATH_TO_KEYSTORE), ("KEYSTORE_PASSWORD" => MASKED_PASSWORD), ("KEYSTORE_ALIAS" => ALIAS), ("SALT" => SALT), ("ITERATION_COUNT" => ITERATION_COUNT), ("ENC_FILE_DIR" => ENC_FILE_DIR)])
```

3.2.10. Obtain Keystore Password From External Source

The `EXT`, `EXTC`, `CMD`, `CMDC` or `CLASS` methods can be used in vault configuration for obtaining the Java keystore password.

```
<vault-option name="KEYSTORE_PASSWORD" value="METHOD_TO_OBTAIN_PASSWORD"/>
```

The description for the methods are listed as:

{EXT}...

Refers to the exact command, where the ... is the exact command. For example:

{EXT}/usr/bin/getmypassword --section 1 --query company, run the `/usr/bin/getmypassword` command, which displays the password on standard output and use it as password for Security Vault’s keystore. In this example, the command is using two options: --section 1 and --query company.

{EXTC[:expiration_in_millis]}...

Refers to the exact command, where the ... is the exact command line that is passed to the `Runtime.exec(String)` method to execute a platform command. The first line of the command output is used as the password. EXTC variant caches the passwords for `expiration_in_millis` milliseconds. Default cache expiration is `0 = infinity`. For example:

{EXTC:120000}/usr/bin/getmypassword --section 1 --query company verifies if the cache contains /usr/bin/getmypassword output, if it contains the output then use it. If it does not contain the output, run the command to output it to cache and use it. In this example, the cache expires in 2 minutes, that is 120000 milliseconds.

{CMD}... or {CMDC[:expiration_in_millis]}...
The general command is a string delimited by , (comma) where the first part is the actual command and further parts represents the parameters. The comma can be backslashed to keep it as a part of the parameter. For example, `{CMD}/usr/bin/getmypassword,--section,1,--query,company`.

```
{CLASS[@jboss_module_spec]}classname[:ctorargs]
```

Where the [:ctorargs] is an optional string delimited by the : (colon) from the classname is passed to the classname ctor. The ctorargs is a comma delimited list of strings. For example, `{CLASS@org.test.passwd}org.test.passwd.ExternamPassworProvider`. In this example, the org.test.passwd.ExternamPassworProvider class is loaded from org.test.passwd module and uses the toCharArray() method to get the password. If toCharArray() is not available the toString() method is used. The org.test.passwd.ExternamPassworProvider class must have the default constructor.
4.1. ABOUT THE JAVA SECURITY MANAGER

The Java Security Manager is a class that manages the external boundary of the Java Virtual Machine (JVM) sandbox, controlling how code executing within the JVM can interact with resources outside the JVM. When the Java Security Manager is activated, the Java API checks with the security manager for approval before executing a wide range of potentially unsafe operations. The Java Security Manager uses a security policy to determine whether a given action will be allowed or denied.

4.2. DEFINE A JAVA SECURITY POLICY

A Java security policy is a set of defined permissions for different classes of code. The Java Security Manager compares actions requested by applications against the security policy. If an action is allowed by the policy, the Security Manager will permit that action to take place. If the action is not allowed by the policy, the Security Manager will deny that action.

IMPORTANT

Previous versions of JBoss EAP defined policies using an external file, e.g. `EAP_HOME/bin/server.policy`. JBoss EAP 7 defines Java Security Policies in two ways: the security-manager subsystem and through XML files in the individual deployments. The security-manager subsystem defines minimum and maximum permission for ALL deployments, while the XML files specify the permissions requested by the individual deployment.

4.2.1. Defining Policies in the Security Manager Subsystem

The security-manager subsystem allows you do define shared or common permissions for all deployments. This is accomplished by defining minimum and maximum permission sets. All deployments will be granted at the least all permissions defined in the minimum permission. The deployment process fails for a deployment if it requests a permission that exceeds the ones defined in the maximum permission set.

Example: Management CLI Command for Updating Minimum Permission Set

```
/subsystem=security-manager/deployment-permissions=default:write-attribute(name=minimum-permissions, value=([{class="java.util.PropertyPermission", actions="read", name="*"}])
```

Example: Management CLI Command for Updating Maximum Permission Set

```
/subsystem=security-manager/deployment-permissions=default:write-attribute(name=maximum-permissions, value=([{class="java.util.PropertyPermission", actions="read,write", name="*"},
{class="java.io.FilePermission", actions="read,write", name="/.-"]})
```

NOTE

If the maximum permission set is not defined, its value defaults to java.security.AllPermission.

You can find a full reference of the security-manager subsystem in the JBoss EAP Configuration Guide.
4.2.2. Defining Policies in the Deployment

In JBoss EAP 7, you can add a `META-INF/permissions.xml` to your deployment, which is part of JSR 342 and is a part of the Jakarta EE specification. This file allows you to specify the permissions needed by the deployment. If a minimum permissions set is defined in the `security-manager` subsystem and a `META-INF/permissions.xml` is added to your deployment, then the union of those permissions is granted. If the permissions requested in the `permissions.xml` exceed the maximum policies defined in the `security-manager` subsystem, its deployment will not succeed. If both `META-INF/permissions.xml` and `META-INF/jboss-permissions.xml` are present in the deployment, then only the permissions requested in the `META-INF/jboss-permissions.xml` are granted.

The specification dictates that `permissions.xml` cover the entire application or top-level deployment module. In cases where you wish to define specific permissions for a subdeployment, you can use the JBoss EAP-specific `META-INF/jboss-permissions.xml`. It follows the same exact format as `permissions.xml` and will apply only to the deployment module in which it is declared.

Example: Sample permissions.xml

```xml
<permissions version="7">
  <permission>
    <class-name>java.util.PropertyPermission</class-name>
    <name>*</name>
    <actions>read</actions>
  </permission>
</permissions>
```

4.2.3. Defining Policies in Modules

You can restrict the permissions of a module by adding a `<permissions>` element to the `module.xml` file. The `<permissions>` element contains zero or more `<grant>` elements, which define the permission to grant to the module. Each `<grant>` element contains the following attributes:

permission
  The qualified class name of the permission to grant.

name
  The permission name to provide to the permission class constructor.

actions
  The (optional) list of actions, required by some permission types.

Example: module.xml with Defined Policies

```xml
<module xmlns="urn:jboss:module:1.5" name="org.jboss.test.example">
  <permissions>
    <grant permission="java.util.PropertyPermission" name="*" actions="read,write" />
    <grant permission="java.io.FilePermission" name="/etc/-" actions="read" />
  </permissions>
</module>
```

If the `<permissions>` element is present, the module will be restricted to only the permissions you have listed. If the `<permissions>` element is not present, there will be no restrictions on the module.
4.3. RUN JBOSS EAP WITH THE JAVA SECURITY MANAGER

**IMPORTANT**

Previous version of JBoss EAP allowed for the use of the `-Djava.security.manager` Java system property as well as custom security managers. Neither of these are supported in JBoss EAP 7. In addition, the Java Security Manager policies are now defined within the `security-manager` subsystem, meaning external policy files and the `-Djava.security.policy` Java system property are not supported JBoss EAP 7.

**IMPORTANT**

Before starting JBoss EAP with the Java Security Manager enabled, you need make sure all security policies are defined in the `security-manager` subsystem.

To run JBoss EAP with the Java Security Manager, you need to use the `secmgr` option during startup. There are two ways to do this:

- Use the flag with the startup script To use the `-secmgr` flag with the startup script, include it when starting up your JBoss EAP instance:

  Example: Startup Script
  
  ```sh
  ./standalone.sh -secmgr
  ```

- Using the Startup Configuration File

  **IMPORTANT**

  The domain or standalone server must be completely stopped before you edit any configuration files.

  **NOTE**

  If you are using JBoss EAP in a managed domain, you must perform the following procedure on each physical host or instance in your domain.

  To enable the Java Security Manager using the startup configuration file, you need to edit either the `standalone.conf` or `domain.conf` file, depending if you are running a standalone instance or managed domain. If running in Windows, the `standalone.conf.bat` or `domain.conf.bat` files are used instead.

  Uncomment the `SECMGR="true"` line in the configuration file:

  **Example: standalone.conf or domain.conf**

  ```
  # Uncomment this to run with a security manager enabled
  SECMGR="true"
  ```

  **Example: standalone.conf.bat or domain.conf.bat**
rem # Uncomment this to run with a security manager enabled
set "SECMGR=true"

4.4. CONSIDERATIONS MOVING FROM PREVIOUS VERSIONS

When moving applications from a previous version of JBoss EAP to JBoss EAP 7 running with the Java Security Manager enabled, you need to be aware of the changes in how policies are defined as well as the necessary configuration needed with both the JBoss EAP configuration and the deployment.

4.4.1. Defining Policies

In previous versions of JBoss EAP, policies were defined in an external configuration file. In JBoss EAP 7, policies are defined using the `security-manager` subsystem and with `permissions.xml` or `jboss-permissions.xml` contained in the deployment. More details on how to use both to define your policies are covered in a previous section.

4.4.2. JBoss EAP Configuration Changes

In previous versions of JBoss EAP, you could use `-Djava.security.manager` and `-Djava.security.policy` Java system properties during JBoss EAP startup. These are no longer supported and the `secmgr` flag should be used instead to enable JBoss EAP to run with the Java Security Manager. More details on the `secmgr` flag are covered in a previous section.

4.4.3. Custom Security Managers

Custom security managers are not supported in JBoss EAP 7.
## APPENDIX A. REFERENCE MATERIAL

### A.1. ELYTRON SUBSYSTEM COMPONENTS REFERENCE

#### Table A.1. add-prefix-role-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>prefix</td>
<td>The prefix to add to each role.</td>
</tr>
</tbody>
</table>

#### Table A.2. add-suffix-role-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>suffix</td>
<td>The suffix to add to each role.</td>
</tr>
</tbody>
</table>

#### Table A.3. aggregate-http-server-mechanism-factory Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>http-server-mechanism-factories</td>
<td>The list of HTTP server factories to aggregate.</td>
</tr>
</tbody>
</table>

#### Table A.4. aggregate-principal-decoder Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>principal-decoders</td>
<td>The list of principal decoders to aggregate.</td>
</tr>
</tbody>
</table>

#### Table A.5. aggregate-principal-transformer Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>principal-transformers</td>
<td>The list of principal transformers to aggregate.</td>
</tr>
</tbody>
</table>

#### Table A.6. aggregate-providers Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>providers</td>
<td>The list of referenced Provider[] resources to aggregate.</td>
</tr>
</tbody>
</table>

#### Table A.7. aggregate-realm Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
</table>
## Attribute Description

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>authentication-realm</td>
<td>Reference to the security realm to use for authentication steps. This is used for obtaining or validating credentials.</td>
</tr>
<tr>
<td>authorization-realm</td>
<td>Reference to the security realm to use for loading the identity for authorization steps.</td>
</tr>
<tr>
<td>authorization-realms</td>
<td>Reference to the security realms to aggregate for loading the identity for authorization steps. For information about using multiple authorization realms, see Configure Authentication and Authorization Using Multiple Identity Stores in the How to Configure Identity Management guide.</td>
</tr>
</tbody>
</table>

**NOTE**

The **authorization-realm** and **authorization-realms** attributes are mutually exclusive. Define only one of the two attributes in a realm.

### Table A.8. aggregate-role-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>role-mappers</td>
<td>The list of role mappers to aggregate.</td>
</tr>
</tbody>
</table>

### Table A.9. aggregate-sasl-server-factory Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sasl-server-factories</td>
<td>The list of SASL server factories to aggregate.</td>
</tr>
</tbody>
</table>

### Table A.10. authentication-configuration Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>anonymous</td>
<td>If <code>true</code> anonymous authentication is allowed. The default is <code>false</code>.</td>
</tr>
<tr>
<td>authentication-name</td>
<td>The authentication name to use.</td>
</tr>
<tr>
<td>authorization-name</td>
<td>The authorization name to use.</td>
</tr>
<tr>
<td>credential-reference</td>
<td>The credential to use for authentication. This can be in clear text or as a reference to a credential stored in a <strong>credential-store</strong>.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>extends</td>
<td>An existing authentication configuration to extend.</td>
</tr>
<tr>
<td>host</td>
<td>The host to use.</td>
</tr>
<tr>
<td>kerberos-security-factory</td>
<td>Reference to a kerberos security factory used to obtain a GSS kerberos credential.</td>
</tr>
<tr>
<td>mechanism-properties</td>
<td>Configuration properties for the SASL authentication mechanism.</td>
</tr>
<tr>
<td>port</td>
<td>The port to use.</td>
</tr>
<tr>
<td>protocol</td>
<td>The protocol to use.</td>
</tr>
<tr>
<td>realm</td>
<td>The realm to use.</td>
</tr>
<tr>
<td>sasl-mechanism-selector</td>
<td>The SASL mechanism selector string. See <code>sasl-mechanism-selector</code> Grammar for usage information.</td>
</tr>
<tr>
<td>security-domain</td>
<td>Reference to a security domain to obtain a forwarded identity.</td>
</tr>
</tbody>
</table>

Table A.11. authentication-context Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>extends</td>
<td>An existing authentication context to extend.</td>
</tr>
<tr>
<td>match-rules</td>
<td>The rules to match against for this authentication context.</td>
</tr>
</tbody>
</table>

Table A.12. authentication-context match-rules Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>match-abstract-type</td>
<td>The abstract type to match against.</td>
</tr>
<tr>
<td>match-abstract-type-authority</td>
<td>The abstract type authority to match against.</td>
</tr>
<tr>
<td>match-host</td>
<td>The host to match against.</td>
</tr>
<tr>
<td>match-local-security-domain</td>
<td>The local security domain to match against.</td>
</tr>
<tr>
<td>match-no-user</td>
<td>If true, rule will match against no user.</td>
</tr>
<tr>
<td>match-path</td>
<td>The patch to match against.</td>
</tr>
</tbody>
</table>
### Table A.13. caching-realm Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>match-port</td>
<td>The port to match against.</td>
</tr>
<tr>
<td>match-protocol</td>
<td>The protocol to match against.</td>
</tr>
<tr>
<td>match-urn</td>
<td>The URN to match against.</td>
</tr>
<tr>
<td>match-user</td>
<td>The user to match against.</td>
</tr>
<tr>
<td>authentication-configuration</td>
<td>Reference to the authentication configuration to use for a successful match.</td>
</tr>
<tr>
<td>ssl-context</td>
<td>Reference to the <code>ssl-context</code> to use for a successful match.</td>
</tr>
</tbody>
</table>

### Table A.14. certificate-authority-account Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>alias</td>
<td>The alias of certificate authority account key in the keystore. If the alias does not already exist in the keystore, a certificate authority account key will be automatically generated and stored as a <code>PrivateKeyEntry</code> under the alias.</td>
</tr>
<tr>
<td>certificate-authority</td>
<td>The name of the certificate authority to use. The default, and only allowed value, is <code>LetsEncrypt</code>.</td>
</tr>
<tr>
<td>contact-urls</td>
<td>A list of URLs that the certificate authority can contact about any issues related to this account.</td>
</tr>
<tr>
<td>credential-reference</td>
<td>The credential to be used when accessing the certificate authority account key.</td>
</tr>
<tr>
<td>key-store</td>
<td>The keystore that contains the certificate authority account key.</td>
</tr>
</tbody>
</table>
### Table A.15. chained-principal-transformer Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>principal-transformers</td>
<td>List of principal transformers to chain.</td>
</tr>
</tbody>
</table>

### Table A.16. client-ssl-context Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cipher-suite-filter</td>
<td>The filter to apply to specify the enabled cipher suites. This filter takes a list of items delimited by colons, commas, or spaces. Each item may be a OpenSSL-style cipher suite name, a standard SSL/TLS cipher suite name, or a keyword such as TLSv1.2 or DES. A full list of keywords as well as additional details on creating a filter can be found in the Javadoc for the CipherSuiteSelector class. The default value is DEFAULT, which corresponds to all known cipher suites that do not have NULL encryption and excludes any cipher suites that have no authentication.</td>
</tr>
<tr>
<td>key-manager</td>
<td>Reference to the key-manager to use within the SSLContext.</td>
</tr>
<tr>
<td>protocols</td>
<td>The enabled protocols. Allowed options: SSLv2, SSLv3, TLSv1, TLSv1.1, TLSv1.2, TLSv1.3. This defaults to enabling TLSv1, TLSv1.1, TLSv1.2, and TLSv1.3.</td>
</tr>
</tbody>
</table>

**WARNING**

Red Hat recommends that SSLv2, SSLv3, and TLSv1.0 be explicitly disabled in favor of TLSv1.1 or TLSv1.2 in all affected packages.

| provider-name     | The name of the provider to use. If not specified, all providers from providers will be passed to the SSLContext.                           |
| providers         | The name of the providers to obtain the Provider[] to use to load the SSLContext.                                                           |
| session-timeout   | The timeout for SSL sessions.                                                                                                                |
| trust-manager     | Reference to the trust-manager to use within the SSLContext.                                                                                 |

### Table A.17. concatenating-principal-decoder Attributes
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>joiner</td>
<td>The string that will be used to join the values in the principal-decoders attribute.</td>
</tr>
<tr>
<td>principal-decoders</td>
<td>The list of principal decoders to concatenate.</td>
</tr>
</tbody>
</table>

**Table A.18. configurable-http-server-mechanism-factory Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>filters</td>
<td>The list of filters to be applied in order to enable or disable mechanisms based on the name.</td>
</tr>
<tr>
<td>http-server-mechanism-factory</td>
<td>Reference to the http server factory to be wrapped.</td>
</tr>
<tr>
<td>properties</td>
<td>Custom properties to be passed in to the HTTP server factory calls.</td>
</tr>
</tbody>
</table>

**Table A.19. configurable-http-server-mechanism-factory filters Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pattern-filter</td>
<td>Filter based on a regular expression pattern.</td>
</tr>
<tr>
<td>enabling</td>
<td>If true the filter will be enabled if the mechanism matches. This defaults to true.</td>
</tr>
</tbody>
</table>

**Table A.20. configurable-sasl-server-factory Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>filters</td>
<td>List of filters to be evaluated sequentially and combined using or.</td>
</tr>
<tr>
<td>properties</td>
<td>Custom properties to be passed in to the SASL server factory calls.</td>
</tr>
<tr>
<td>protocol</td>
<td>The protocol passed into the factory when creating the mechanism.</td>
</tr>
<tr>
<td>sasl-server-factory</td>
<td>Reference to the SASL server factory to be wrapped.</td>
</tr>
<tr>
<td>server-name</td>
<td>The server name passed into the factory when creating the mechanism.</td>
</tr>
</tbody>
</table>

**Table A.21. configurable-sasl-server-factory filters Attributes**
### Table A.22. constant-permission-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>permission-sets</td>
<td>The permission sets to assign in the event of a match. Permission sets can be used to assign permissions to an identity.</td>
</tr>
</tbody>
</table>

**NOTE**

The `permissions` attribute is deprecated, and is replaced by `permission-sets`.

### Table A.23. constant-principal-decoder Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>The constant value the principal decoder will always return.</td>
</tr>
</tbody>
</table>

### Table A.24. constant-principal-transformer Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>The constant value this principal transformer will always return.</td>
</tr>
</tbody>
</table>

### Table A.25. constant-realm-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>realm-name</td>
<td>Reference to the realm that will be returned.</td>
</tr>
</tbody>
</table>
### Table A.26. case-principal-transformer attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>upper-case</td>
<td>An optional attribute that converts a principal transformer’s name to uppercase characters when set as true, which is the default setting. Set the attribute to false to convert the principal transformer’s name to lowercase characters.</td>
</tr>
</tbody>
</table>

### Table A.27. constant-role-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>roles</td>
<td>The list of roles that will be returned.</td>
</tr>
</tbody>
</table>

### Table A.28. credential-store Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>create</td>
<td>Specifies whether the credential store should create storage when it does not exist.</td>
</tr>
<tr>
<td>credential-reference</td>
<td>The reference to the credential used to create protection parameter. This can be in clear text or as a reference to a credential stored in a credential-store.</td>
</tr>
<tr>
<td>implementation-properties</td>
<td>Map of credentials store implementation-specific properties.</td>
</tr>
<tr>
<td>location</td>
<td>The file name of the credential store storage.</td>
</tr>
<tr>
<td>modifiable</td>
<td>Whether the credential store is modifiable.</td>
</tr>
<tr>
<td>other-providers</td>
<td>The name of the providers to obtain the providers to search for the one that can create the required Jakarta Connectors objects within the credential store. This is valid only for keystore-based credential store. If this is not specified, then the global list of providers is used instead.</td>
</tr>
<tr>
<td>provider-name</td>
<td>The name of the provider to use to instantiate the CredentialStoreSpi. If the provider is not specified, then the first provider found that can create an instance of the specified type will be used.</td>
</tr>
<tr>
<td>providers</td>
<td>The name of the providers to obtain the providers to search for the one that can create the required credential store type. If this is not specified, then the global list of providers is used instead.</td>
</tr>
<tr>
<td>relative-to</td>
<td>The base path this credential store path is relative to.</td>
</tr>
</tbody>
</table>
Table A.29. credential-store alias

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>entry-type</td>
<td>Type of credential entry stored in the credential store.</td>
</tr>
<tr>
<td>secret-value</td>
<td>Secret value such as password.</td>
</tr>
</tbody>
</table>

Table A.30. credential-store KeyStoreCredentialStore implementation properties

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cryptoAlg</td>
<td>Cryptographic algorithm name to be used to encrypt decrypt entries at external storage. This attribute is only valid if external is enabled. Defaults to AES.</td>
</tr>
<tr>
<td>external</td>
<td>Whether data is stored to external storage and encrypted by the keyAlias. Defaults to false.</td>
</tr>
<tr>
<td>externalPath</td>
<td>Specifies path to external storage. This attribute is only valid if external is enabled.</td>
</tr>
<tr>
<td>keyAlias</td>
<td>The secret key alias within the credential store that is used to encrypt or decrypt data to the external storage.</td>
</tr>
<tr>
<td>keyStoreType</td>
<td>The keystore type, such as PKCS11. Defaults to KeyStore.getDefaultType().</td>
</tr>
</tbody>
</table>

Table A.31. custom-credential-security-factory Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>configuration</td>
<td>The optional key and value configuration for the custom security factory.</td>
</tr>
<tr>
<td>class-name</td>
<td>The class name of the implementation of the custom security factory.</td>
</tr>
<tr>
<td>module</td>
<td>The module to use to load the custom security factory.</td>
</tr>
</tbody>
</table>

Table A.32. custom-modifiable-realm Attributes
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>configuration</td>
<td>The optional key and value configuration for the custom realm.</td>
</tr>
<tr>
<td>class-name</td>
<td>The class name of the implementation of the custom realm.</td>
</tr>
<tr>
<td>module</td>
<td>The module to use to load the custom realm.</td>
</tr>
</tbody>
</table>

**Table A.33. custom-permission-mapper Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>configuration</td>
<td>The optional key and value configuration for the permission mapper.</td>
</tr>
<tr>
<td>class-name</td>
<td>Fully qualified class name of the permission mapper.</td>
</tr>
<tr>
<td>module</td>
<td>Name of the module to use to load the permission mapper.</td>
</tr>
</tbody>
</table>

**Table A.34. custom-principal-decoder Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>configuration</td>
<td>The optional key and value configuration for the principal decoder.</td>
</tr>
<tr>
<td>class-name</td>
<td>Fully qualified class name of the principal decoder.</td>
</tr>
<tr>
<td>module</td>
<td>Name of the module to use to load the principal decoder.</td>
</tr>
</tbody>
</table>

**Table A.35. custom-principal-transformer Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>configuration</td>
<td>The optional key and value configuration for the principal transformer.</td>
</tr>
<tr>
<td>class-name</td>
<td>Fully qualified class name of the principal transformer.</td>
</tr>
<tr>
<td>module</td>
<td>Name of the module to use to load the principal transformer.</td>
</tr>
</tbody>
</table>

**Table A.36. custom-realm Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>configuration</td>
<td>The optional key and value configuration for the custom realm.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>class-name</td>
<td>Fully qualified class name of the custom realm.</td>
</tr>
<tr>
<td>module</td>
<td>Name of the module to use to load the custom realm.</td>
</tr>
</tbody>
</table>

Table A.37. custom-realm-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>configuration</td>
<td>The optional key and value configuration for the realm mapper.</td>
</tr>
<tr>
<td>class-name</td>
<td>Fully qualified class name of the realm mapper.</td>
</tr>
<tr>
<td>module</td>
<td>Name of the module to use to load the realm mapper.</td>
</tr>
</tbody>
</table>

Table A.38. custom-role-decoder Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>configuration</td>
<td>The optional key and value configuration for the role decoder.</td>
</tr>
<tr>
<td>class-name</td>
<td>Fully qualified class name of the role decoder.</td>
</tr>
<tr>
<td>module</td>
<td>Name of the module to use to load the role decoder.</td>
</tr>
</tbody>
</table>

Table A.39. custom-role-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>configuration</td>
<td>The optional key and value configuration for the role mapper.</td>
</tr>
<tr>
<td>class-name</td>
<td>Fully qualified class name of the role mapper.</td>
</tr>
<tr>
<td>module</td>
<td>Name of the module to use to load the role mapper.</td>
</tr>
</tbody>
</table>

Table A.40. dir-context Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>authentication-context</td>
<td>The authentication context to obtain login credentials to connect to the LDAP server. Can be omitted if authentication-level is none, which is equivalent to anonymous authentication.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>authentication-level</td>
<td>The authentication level, meaning security level or authentication mechanism, to use. Corresponds to SECURITY_AUTHENTICATION or java.naming.security.authentication environment property. Allowed values are none, simple and sasl_mech format. The sasl_mech format is a space-separated list of SASL mechanism names.</td>
</tr>
<tr>
<td>connection-timeout</td>
<td>The timeout for connecting to the LDAP server in milliseconds.</td>
</tr>
<tr>
<td>credential-reference</td>
<td>The credential reference to authenticate and connect to the LDAP server. This can be omitted if authentication-level is none, which is equivalent to anonymous authentication.</td>
</tr>
<tr>
<td>enable-connection-pooling</td>
<td>If true connection pooling is enabled. This defaults to false.</td>
</tr>
<tr>
<td>module</td>
<td>Name of module that will be used as the class loading base.</td>
</tr>
<tr>
<td>principal</td>
<td>The principal to authenticate and connect to the LDAP server. This can be omitted if authentication-level is none which is equivalent to anonymous authentication.</td>
</tr>
<tr>
<td>properties</td>
<td>The additional connection properties for the DirContext.</td>
</tr>
<tr>
<td>read-timeout</td>
<td>The read timeout for an LDAP operation in milliseconds.</td>
</tr>
<tr>
<td>referral-mode</td>
<td>The mode used to determine if referrals should be followed. Allowed values are FOLLOW, IGNORE, and THROW. This defaults to IGNORE.</td>
</tr>
<tr>
<td>ssl-context</td>
<td>The name of the SSL context used to secure connection to the LDAP server.</td>
</tr>
<tr>
<td>url</td>
<td>The connection URL.</td>
</tr>
</tbody>
</table>

**Table A.41. filesystem-realm Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>encoded</td>
<td>Whether the identity names should be stored encoded (Base32) in file names.</td>
</tr>
<tr>
<td>levels</td>
<td>The number of levels of directory hashing to apply. The default value is 2.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>path</td>
<td>The path to the file containing the realm.</td>
</tr>
<tr>
<td>relative-to</td>
<td>The predefined relative path to use with <code>path</code>. For example <code>jboss.server.config.dir</code>.</td>
</tr>
</tbody>
</table>

Table A.42. filtering-key-store Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>alias-filter</td>
<td>A filter to apply to the aliases returned from the <code>key-store</code>. It can either be a comma-separated list of aliases to return or one of the following formats:</td>
</tr>
<tr>
<td></td>
<td>- ALL:-alias1:-alias2</td>
</tr>
<tr>
<td></td>
<td>- NONE:+alias1:+alias2</td>
</tr>
</tbody>
</table>

**NOTE**

The `alias-filter` attribute is case sensitive. Because the use of mixed-case or uppercase aliases, such as `elytronAppServer`, might not be recognized by some keystore providers, it is recommended to use lowercase aliases, such as `elytronappserver`.

| key-store   | Reference to the `key-store` to filter.                                    |

Table A.43. http-authentication-factory Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>http-server-mechanism-factory</td>
<td>The <code>HttpServerAuthenticationMechanismFactory</code> to associate with this resource.</td>
</tr>
<tr>
<td>mechanism-configurations</td>
<td>The list of mechanism-specific configurations.</td>
</tr>
<tr>
<td>security-domain</td>
<td>The security domain to associate with this resource.</td>
</tr>
</tbody>
</table>

Table A.44. http-authentication-factory mechanism-configurations Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>credential-security-factory</td>
<td>The security factory to use to obtain a credential as required by the mechanism.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>final-principal-transformer</td>
<td>A final principal transformer to apply for this mechanism realm.</td>
</tr>
<tr>
<td>host-name</td>
<td>The host name this configuration applies to.</td>
</tr>
<tr>
<td>mechanism-name</td>
<td>This configuration will only apply where a mechanism with the name specified is used. If this attribute is omitted then this will match any mechanism name.</td>
</tr>
<tr>
<td>mechanism-realm-configurations</td>
<td>The list of definitions of the realm names as understood by the mechanism.</td>
</tr>
<tr>
<td>pre-realm-principal-transformer</td>
<td>A principal transformer to apply before the realm is selected.</td>
</tr>
<tr>
<td>post-realm-principal-transformer</td>
<td>A principal transformer to apply after the realm is selected.</td>
</tr>
<tr>
<td>protocol</td>
<td>The protocol this configuration applies to.</td>
</tr>
<tr>
<td>realm-mapper</td>
<td>The realm mapper to be used by the mechanism.</td>
</tr>
</tbody>
</table>

Table A.45. http-authentication-factory mechanism-configurations mechanism-realm-configurations Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>final-principal-transformer</td>
<td>A final principal transformer to apply for this mechanism realm.</td>
</tr>
<tr>
<td>post-realm-principal-transformer</td>
<td>A principal transformer to apply after the realm is selected.</td>
</tr>
<tr>
<td>pre-realm-principal-transformer</td>
<td>A principal transformer to apply before the realm is selected.</td>
</tr>
<tr>
<td>realm-mapper</td>
<td>The realm mapper to be used by the mechanism.</td>
</tr>
<tr>
<td>realm-name</td>
<td>The name of the realm to be presented by the mechanism.</td>
</tr>
</tbody>
</table>

Table A.46. identity-realm Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute-name</td>
<td>The name of the attribute associated with this identity.</td>
</tr>
<tr>
<td>attribute-values</td>
<td>The list of values associated with the identities attribute.</td>
</tr>
<tr>
<td>identity</td>
<td>The identity available from the security realm.</td>
</tr>
</tbody>
</table>

Table A.47. jaspi-configuration Attributes
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>A name that allows the resource to be referenced in the management model.</td>
</tr>
<tr>
<td>layer</td>
<td>Used when registering this configuration with the <code>AuthConfigFactory</code>. Can</td>
</tr>
<tr>
<td></td>
<td>be omitted to allow wildcard matching.</td>
</tr>
<tr>
<td>application-context</td>
<td>Used when registering this configuration with the <code>AuthConfigFactory</code>. Can</td>
</tr>
<tr>
<td></td>
<td>be omitted to allow wildcard matching.</td>
</tr>
<tr>
<td>description</td>
<td>Is used to provide a description to the <code>AuthConfigFactory</code>.</td>
</tr>
</tbody>
</table>

Table A.48. `jaspi-configuration server-auth-module` Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>class-name</td>
<td>The fully qualified class name of the <code>ServerAuthModule</code>.</td>
</tr>
<tr>
<td>module</td>
<td>The module to load the <code>ServerAuthModule</code> from.</td>
</tr>
<tr>
<td>flag</td>
<td>The control flag to indicate how this module operates in relation to the</td>
</tr>
<tr>
<td></td>
<td>other modules.</td>
</tr>
<tr>
<td>options</td>
<td>Configuration options to be passed into the <code>ServerAuthModule</code> on</td>
</tr>
<tr>
<td></td>
<td>initialization.</td>
</tr>
</tbody>
</table>

Table A.49. `jdbc-realm` Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>principal-query</td>
<td>The list of authentication queries used to authenticate users based on</td>
</tr>
<tr>
<td></td>
<td>specific key types.</td>
</tr>
</tbody>
</table>

Table A.50. `jdbc-realm principal-query` Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute-mapping</td>
<td>The list of attribute mappings defined for this resource.</td>
</tr>
<tr>
<td>bcrypt-mapper</td>
<td>A key mapper that maps a column returned from a SQL query to a <code>Bcrypt</code> key</td>
</tr>
<tr>
<td></td>
<td>type.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>clear-password-mapper</td>
<td>A key mapper that maps a column returned from a SQL query to a clear password key type. This has a <strong>password-index</strong> child element that is the column index from an authentication query that represents the user’s password.</td>
</tr>
<tr>
<td>data-source</td>
<td>The name of the datasource used to connect to the database.</td>
</tr>
<tr>
<td>salted-simple-digest-mapper</td>
<td>A key mapper that maps a column returned from a SQL query to a <strong>Salted Simple Digest</strong> key type.</td>
</tr>
<tr>
<td>scram-mapper</td>
<td>A key mapper that maps a column returned from a SQL query to a <strong>SCRAM</strong> key type.</td>
</tr>
<tr>
<td>simple-digest-mapper</td>
<td>A key mapper that maps a column returned from a SQL query to a <strong>Simple Digest</strong> key type.</td>
</tr>
<tr>
<td>sql</td>
<td>The SQL statement used to obtain the keys as table columns for a specific user and map them accordingly with their type.</td>
</tr>
</tbody>
</table>

**Table A.51. jdbc-realm principal-query attribute-mapping Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>index</td>
<td>The column index from a query that representing the mapped attribute.</td>
</tr>
<tr>
<td>to</td>
<td>The name of the identity attribute mapped from a column returned from a SQL query.</td>
</tr>
</tbody>
</table>

**Table A.52. jdbc-realm principal-query bcrypt-mapper Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>iteration-count-index</td>
<td>The column index from an authentication query that represents the password’s iteration count, if supported.</td>
</tr>
<tr>
<td>password-index</td>
<td>The column index from an authentication query that represents the user’s password.</td>
</tr>
<tr>
<td>salt-index</td>
<td>The column index from an authentication query that represents the password’s salt, if supported.</td>
</tr>
</tbody>
</table>

**Table A.53. jdbc-realm principal-query salted-simple-digest-mapper Attributes**
### Table A.54. jdbc-realm principal-query simple-digest-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>password-index</td>
<td>The column index from an authentication query that represents the user’s password.</td>
</tr>
<tr>
<td>salt-index</td>
<td>The column index from an authentication query that represents the password’s salt, if supported.</td>
</tr>
</tbody>
</table>

### Table A.55. jdbc-realm principal-query scram-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>algorithm</td>
<td>The algorithm for a specific password key mapper. The allowed values are <code>scram-sha-1</code> and <code>scram-sha-256</code>. The default value is <code>scram-sha-256</code>.</td>
</tr>
<tr>
<td>iteration-count-index</td>
<td>The column index from an authentication query that represents the password’s iteration count, if supported.</td>
</tr>
<tr>
<td>password-index</td>
<td>The column index from an authentication query that represents the user’s password.</td>
</tr>
<tr>
<td>salt-index</td>
<td>The column index from an authentication query that represents the password’s salt, if supported.</td>
</tr>
</tbody>
</table>

### Table A.56. kerberos-security-factory Attributes
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>debug</td>
<td>If <code>true</code> the JAAS step of obtaining the credential will have debug logging enabled. Defaults to <code>false</code>.</td>
</tr>
<tr>
<td>mechanism-names</td>
<td>The mechanism names the credential should be usable with. Names will be converted to OIDs and used together with OIDs from <code>mechanism-oids</code> attribute.</td>
</tr>
<tr>
<td>mechanism-oids</td>
<td>The list of mechanism OIDs the credential should be usable with.</td>
</tr>
<tr>
<td>minimum-remaining-lifetime</td>
<td>The amount of time in seconds a cached credential can have before it is recreated.</td>
</tr>
<tr>
<td>obtain-kerberos-ticket</td>
<td>Should the <code>KerberosTicket</code> also be obtained and associated with the credential. This is required to be true where credentials are delegated to the server.</td>
</tr>
<tr>
<td>options</td>
<td>The <code>Krb5LoginModule</code> additional options.</td>
</tr>
<tr>
<td>path</td>
<td>The path of the keytab to load to obtain the credential.</td>
</tr>
<tr>
<td>principal</td>
<td>The principal represented by the keytab.</td>
</tr>
<tr>
<td>relative-to</td>
<td>The relative path to the keytab.</td>
</tr>
<tr>
<td>request-lifetime</td>
<td>How much lifetime should be requested for newly created credentials.</td>
</tr>
<tr>
<td>required</td>
<td>Whether the keytab file with an adequate principal is required to exist at the time the service starts.</td>
</tr>
<tr>
<td>server</td>
<td>If <code>true</code> this factory is used for the server-side portion of Kerberos authentication. If <code>false</code> it is used for the client-side. Defaults to <code>true</code>.</td>
</tr>
<tr>
<td>wrap-gss-credential</td>
<td>Whether generated GSS credentials should be wrapped to prevent improper disposal.</td>
</tr>
</tbody>
</table>

Table A.57. key-manager Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>algorithm</td>
<td>The name of the algorithm to use to create the underlying <code>KeyManagerFactory</code>. This is provided by the JDK. For example, a JDK that uses SunJSSE provides the <code>PKIX</code> and <code>SunX509</code> algorithms. More details on SunJSSE can be found in the <code>Java Secure Socket Extension (JSSE) Reference Guide</code>.</td>
</tr>
</tbody>
</table>
### Attribute

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>alias-filter</strong></td>
<td>A filter to apply to the aliases returned from the keystore. This can either be a comma-separated list of aliases to return or one of the following formats:</td>
</tr>
<tr>
<td></td>
<td>- ALL::alias1::alias2</td>
</tr>
<tr>
<td></td>
<td>- NONE:+alias1:+alias2</td>
</tr>
<tr>
<td><strong>credential-reference</strong></td>
<td>The credential reference to decrypt keystore item. This can be specified in clear text or as a reference to a credential stored in a <strong>credential-store</strong>. This is not a password of the keystore.</td>
</tr>
<tr>
<td><strong>key-store</strong></td>
<td>Reference to the <strong>key-store</strong> to use to initialize the underlying <strong>KeyManagerFactory</strong>.</td>
</tr>
<tr>
<td><strong>provider-name</strong></td>
<td>The name of the provider to use to create the underlying <strong>KeyManagerFactory</strong>.</td>
</tr>
<tr>
<td><strong>providers</strong></td>
<td>Reference to obtain the <strong>Provider[]</strong> to use when creating the underlying <strong>KeyManagerFactory</strong>.</td>
</tr>
</tbody>
</table>

### Table A.58. key-store Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>alias-filter</strong></td>
<td>A filter to apply to the aliases returned from the keystore, can either be a comma separated list of aliases to return or one of the following formats:</td>
</tr>
<tr>
<td></td>
<td>- ALL::alias1::alias2</td>
</tr>
<tr>
<td></td>
<td>- NONE:+alias1:+alias2</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
<td>The <strong>alias-filter</strong> attribute is case sensitive. Because the use of mixed-case or uppercase aliases, such as <strong>elytronAppServer</strong>, might not be recognized by some keystore providers, it is recommended to use lowercase aliases, such as <strong>elytronappserver</strong>.</td>
</tr>
<tr>
<td><strong>credential-reference</strong></td>
<td>The password to use to access the keystore. This can be specified in clear text or as a reference to a credential stored in a <strong>credential-store</strong>.</td>
</tr>
<tr>
<td><strong>path</strong></td>
<td>The path to the keystore file.</td>
</tr>
</tbody>
</table>
### key-store-realm Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>provider-name</td>
<td>The name of the provider to use to load the keystore. Setting this attribute disables searching for the first provider that can create a keystore of the specified type.</td>
</tr>
<tr>
<td>providers</td>
<td>A reference to the providers that should be used to obtain the list of provider instances to search. If not specified, the global list of providers will be used instead.</td>
</tr>
<tr>
<td>relative-to</td>
<td>The base path this store is relative to. This can be a full path or predefined path such as <code>jboss.server.config.dir</code>.</td>
</tr>
<tr>
<td>required</td>
<td>If <strong>true</strong> the keystore file referenced is required to exist at the time the keystore service starts. The default value is <strong>false</strong>.</td>
</tr>
<tr>
<td>type</td>
<td>The type of the keystore, for example, <strong>JKS</strong>.</td>
</tr>
</tbody>
</table>

**NOTE**

The following keystore types are detected automatically:

- JKS
- JCEKS
- PKCS12
- BKS
- BCFKS
- UBER

The other keystore types must be specified manually.

A full list of keystore types can be found in the *Java Cryptography Architecture Standard Algorithm Name Documentation for JDK 8*.

### ldap-key-store Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>key-store</td>
<td>Reference to the keystore used to back this security realm.</td>
</tr>
</tbody>
</table>

---

Table A.59. key-store-realm Attributes

Table A.60. ldap-key-store Attributes
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>alias-attribute</td>
<td>The name of LDAP attribute where the item alias will be stored.</td>
</tr>
<tr>
<td>certificate-attribute</td>
<td>The name of LDAP attribute where the certificate will be stored.</td>
</tr>
<tr>
<td>certificate-chain-attribute</td>
<td>The name of LDAP attribute where the certificate chain will be stored.</td>
</tr>
<tr>
<td>certificate-chain-encoding</td>
<td>The encoding of the certificate chain.</td>
</tr>
<tr>
<td>certificate-type</td>
<td>The type of the certificate.</td>
</tr>
<tr>
<td>dir-context</td>
<td>The name of the dir-context which will be used to communication with LDAP server.</td>
</tr>
<tr>
<td>filter-alias</td>
<td>The LDAP filter for obtaining an item in the keystore by alias.</td>
</tr>
<tr>
<td>filter-certificate</td>
<td>The LDAP filter for obtaining an item in the keystore by certificate.</td>
</tr>
<tr>
<td>filter-iterate</td>
<td>The LDAP filter for iterating over all items of the keystore.</td>
</tr>
<tr>
<td>key-attribute</td>
<td>The name of LDAP attribute where the key will be stored.</td>
</tr>
<tr>
<td>key-type</td>
<td>The type of keystore that is stored in a serialized manner in the LDAP attribute. For example, <strong>JKS</strong>. A full list of keystore types can be found in the Java Cryptography Architecture Standard Algorithm Name Documentation for JDK 8.</td>
</tr>
<tr>
<td>new-item-template</td>
<td>Configuration for item creation. This defines how the LDAP entry of newly created keystore item will look.</td>
</tr>
<tr>
<td>search-path</td>
<td>The path in LDAP where the keystore items will be searched.</td>
</tr>
<tr>
<td>search-recursive</td>
<td>If the LDAP search should be recursive.</td>
</tr>
<tr>
<td>search-time-limit</td>
<td>The time limit in milliseconds for obtaining keystore items from LDAP. Defaults to <strong>10000</strong>.</td>
</tr>
</tbody>
</table>

**Table A.61. ldap-key-store new-item-template Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>new-item-attributes</td>
<td>The LDAP attributes which will be set for newly created items. This takes a list of items with name and value pairs.</td>
</tr>
</tbody>
</table>
The path in LDAP where the newly created keystore items will be stored.

The name of LDAP RDN for the newly created items.

### Table A.62. ldap-realm Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>allow-blank-password</td>
<td>Whether this realm supports blank password direct verification. A blank password attempt will be rejected otherwise.</td>
</tr>
<tr>
<td>dir-context</td>
<td>The name of the dir-context which will be used to connect to the LDAP server.</td>
</tr>
<tr>
<td>direct-verification</td>
<td>If <code>true</code> this realm supports verification of credentials by directly connecting to LDAP as the account being authenticated; otherwise, the password is retrieved from the LDAP server and verified in JBoss EAP. If enabled, the JBoss EAP server must be able to obtain the plain user password from the client, which requires either the <code>PLAIN</code> SASL or <code>BASIC</code> HTTP mechanism be used for authentication. Defaults to <code>false</code>.</td>
</tr>
<tr>
<td>identity-mapping</td>
<td>The configuration options that define how principals are mapped to their corresponding entries in the underlying LDAP server.</td>
</tr>
</tbody>
</table>

### Table A.63. ldap-realm identity-mapping Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rdn-identifier</td>
<td>The RDN part of the principal’s DN to be used to obtain the principal’s name from an LDAP entry. This is also used when creating new identities.</td>
</tr>
<tr>
<td>use-recursive-search</td>
<td>If <code>true</code> identity search queries are recursive. Defaults to <code>false</code>.</td>
</tr>
<tr>
<td>search-base-dn</td>
<td>The base DN to search for identities.</td>
</tr>
<tr>
<td>attribute-mapping</td>
<td>List of attribute mappings defined for this resource.</td>
</tr>
<tr>
<td>filter-name</td>
<td>The LDAP filter for getting identity by name.</td>
</tr>
<tr>
<td>iterator-filter</td>
<td>The LDAP filter for iterating over identities of the realm.</td>
</tr>
</tbody>
</table>
### Attribute Description

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>new-identity-attributes</td>
<td>The list of attributes of newly created identities and is required for modifiability of the realm. This is a list of name and value pair objects.</td>
</tr>
<tr>
<td>user-password-mapper</td>
<td>The credential mapping for a credential similar to userPassword.</td>
</tr>
<tr>
<td>otp-credential-mapper</td>
<td>The credential mapping for OTP credential.</td>
</tr>
<tr>
<td>x509-credential-mapper</td>
<td>The configuration allowing to use LDAP as storage of X509 credentials. If none of the -from child attributes are defined, then this configuration will be ignored. If more than one -from child attribute is defined, then the user certificate must match all the defined criteria.</td>
</tr>
</tbody>
</table>

### Table A.64. ldap-realm identity-mapping attribute-mapping Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>extract-rdn</td>
<td>The RDN key to use as the value for an attribute, in case the value in its raw form is in X.500 format.</td>
</tr>
<tr>
<td>filter</td>
<td>The filter to use to obtain the values for a specific attribute.</td>
</tr>
<tr>
<td>filter-base-dn</td>
<td>The name of the context where the filter should be performed.</td>
</tr>
<tr>
<td>from</td>
<td>The name of the LDAP attribute to map to an identity attribute. If not defined, DN of entry is used.</td>
</tr>
<tr>
<td>reference</td>
<td>The name of LDAP attribute containing DN of entry to obtain value from.</td>
</tr>
<tr>
<td>role-recursion</td>
<td>Maximum depth for recursive role assignment. Use 0 to specify no recursion. Defaults to 0.</td>
</tr>
<tr>
<td>role-recursion-name</td>
<td>Determine the LDAP attribute of role entry which will be a substitute for &quot;{0}&quot; in filter-name when searching roles of role.</td>
</tr>
<tr>
<td>search-recursive</td>
<td>If true attribute LDAP search queries are recursive. Defaults to true.</td>
</tr>
</tbody>
</table>
The name of the identity attribute mapped from a specific LDAP attribute. If not provided, the name of the attribute is the same as define in `from`. If the `from` is not defined too, value `dn` is used.

Table A.65. ldap-realm identity-mapping user-password-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>from</code></td>
<td>The name of the LDAP attribute to map to an identity attribute. If not defined, DN of entry is used.</td>
</tr>
<tr>
<td><code>verifiable</code></td>
<td>If <code>true</code> password can be used to verify the user. Defaults to <code>true</code>.</td>
</tr>
<tr>
<td><code>writable</code></td>
<td>If <code>true</code> password can be changed. Defaults to <code>false</code>.</td>
</tr>
</tbody>
</table>

Table A.66. ldap-realm identity-mapping otp-credential-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>algorithm-from</code></td>
<td>The name of the LDAP attribute of OTP algorithm.</td>
</tr>
<tr>
<td><code>hash-from</code></td>
<td>The name of the LDAP attribute of OTP hash function.</td>
</tr>
<tr>
<td><code>seed-from</code></td>
<td>The name of the LDAP attribute of OTP seed.</td>
</tr>
<tr>
<td><code>sequence-from</code></td>
<td>The name of the LDAP attribute of OTP sequence number.</td>
</tr>
</tbody>
</table>

Table A.67. ldap-realm identity-mapping x509-credential-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>certificate-from</code></td>
<td>The name of the LDAP attribute to map to an encoded user certificate. If not defined, encoded certificate will not be checked.</td>
</tr>
<tr>
<td><code>digest-algorithm</code></td>
<td>The digest algorithm, which is the hash function, used to compute digest of the user certificate. Will be used only if <code>digest-from</code> has been defined.</td>
</tr>
<tr>
<td><code>digest-from</code></td>
<td>The name of the LDAP attribute to map to a user certificate digest. If not defined, certificate digest will not be checked.</td>
</tr>
<tr>
<td><code>serial-number-from</code></td>
<td>The name of the LDAP attribute to map to a serial number of user certificate. If not defined, serial number will not be checked.</td>
</tr>
</tbody>
</table>
### Table A.68. logical-permission-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>subject-dn-from</td>
<td>The name of the LDAP attribute to map to a subject DN of user certificate. If not defined, subject DN will not be checked.</td>
</tr>
</tbody>
</table>

### Table A.69. logical-role-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>left</td>
<td>Reference to a role mapper to be used on the left side of the operation.</td>
</tr>
<tr>
<td>logical-operation</td>
<td>The logical operation to be performed on the role mapper mappings. Allowed values are: and, minus, or, and xor.</td>
</tr>
<tr>
<td>right</td>
<td>Reference to a role mapper to be used on the right side of the operation.</td>
</tr>
</tbody>
</table>

### Table A.70. mapped-regex-realm-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>delegate-realm-mapper</td>
<td>The realm mapper to delegate to if there is no match using the pattern.</td>
</tr>
<tr>
<td>pattern</td>
<td>The regular expression which must contain at least one capture group to extract the realm from the name.</td>
</tr>
<tr>
<td>realm-map</td>
<td>Mapping of realm name extracted using the regular expression to a defined realm name.</td>
</tr>
</tbody>
</table>

### Table A.71. mechanism-provider-filtering-sasl-server-factory Attributes
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>enabling</td>
<td>If true no provider loaded mechanisms are enabled unless matched by one of the filters. This defaults to true.</td>
</tr>
<tr>
<td>filters</td>
<td>The list of filters to apply when comparing the mechanisms from the providers. A filter matches when all of the specified values match the mechanism and provider pair.</td>
</tr>
<tr>
<td>sasl-server-factory</td>
<td>Reference to a SASL server factory to be wrapped by this definition.</td>
</tr>
</tbody>
</table>

Table A.72. mechanism-provider-filtering-sasl-server-factory filters Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mechanism-name</td>
<td>The name of the SASL mechanism this filter matches with.</td>
</tr>
<tr>
<td>provider-name</td>
<td>The name of the provider this filter matches.</td>
</tr>
<tr>
<td>provider-version</td>
<td>The version to use when comparing the provider’s version.</td>
</tr>
<tr>
<td>version-comparison</td>
<td>The equality to use when evaluating the Provider’s version. The allowed values are less-than and greater-than. The default value is less-than.</td>
</tr>
</tbody>
</table>

Table A.73. online-certificate-status-protocol Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>responder</td>
<td>Override the OCSP Responder URI resolved from the certificate.</td>
</tr>
<tr>
<td>responder-certificate</td>
<td>Alias for responder certificate located in responder-keystore or trust-manager keystore if responder-keystore is not defined.</td>
</tr>
<tr>
<td>responder-keystore</td>
<td>Alternative keystore for responder certificate. responder-certificate must be defined.</td>
</tr>
<tr>
<td>prefer-crls</td>
<td>When both OCSP and CRL mechanisms are configured, OCSP mechanism is called first. When prefer-crls is set to true, the CRL mechanism is called first.</td>
</tr>
</tbody>
</table>

Table A.74. properties-realm Attributes
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>groups-attribute</td>
<td>The name of the attribute in the returned AuthorizationIdentity that should contain the group membership information for the identity.</td>
</tr>
<tr>
<td>groups-properties</td>
<td>The properties file containing the users and their groups.</td>
</tr>
<tr>
<td>users-properties</td>
<td>The properties file containing the users and their passwords.</td>
</tr>
</tbody>
</table>

**Table A.75. properties-realm users-properties Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>digest-realm-name</td>
<td>The default realm name to use for digested passwords if one is not discovered in the properties file.</td>
</tr>
<tr>
<td>path</td>
<td>The path to the file containing the users and their passwords. The file should contain realm name declaration.</td>
</tr>
<tr>
<td>plain-text</td>
<td>If true the passwords in properties file stored in plain text. If false they are pre-hashed, taking the form of $\text{HEX( MD5( username &quot;&quot;:&quot; realm &quot;&quot;:&quot; password)))}. Defaults to false.</td>
</tr>
<tr>
<td>relative-to</td>
<td>The predefined path the path is relative to.</td>
</tr>
</tbody>
</table>

**Table A.76. properties-realm groups-properties Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>path</td>
<td>The path to the file containing the users and their groups.</td>
</tr>
<tr>
<td>relative-to</td>
<td>The predefined path the path is relative to.</td>
</tr>
</tbody>
</table>

**Table A.77. provider-http-server-mechanism-factory Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>providers</td>
<td>The providers to use to locate the factories. If not specified, the globally registered list of providers will be used.</td>
</tr>
</tbody>
</table>

**Table A.78. provider-loader Attributes**
### Table A.79. provider-sasl-server-factory Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>providers</td>
<td>The providers to use to locate the factories. If not specified, the globally registered list of providers will be used.</td>
</tr>
</tbody>
</table>

### Table A.80. regex-principal-transformer Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pattern</td>
<td>The regular expression to use to locate the portion of the name to be replaced.</td>
</tr>
<tr>
<td>replace-all</td>
<td>If <code>true</code> all occurrences of the pattern matched are replaced. If <code>false</code> only the first occurrence is replaced. Defaults to <code>false</code>.</td>
</tr>
<tr>
<td>replacement</td>
<td>The value to be used as the replacement.</td>
</tr>
</tbody>
</table>

### Table A.81. regex-validating-principal-transformer Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>match</td>
<td>If <code>true</code> the name must match the given pattern to make validation successful. If <code>false</code> the name must not match the given pattern to make validation successful. This defaults to <code>true</code>.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>pattern</td>
<td>The regular expression to use for the principal transformer.</td>
</tr>
</tbody>
</table>

Table A.82. sasl-authentication-factory Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mechanism-configurations</td>
<td>The list of mechanism specific configurations.</td>
</tr>
<tr>
<td>sasl-server-factory</td>
<td>The SASL server factory to associate with this resource.</td>
</tr>
<tr>
<td>security-domain</td>
<td>The security domain to associate with this resource.</td>
</tr>
</tbody>
</table>

Table A.83. sasl-authentication-factory mechanism-configurations Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>credential-security-factory</td>
<td>The security factory to use to obtain a credential as required by the mechanism.</td>
</tr>
<tr>
<td>final-principal-transformer</td>
<td>A final principal transformer to apply for this mechanism realm.</td>
</tr>
<tr>
<td>host-name</td>
<td>The host name this configuration applies to.</td>
</tr>
<tr>
<td>mechanism-name</td>
<td>This configuration will only apply where a mechanism with the name specified is used. If this attribute is omitted then this will match any mechanism name.</td>
</tr>
<tr>
<td>mechanism-realm-configurations</td>
<td>The list of definitions of the realm names as understood by the mechanism.</td>
</tr>
<tr>
<td>protocol</td>
<td>The protocol this configuration applies to.</td>
</tr>
<tr>
<td>post-realm-principal-transformer</td>
<td>A principal transformer to apply after the realm is selected.</td>
</tr>
<tr>
<td>pre-realm-principal-transformer</td>
<td>A principal transformer to apply before the realm is selected.</td>
</tr>
<tr>
<td>realm-mapper</td>
<td>The realm mapper to be used by the mechanism.</td>
</tr>
</tbody>
</table>

Table A.84. sasl-authentication-factory mechanism-configurations mechanism-realm-configurations Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>final-principal-transformer</td>
<td>A final principal transformer to apply for this mechanism realm.</td>
</tr>
</tbody>
</table>
### Attribute Description

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>post-realm-principal-transformer</td>
<td>A principal transformer to apply after the realm is selected.</td>
</tr>
<tr>
<td>pre-realm-principal-transformer</td>
<td>A principal transformer to apply before the realm is selected.</td>
</tr>
<tr>
<td>realm-mapper</td>
<td>The realm mapper to be used by the mechanism.</td>
</tr>
<tr>
<td>realm-name</td>
<td>The name of the realm to be presented by the mechanism.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>post-realm-principal-transformer</td>
<td>A principal transformer to apply after the realm is selected.</td>
</tr>
<tr>
<td>pre-realm-principal-transformer</td>
<td>A principal transformer to apply before the realm is selected.</td>
</tr>
<tr>
<td>realm-mapper</td>
<td>The realm mapper to be used by the mechanism.</td>
</tr>
<tr>
<td>realm-name</td>
<td>The name of the realm to be presented by the mechanism.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>post-realm-principal-transformer</td>
<td>A principal transformer to apply after the realm is selected.</td>
</tr>
<tr>
<td>pre-realm-principal-transformer</td>
<td>A principal transformer to apply before the realm is selected.</td>
</tr>
</tbody>
</table>

#### Table A.85. server-ssl-context Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>authentication-optional</td>
<td>If true rejecting of the client certificate by the security domain will not prevent the connection. This allows a fall through to use other authentication mechanisms, such as form login, when the client certificate is rejected by security domain. This has an effect only when the security domain is set. This defaults to false.</td>
</tr>
<tr>
<td>cipher-suite-filter</td>
<td>The filter to apply to specify the enabled cipher suites. This filter takes a list of items delimited by colons, commas, or spaces. Each item may be an OpenSSL-style cipher suite name, a standard SSL/TLS cipher suite name, or a keyword such as TLSv1.2 or DES. A full list of keywords as well as additional details on creating a filter can be found in the Javadoc for the CipherSuiteSelector class. The default value is DEFAULT, which corresponds to all known cipher suites that do not have NULL encryption and excludes any cipher suites that have no authentication.</td>
</tr>
<tr>
<td>final-principal-transformer</td>
<td>A final principal transformer to apply for this mechanism realm.</td>
</tr>
<tr>
<td>key-manager</td>
<td>Reference to the key managers to use within the SSLContext.</td>
</tr>
<tr>
<td>maximum-session-cache-size</td>
<td>The maximum number of SSL/TLS sessions to be cached.</td>
</tr>
<tr>
<td>need-client-auth</td>
<td>If true a client certificate is required on SSL handshake. Connection without trusted client certificate will be rejected. This defaults to false.</td>
</tr>
<tr>
<td>post-realm-principal-transformer</td>
<td>A principal transformer to apply after the realm is selected.</td>
</tr>
<tr>
<td>pre-realm-principal-transformer</td>
<td>A principal transformer to apply before the realm is selected.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>protocols</td>
<td>The enabled protocols. Allowed options are <code>SSLv2, SSLv3, TLSv1, TLSv1.1, TLSv1.2, TLSv1.3</code>. This defaults to enabling <code>TLSv1, TLSv1.1, TLSv1.2, and TLSv1.3</code>.</td>
</tr>
<tr>
<td>provider-name</td>
<td>The name of the provider to use. If not specified, all providers from providers will be passed to the <code>SSLContext</code>.</td>
</tr>
<tr>
<td>providers</td>
<td>The name of the providers to obtain the <code>Provider[]</code> to use to load the <code>SSLContext</code>.</td>
</tr>
<tr>
<td>realm-mapper</td>
<td>The realm mapper to be used for SSL authentication.</td>
</tr>
<tr>
<td>security-domain</td>
<td>The security domain to use for authentication during SSL/TLS session establishment.</td>
</tr>
<tr>
<td>session-timeout</td>
<td>The timeout for SSL/TLS sessions.</td>
</tr>
<tr>
<td>trust-manager</td>
<td>Reference to the <code>trust-manager</code> to use within the <code>SSLContext</code>.</td>
</tr>
<tr>
<td>use-cipher-suites-order</td>
<td>If <code>true</code> the cipher suites order defined on the server will be used. If <code>false</code> the cipher suites order presented by the client will be used. Defaults to <code>true</code>.</td>
</tr>
<tr>
<td>want-client-auth</td>
<td>If <code>true</code> a client certificate will be requested, but not required, on SSL handshake. If a security domain is referenced and supports X509 evidence, this will be set to <code>true</code> automatically. This is ignored when <code>need-client-auth</code> is set. This defaults to <code>false</code>.</td>
</tr>
<tr>
<td>wrap</td>
<td>If <code>true</code>, the returned <code>SSLEngine</code>, <code>SSL_SOCKET</code>, and <code>SSL_SERVER_SOCKET</code> instances will be wrapped to protect against further modification. This defaults to <code>false</code>.</td>
</tr>
</tbody>
</table>

**WARNING**
Red Hat recommends that SSLv2, SSLv3, and TLSv1.0 be explicitly disabled in favor of TLSv1.1 or TLSv1.2 in all affected packages.
NOTE

The realm mapper and principal transformer attributes for a server-ssl-context apply only for the SASL EXTERNAL mechanism, where the certificate is verified by the trust manager. HTTP CLIENT-CERT authentication settings are configured in an http-authentication-factory.

Table A.86. service-loader-http-server-mechanism-factory Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>module</td>
<td>The module to use to obtain the class loader to load the factories. If not specified the class loader to load the resource will be used instead.</td>
</tr>
</tbody>
</table>

Table A.87. service-loader-sasl-server-factory Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>module</td>
<td>The module to use to obtain the class loader to load the factories. If not specified the class loader to load the resource will be used instead.</td>
</tr>
</tbody>
</table>

Table A.88. simple-permission-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mapping-mode</td>
<td>The mapping mode that should be used in the event of multiple matches. Allowed values are, and, or, xor, unless, and first. The default is first.</td>
</tr>
<tr>
<td>permission-mappings</td>
<td>The list of defined permission mappings.</td>
</tr>
</tbody>
</table>

Table A.89. simple-permission-mapper permission-mappings Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
</table>
| permission-sets | The permission sets to assign in the event of a match. Permission sets can be used to assign permissions to an identity. **permission-sets** can take the following attribute:  
  * permission-set  
    A reference to a permission set. |

**IMPORTANT**

The permissions attribute is deprecated, and is replaced by permission-sets.
principals
The list of principals to compare when mapping permissions, if the identities principal matches any one in the list it is a match.

roles
The list of roles to compare when mapping permissions, if the identity is a member of any one in the list it is a match.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>principals</td>
<td>The list of principals to compare when mapping permissions, if the identities principal matches any one in the list it is a match.</td>
</tr>
<tr>
<td>roles</td>
<td>The list of roles to compare when mapping permissions, if the identity is a member of any one in the list it is a match.</td>
</tr>
</tbody>
</table>

Table A.90. permission-set permission Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>action</td>
<td>The action to pass to the permission as it is constructed.</td>
</tr>
<tr>
<td>class-name</td>
<td>The fully qualified class name of the permission.</td>
</tr>
<tr>
<td>module</td>
<td>The module to use to load the permission.</td>
</tr>
<tr>
<td>target-name</td>
<td>The target name to pass to the permission as it is constructed.</td>
</tr>
</tbody>
</table>

Table A.91. simple-regex-realm-mapper Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>delegate-realm-mapper</td>
<td>The realm mapper to delegate to if there is no match using the pattern.</td>
</tr>
<tr>
<td>pattern</td>
<td>The regular expression which must contain at least one capture group to extract the realm from the name.</td>
</tr>
</tbody>
</table>

Table A.92. simple-role-decoder Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute</td>
<td>The name of the attribute from the identity to map directly to roles.</td>
</tr>
</tbody>
</table>

Table A.93. source-address-role-decoder Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pattern</td>
<td>A regular expression that specifies the IP address of a client or the IP addresses of clients to match.</td>
</tr>
<tr>
<td>source-address</td>
<td>Specifies the IP address of the client.</td>
</tr>
</tbody>
</table>
Table A.94. syslog-audit-log Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>roles</td>
<td>Provides the list of roles to assign to a user if the IP address of the client matches the values specified in the pattern attribute or the source-address attribute.</td>
</tr>
<tr>
<td><strong>NOTE</strong></td>
<td>You must specify at least one IP address in either the source-address attribute or the pattern attribute. Otherwise, you cannot make authorization decisions based on the IP address of a client.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>format</td>
<td>The format that audit events should be recorded in.</td>
</tr>
<tr>
<td></td>
<td>Supported values:</td>
</tr>
<tr>
<td></td>
<td>- SIMPLE</td>
</tr>
<tr>
<td></td>
<td>- JSON</td>
</tr>
<tr>
<td></td>
<td>Default value:</td>
</tr>
<tr>
<td></td>
<td>- SIMPLE</td>
</tr>
<tr>
<td>host-name</td>
<td>The host name to be be embedded into all events sent to the syslog server.</td>
</tr>
<tr>
<td>port</td>
<td>The listening port on the syslog server.</td>
</tr>
<tr>
<td>reconnect-attempts</td>
<td>The maximum number of times that Elytron will attempt to send successive messages to a syslog server before closing the connection. The value of this attribute is only valid when the transmission protocol used is UDP.</td>
</tr>
<tr>
<td></td>
<td>Supported values:</td>
</tr>
<tr>
<td></td>
<td>- Any positive integer value.</td>
</tr>
<tr>
<td></td>
<td>- -1 indicates infinite reconnect attempts.</td>
</tr>
<tr>
<td></td>
<td>Default value:</td>
</tr>
<tr>
<td></td>
<td>- 0</td>
</tr>
<tr>
<td>server-address</td>
<td>IP address of the syslog server, or a name that can be resolved by Java’s InetAddress.getByName() method.</td>
</tr>
</tbody>
</table>
### Attribute Description

**ssl-context**  
The SSL context to use when connecting to the syslog server. This attribute is only required if **transport** is set to **SSL_TCP**.

**syslog-format**  
The RFC format to be used for describing the audit event.

Supported values:
- RFC5424
- RFC3164

Default value:
- RFC5424

**transport**  
The transport layer protocol to use to connect to the syslog server.

Supported values:
- UDP
- TCP
- SSL_TCP

Default value:
- TCP

---

**Table A.95. token-realm Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>jwt</td>
<td>A token validator to be used in conjunction with a token-based realm that handles security tokens based on the JWT/JWS standard.</td>
</tr>
<tr>
<td>oauth2-introspection</td>
<td>A token validator to be used in conjunction with a token-based realm that handles OAuth2 Access Tokens and validates them using an endpoint compliant with the RFC-7662 OAuth2 Token Introspection specification.</td>
</tr>
<tr>
<td>principal-claim</td>
<td>The name of the claim that should be used to obtain the principal’s name. The default is <strong>username</strong>.</td>
</tr>
</tbody>
</table>

---

**Table A.96. token-realm jwt Attributes**
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>audience</td>
<td>A list of strings representing the audiences supported by this configuration. During validation JWT tokens must have an <strong>aud</strong> claim that contains one of the values defined here.</td>
</tr>
<tr>
<td>certificate</td>
<td>The name of the certificate with a public key to load from the keystore that is defined by the <strong>key-store</strong> attribute.</td>
</tr>
<tr>
<td>client-ssl-context</td>
<td>The SSL context to use for a remote <strong>JSON Web Key (JWK)</strong>. This enables you to use the URL from the <strong>jku</strong> (JSON Key URL) header parameter to fetch public keys for token verification.</td>
</tr>
<tr>
<td>host-name-verification-policy</td>
<td>A policy that defines how host names should be verified when using remote JSON Web Keys. You can set either of the following values for the attribute:</td>
</tr>
<tr>
<td></td>
<td>- <strong>ANY</strong>, which disables hostname verification.</td>
</tr>
<tr>
<td></td>
<td>- <strong>DEFAULT</strong>, which denies connections where a certificate mismatch occurs between a server name from the certificate and the connecting host.</td>
</tr>
<tr>
<td>issuer</td>
<td>A list of strings representing the issuers supported by this configuration. During validation JWT tokens must have an <strong>iss</strong> claim that contains one of the values defined here.</td>
</tr>
<tr>
<td>key-store</td>
<td>The keystore from which the certificate with a public key should be loaded. This attribute, along with the <strong>certificate</strong> attribute, can also be used as an alternative to the <strong>public-key</strong>.</td>
</tr>
<tr>
<td>public-key</td>
<td>A public key in PEM Format. During validation, if a public key is provided, the signature will be verified based on the key value provided by this attribute.</td>
</tr>
<tr>
<td></td>
<td>Alternatively, you can define a <strong>key-store</strong> and a <strong>certificate</strong> to configure the public key. This alternative key is used to verify tokens without the <strong>kid</strong> (Key ID) claim.</td>
</tr>
</tbody>
</table>

**Table A.97. token-realm oauth2-introspection Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>client-id</td>
<td>The identifier of the client on the OAuth2 Authorization Server.</td>
</tr>
<tr>
<td>client-secret</td>
<td>The secret of the client.</td>
</tr>
<tr>
<td>client-ssl-context</td>
<td>The SSL context to be used if the introspection endpoint is using HTTPS.</td>
</tr>
</tbody>
</table>
A policy that defines how host names should be verified when using HTTPS. You can set either of the following values for the attribute:

- **ANY**, which disables hostname verification.
- **DEFAULT**, which denies connections where a certificate mismatch occurs between a server name from the certificate and the connecting host.

The URL of token introspection endpoint.

### Table A.98. trust-manager Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
</table>
| host-name-verification-policy | A policy that defines how host names should be verified when using HTTPS. You can set either of the following values for the attribute:  
  - **ANY**, which disables hostname verification.  
  - **DEFAULT**, which denies connections where a certificate mismatch occurs between a server name from the certificate and the connecting host. |
| introspection-url           | The URL of token introspection endpoint.                                                     |
| algorithm                  | The name of the algorithm to use to create the underlying TrustManagerFactory. This is provided by the JDK. For example, a JDK that uses SunJSSE provides the PKIX and SunX509 algorithms. More details on SunJSSE can be found in the Java Secure Socket Extension (JSSE) Reference Guide. |
| alias-filter               | A filter to apply to the aliases returned from the keystore. This can either be a comma-separated list of aliases to return or one of the following formats:  
  - **ALL**:alias1:alias2  
  - **NONE**:+alias1:+alias2 |
| certificate-revocation-list | Enables the certificate revocation list that can be checked by a trust manager. The attributes of certificate-revocation-list are:  
  - **path** - The path to the configuration file that is used to initialize the provider.  
  - **relative-to** - The base path of the certificate revocation list file.  
  - **maximum-cert-path** - The maximum number of non-self-issued intermediate certificates that can exist in a certification path. The default value is 5. (Deprecated. Use maximum-cert-path in trust-manager.)  

See Using a Certificate Revocation List for more information. |
| key-store                  | Reference to the key-store to use to initialize the underlying TrustManagerFactory. |

See Using a Certificate Revocation List for more information.
The maximum number of non-self-issued intermediate certificates that can exist in a certification path. The default value is 5.

This attribute has been moved to trust-manager from certificate-revocation-list inside trust-manager in JBoss EAP 7.3. For backward compatibility, the attribute is also present in certificate-revocation-list. Going forward, use maximum-cert-path in trust-manager.

**NOTE**

Define maximum-cert-path in either trust-manager or in certificate-revocation-list not in both.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximum-cert-path</td>
<td>The maximum number of non-self-issued intermediate certificates that can exist in a certification path. The default value is 5. This attribute has been moved to trust-manager from certificate-revocation-list inside trust-manager in JBoss EAP 7.3. For backward compatibility, the attribute is also present in certificate-revocation-list. Going forward, use maximum-cert-path in trust-manager.</td>
</tr>
</tbody>
</table>

Check revocation status of only the leaf certificate. This is an optional attribute. The default values is false.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>only-leaf-cert</td>
<td>Check revocation status of only the leaf certificate. This is an optional attribute. The default values is false.</td>
</tr>
</tbody>
</table>

The name of the provider to use to create the underlying TrustManagerFactory.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>provider-name</td>
<td>The name of the provider to use to create the underlying TrustManagerFactory.</td>
</tr>
</tbody>
</table>

Reference to obtain the Provider[] to use when creating the underlying TrustManagerFactory.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>providers</td>
<td>Reference to obtain the Provider[] to use when creating the underlying TrustManagerFactory.</td>
</tr>
</tbody>
</table>

When set to true, certificates with an unknown revocation status are accepted. This is an optional attribute. The default value is false.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>soft-fail</td>
<td>When set to true, certificates with an unknown revocation status are accepted. This is an optional attribute. The default value is false.</td>
</tr>
</tbody>
</table>

**Table A.99. x500-attribute-principal-decoder Attributes**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute-name</td>
<td>The name of the X.500 attribute to map. This can also be defined using the oid attribute.</td>
</tr>
</tbody>
</table>

When set to true, the principal decoder will attempt to convert a principal to a X500Principal, if it is not already of that type. If the conversion fails, the original value is used as the principal.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>convert</td>
<td>When set to true, the principal decoder will attempt to convert a principal to a X500Principal, if it is not already of that type. If the conversion fails, the original value is used as the principal.</td>
</tr>
</tbody>
</table>

The joining string. The default value is a period (.)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>joiner</td>
<td>The joining string. The default value is a period (.).</td>
</tr>
</tbody>
</table>

The maximum number of occurrences of the attribute to map. The default value is 2147483647.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximum-segments</td>
<td>The maximum number of occurrences of the attribute to map. The default value is 2147483647.</td>
</tr>
</tbody>
</table>

The OID of the X.500 attribute to map. This can also be defined using the attribute-name attribute.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>oid</td>
<td>The OID of the X.500 attribute to map. This can also be defined using the attribute-name attribute.</td>
</tr>
</tbody>
</table>
### Table A.100. x509-subject-alternative-name-evidence-decoder Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>required-attributes</td>
<td>The list of attribute names of the attributes that must be present in the principal</td>
</tr>
<tr>
<td>required-oids</td>
<td>The list of OIDs of the attributes that must be present in the principal.</td>
</tr>
<tr>
<td>reverse</td>
<td>If true the attribute values will be processed and returned in reverse order. The default value is false.</td>
</tr>
<tr>
<td>start-segment</td>
<td>The starting occurrence of the attribute you want to map. This uses a zero-based index and the default value is 0.</td>
</tr>
</tbody>
</table>

#### alt-name-type

The subject alternative name type. Must be one of the following subject alternative name types:

- `directoryName`
- `dNSName`
- `iPAddress`
- `registeredID`
- `rfc822Name`
- `uniformResourceIdentifier`

This is a required attribute.

#### segment

- The 0-based occurrence of the subject alternative name to map.
- This attribute is used when there is more than one subject alternative name of the given type. The default value is 0.

---

### A.2. CONFIGURE YOUR ENVIRONMENT TO USE THE BOUNCYCASTLE PROVIDER

You can configure your JBoss EAP installation to use a BouncyCastle provider. The Bouncy Castle JARs are not provided by Red Hat, and must be obtained directly from Bouncy Castle.

**IMPORTANT**

Java 8 must be used when the BouncyCastle providers are specified, as the BouncyCastle APIs are only certified up to Java 8.
1. Include both BouncyCastle JARs, beginning with <code>bc-fips</code> and <code>bctls-fips</code>, on your JDK's classpath. For Java 8 this is accomplished by placing the JAR files in <code>$JAVA_HOME/lib/ext</code>.

2. Using either of the following methods, include the BouncyCastle providers in your Java security configuration file:

   - A default configuration file, <code>java.security</code>, is provided in your JDK, and can be updated to include the BouncyCastle providers. This file is used if no other security configuration files are specified. See the JDK vendor’s documentation for the location of this file.

   - Define a custom Java security configuration file and reference it by adding the <code>-Djava.security.properties=/path/to/java.security.properties</code> system property. When referenced using two equal signs the default policy is overwritten, and only the providers defined in the referenced file are used. When a single equal sign is used, as in <code>-Djava.security.properties=/path/to/java.security.properties</code>, then the providers are appended to the default security file, preferring to use the file passed in the argument when keys are specified in both files. This option is useful when having multiple JVMs running on the same host that require different security settings.

   An example configuration file that defines these providers is seen below.

   **Example: BouncyCastle Security Policy**

   ```
   # We can override the values in the JRE_HOME/lib/security/java.security # file here. If both properties files specify values for the same key, the # value from the command-line properties file is selected, as it is the last # one loaded. We can reorder and change security providers in this file. security.provider.1=org.bouncycastle.jcajce.provider.BouncyCastleFipsProvider security.provider.2=org.bouncycastle.jsse.provider.BouncyCastleJsseProvider fips:BCFIPS security.provider.3=sun.security.provider.Sun security.provider.4=com.sun.crypto.provider.SunJCE
   # This is a comma-separated list of algorithm and/or algorithm:provider # entries.
   #
   securerandom.strongAlgorithms=DEFAULT:BCFIPS
   ```

   **IMPORTANT**

   If the default configuration file is updated, then every other <code>security.provider.X</code> line in this file, for example <code>security.provider.2</code>, must increase its value of <code>X</code> to ensure that this provider is given priority. Each provider must have a unique priority.

3. Configure the elytron subsystem to exclusively use the BouncyCastle providers. By default, the system is configured to use both the elytron and openssl providers. Because it also includes a TLS implementation, it is recommended to disable the OpenSSL provider to ensure the TLS implementation from Bouncy Castle is used.

   ```
   /subsystem=elytron:write-attribute(name=final-providers,value=elytron)
   ```

4. Reload the server for the changes to take effect.

   ```
   reload
   ```
## A.3. SASL AUTHENTICATION MECHANISMS REFERENCE

### A.3.1. Support Level for SASL Authentication Mechanisms

<table>
<thead>
<tr>
<th>Name</th>
<th>Support Level</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANONYMOUS</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>DIGEST-SHA-512</td>
<td>Technology Preview</td>
<td>Supported but name not currently IANA registered.</td>
</tr>
<tr>
<td>DIGEST-SHA-256</td>
<td>Technology Preview</td>
<td>Supported but name not currently IANA registered.</td>
</tr>
<tr>
<td>DIGEST-SHA</td>
<td>Technology Preview</td>
<td>Supported but name not currently IANA registered.</td>
</tr>
<tr>
<td>DIGEST-MD5</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>EXTERNAL</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>GS2-KRB5</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>GS2-KRB5-PLUS</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>GSSAPI</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>JBOSS-LOCAL-USER</td>
<td>Supported</td>
<td>Supported but name not currently IANA registered.</td>
</tr>
<tr>
<td>OAUTHBEARER</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>OTP</td>
<td>Not supported</td>
<td></td>
</tr>
<tr>
<td>PLAIN</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>SCRAM-SHA-1</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>SCRAM-SHA-1-PLUS</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>SCRAM-SHA-256</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>SCRAM-SHA-256-PLUS</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>SCRAM-SHA-384</td>
<td>Supported</td>
<td></td>
</tr>
<tr>
<td>SCRAM-SHA-384-PLUS</td>
<td>Supported</td>
<td></td>
</tr>
</tbody>
</table>
A.3.2. SASL Authentication Mechanism Properties

You can see a list of standard Java SASL authentication mechanism properties in the Java documentation. Other JBoss EAP-specific SASL authentication mechanism properties are listed in the following tables.

Table A.101. SASL Properties Used During SASL Mechanism Negotiation or Authentication Exchange

<table>
<thead>
<tr>
<th>Property</th>
<th>Client / Server</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>com.sun.security.sasl.digest.realm</td>
<td>Server</td>
<td>Used by some SASL mechanisms, including the DIGEST-MD5 algorithm supplied with most Oracle JDKs, to provide the list of possible server realms to the mechanism. Each realm name must be separated by a space character (U+0020).</td>
</tr>
<tr>
<td>com.sun.security.sasl.digest.utf8</td>
<td>Client, server</td>
<td>Used by some SASL mechanisms, including the DIGEST-MD5 algorithm supplied with most Oracle JDKs, to indicate that information exchange should take place using UTF-8 character encoding instead of the default Latin-1/ISO-8859-1 encoding. The default value is true.</td>
</tr>
<tr>
<td>wildfly.sasl.authentication-timeout</td>
<td>Server</td>
<td>The amount of time, in seconds, after which a server should terminate an authentication attempt. The default value is 150 seconds.</td>
</tr>
<tr>
<td>Property</td>
<td>Client / Server</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>wildfly.sasl.channel-binding-required</td>
<td>Client, server</td>
<td>Indicates that a mechanism which supports channel binding is required. A value of true indicates that channel binding is required. Any other value, or lack of this property, indicates that channel binding is not required.</td>
</tr>
<tr>
<td>wildfly.sasl.digest.alternative_protocols</td>
<td>Server</td>
<td>Supplies a separated list of alternative protocols that are acceptable in responses received from the client. The list can be space, comma, tab, or new line separated.</td>
</tr>
<tr>
<td>wildfly.sasl.gssapi.client.delegate-credential</td>
<td>Client</td>
<td>Specifies if the GSSAPI mechanism supports credential delegation. If set to true, the credential is delegated from the client to the server.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This property defaults to true if a GSSCredential is provided using the javax.security.sasl.credentials property. Otherwise, the default value is false.</td>
</tr>
<tr>
<td>wildfly.sasl.gs2.client.delegate-credential</td>
<td>Client</td>
<td>Specifies if the GS2 mechanism supports credential delegation. If set to true, the credential is delegated from the client to the server.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This property defaults to true if a GSSCredential is provided using a CredentialCallback. Otherwise, the default value is false.</td>
</tr>
<tr>
<td>wildfly.sasl.local-user.challenge-path</td>
<td>Server</td>
<td>Specifies the directory in which the server generates the challenge file. The default value is the java.io.tmpdir system property.</td>
</tr>
<tr>
<td>wildfly.sasl.local-user.default-user</td>
<td>Server</td>
<td>The user name to use for silent authentication.</td>
</tr>
<tr>
<td>wildfly.sasl.local-user.quiet-auth</td>
<td>Client</td>
<td>Enables silent authentication for a local user. The default value is true.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Note that the Jakarta Enterprise Beans client and naming client disables silent local authentication if this property is not explicitly defined and a callback handler or user name was specified in the client configuration.</td>
</tr>
<tr>
<td>wildfly.sasl.local-user.use-secure-random</td>
<td>Server</td>
<td>Specifies whether the server uses a secure random number generator when creating the challenge. The default value is true.</td>
</tr>
<tr>
<td>Property</td>
<td>Client / Server</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>wildfly.sasl.mechanism-query-all</td>
<td>Client, server</td>
<td>Indicates that all possible supported mechanism names should be returned, regardless of the presence or absence of any other properties.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>This property is only effective on calls to SaslServerFactory#getMechanismNames(Map) or SaslClientFactory#getMechanismNames(Map) for Elytron-provided SASL factories.</td>
</tr>
<tr>
<td>wildfly.sasl.otp.alternate-dictionary</td>
<td>Client</td>
<td>Provides an alternate dictionary to the OTP SASL mechanism. Each dictionary word must be separated by a space character (U+0020).</td>
</tr>
<tr>
<td>wildfly.sasl.relax-compliance</td>
<td>Server</td>
<td>The specifications for the SASL mechanisms mandate certain behavior and verification of that behavior at the opposite side of the connection. When interacting with other SASL mechanism implementations, some of these requirements are interpreted loosely. If this property is set to true, checking is relaxed where differences in specification interpretation has been identified. The default value is false.</td>
</tr>
<tr>
<td>wildfly.sasl.scram.min-iteration-count</td>
<td>Client, server</td>
<td>The minimum iteration count to use for SCRAM. The default value is 4096.</td>
</tr>
<tr>
<td>wildfly.sasl.scram.max-iteration-count</td>
<td>Client, server</td>
<td>The maximum iteration count to use for SCRAM. The default value is 32786.</td>
</tr>
<tr>
<td>wildfly.sasl.secure-rng</td>
<td>Client, server</td>
<td>The algorithm name of a SecureRandom implementation to use. Using this property can improve security, at the cost of performance.</td>
</tr>
<tr>
<td>wildfly.security.sasl.digest.ciphers</td>
<td>Client, server</td>
<td>Comma-separated list of supported ciphers that directly limits the set of supported ciphers for SASL mechanisms.</td>
</tr>
</tbody>
</table>

Table A.102. SASL Properties Used After Authentication

<table>
<thead>
<tr>
<th>Property</th>
<th>Client / Server</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>wildfly.sasl.principal</td>
<td>Client</td>
<td>Contains the negotiated client principal after a successful SASL client-side authentication.</td>
</tr>
<tr>
<td>wildfly.sasl.security-identity</td>
<td>Server</td>
<td>Contains the negotiated security identity after a successful SASL server-side authentication.</td>
</tr>
</tbody>
</table>
A.4. SECURITY AUTHORIZATION ARGUMENTS

Arguments to the `security` commands in JBoss EAP are determined by the defined mechanism. Each mechanism requires different properties, and it is recommended to use tab completion to examine the various requirements for the defined mechanism.

Table A.103. Universal Arguments

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>--mechanism</td>
<td>Specifies the mechanism to enable or disable. A list of supported SASL mechanisms is available at Support Level for SASL Authentication Mechanisms, and the BASIC, CLIENT_CERT, DIGEST, DIGEST-SHA-256, and FORM HTTP authentication mechanisms are currently supported.</td>
</tr>
<tr>
<td>--no-reload</td>
<td>If specified, then the server is not reloaded after the security command is completed.</td>
</tr>
</tbody>
</table>

Mechanism Specific Attributes
The following attributes are only eligible for specific mechanisms. They are grouped below based on their function.

Table A.104. key-store Realm

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>--key-store-name</td>
<td>The name of the truststore as an existing keystore. This must be specified if --key-store-realm-name is not used for the EXTERNAL SASL mechanism or the CLIENT_CERT HTTP mechanism.</td>
</tr>
<tr>
<td>--key-store-realm-name</td>
<td>The name of the truststore as an existing keystore realm. This must be specified if --key-store-name is not used for the EXTERNAL SASL mechanism or the CLIENT_CERT HTTP mechanism.</td>
</tr>
<tr>
<td>--roles</td>
<td>An optional argument that defines a comma separated list of roles associated with the current identity. If no existing role mapper contains the specified list of roles, then a role mapper will be generated and assigned.</td>
</tr>
</tbody>
</table>

Table A.105. file-system Realm

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>--exposed-realm</td>
<td>The realm exposed to the user.</td>
</tr>
<tr>
<td>--file-system-realm-name</td>
<td>The name of the filesystem realm.</td>
</tr>
</tbody>
</table>
The name of the role decoder used to extract the roles from the user’s repository. This attribute is only used if `--file-system-realm-name` is specified.

**Attribute**  
Description

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>--user-role-decoder</code></td>
<td></td>
</tr>
</tbody>
</table>

**Table A.106. Properties Realm**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>--exposed-realm</code></td>
<td>The realm exposed to the user. This value must match the <code>realm-name</code> defined in the user’s properties file.</td>
</tr>
<tr>
<td><code>--groups-properties-file</code></td>
<td>A path to the properties file that contains the <code>groups</code> attribute for management operations, or the <code>roles</code> for the undertow server.</td>
</tr>
<tr>
<td><code>--properties-realm-name</code></td>
<td>The name of an existing properties realm.</td>
</tr>
<tr>
<td><code>--relative-to</code></td>
<td>Adjusts the paths of <code>--group-properties-file</code> and <code>--users-properties-file</code> to be relative to a system property.</td>
</tr>
<tr>
<td><code>--users-properties-file</code></td>
<td>A path to the properties file that contains the user details.</td>
</tr>
</tbody>
</table>

**Table A.107. Miscellaneous Properties**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>--management-interface</code></td>
<td>The management interface to configure for management authentication commands. This defaults to the <code>http-interface</code>.</td>
</tr>
<tr>
<td><code>--new-auth-factory-name</code></td>
<td>Used to specify a name for the authentication factory. If not defined, a name is automatically created.</td>
</tr>
<tr>
<td><code>--new-realm-name</code></td>
<td>Used to specify a name for the properties file realm resource. If not defined, a name is automatically created.</td>
</tr>
<tr>
<td><code>--new-security-domain</code></td>
<td>Used to specify a name for the security domain. If not defined, a name is automatically created.</td>
</tr>
<tr>
<td><code>--super-user</code></td>
<td>Configures a local user with super-user permissions. Usable with the <code>JBoss-Local-User</code> mechanism.</td>
</tr>
</tbody>
</table>

**A.5. ELYTRON CLIENT SIDE ONE WAY EXAMPLE**

After configuring a server SSL context, it is important to test the configuration if possible. An Elytron client SSL context can be placed in a configuration file and then executed from the management CLI,
allowing functional testing of the server configuration. These steps assume that the server-side configuration is completed, and the server has been reloaded if necessary.

1. If the server keystore already exists, then proceed to the next step; otherwise, create the server keystore.

```
$ keytool -genkeypair -alias localhost -keyalg RSA -keysize 1024 -validity 365 -keystore server.keystore.jks -dname "CN=localhost" -keypass secret -storepass secret
```

2. If the server certificate has already been exported, then proceed to the next step; otherwise, export the server certificate.

```
$ keytool -exportcert -keystore server.keystore.jks -alias localhost -keypass secret -storepass secret -file server.cer
```

3. Import the server certificate into the client’s truststore.

```
$ keytool -importcert -keystore client.truststore.jks -storepass secret -alias localhost -trustcacerts -file server.cer
```

4. Define the client–side SSL context inside of `example-security.xml`. This configuration file contains an Elytron `authentication-client` that defines the authentication and SSL configuration for outbound connections. The following file demonstrates defining a client SSL context and keystore.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<configuration>
  <authentication-client xmlns="urn:elytron:client:1.2">
    <key-stores>
      <key-store name="clientStore" type="jks">
        <file name="/path/to/client.truststore.jks"/>
        <key-store-clear-password password="secret"/>
      </key-store>
    </key-stores>
    <ssl-contexts>
      <ssl-context name="client-SSL-context">
        <trust-store key-store-name="clientStore"/>
      </ssl-context>
    </ssl-contexts>
    <ssl-context-rules>
      <rule use-ssl-context="client-SSL-context"/>
    </ssl-context-rules>
  </authentication-client>
</configuration>
```

5. Using the management CLI, reference the newly created file and attempt to access the server. The following command accesses the management interface and executes the `whoami` command.

```
$ EAP_HOME/bin/jboss-cli.sh -c --controller=remote+https://127.0.0.1:9993 -Dwildfly.config.url=/path/to/example-security.xml :whoami
```
A.6. ELYTRON CLIENT SIDE TWO WAY EXAMPLE

After configuring a server SSL context, it is important to test the configuration if possible. An Elytron client SSL context can be placed in a configuration file and then executed from the management CLI, allowing functional testing of the server configuration. These steps assume that the server-side configuration is completed, and the server has been reloaded if necessary.

1. If the server and client keystores already exist, then proceed to the next step; otherwise, create the server and client keystores.

   $ keytool -genkeypair -alias localhost -keyalg RSA -keysize 1024 -validity 365 -keystore server.keystore.jks -dname "CN=localhost" -keypass secret -storepass secret
   $ keytool -genkeypair -alias client -keyalg RSA -keysize 1024 -validity 365 -keystore client.keystore.jks -dname "CN=client" -keypass secret -storepass secret

2. If the server and client certificates have already been exported, then proceed to the next step; otherwise, export the server and client certificates.

   $ keytool -exportcert  -keystore server.keystore.jks -alias localhost -keypass secret -storepass secret -file server.cer
   $ keytool -exportcert  -keystore client.keystore.jks -alias client -keypass secret -storepass secret -file client.cer

3. Import the server certificate into the client’s truststore.

   $ keytool -importcert -keystore client.truststore.jks -storepass secret -alias localhost -trustcacerts -file server.cer

4. Import the client certificate into the server’s truststore.

   $ keytool -importcert -keystore server.truststore.jks -storepass secret -alias client -trustcacerts -file client.cer

5. Define the client-side SSL context inside of example-security.xml. This configuration file contains an Elytron authentication-client that defines the authentication and SSL configuration for outbound connections. The following file demonstrates defining a client SSL context and keystore.

   ```xml
   <configuration>
   <authentication-client xmlns="urn:elytron:client:1.2">
   <key-stores>
   <key-store name="clientStore" type="jks">
   <file name="/path/to/client.truststore.jks"/>
   <key-store-clear-password password="secret"/>
   </key-store>
   </key-stores>
   <key-stores>
   <key-store name="clientKeyStore" type="jks">
   <file name="/path/to/client.keystore.jks"/>
   <key-store-clear-password password="secret"/>
   </key-store>
   </key-stores>
   <ssl-contexts>
   <ssl-context name="client-SSL-context">
   ```
6. Using the management CLI, reference the newly created file and attempt to access the server. The following command accesses the management interface and executes the `whoami` command.

```bash
$ EAP_HOME/bin/jboss-cli.sh -c --controller=remote+https://127.0.0.1:9993 -Dwildfly.config.url=/path/to/example-security.xml :whoami
```