



# **Talend ESB STS**

## User Guide

### **5.1**

# Talend ESB STS: User Guide

Publication date 3 May 2012  
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# Chapter 1. Introduction

## 1.1. What is a Security Token Service?

An informal description of a Security Token Service is that it is a web service that offers some or all of the following services (among others):

- It can issue a Security Token of some sort based on presented or configured credentials.
- It can say whether a given Security Token is valid or not.
- It can renew (extend the validity of) a given Security Token.
- It can cancel (remove the validity of) a given Security Token.
- It can transform a given Security Token into a Security Token of a different sort.

Offloading this functionality to another service greatly simplifies client and service provider functionality, as they can simply call the STS appropriately rather than have to handle the security processing logic themselves. For example, the WSDL of a service provider might state that a particular type of security token is required to access the service. Then:

1. A client of the service can ask an STS for a Security Token of that particular type, which is then sent to the service provider.
2. The service provider could choose to validate the received token locally, or dispatch the token to an STS for validation.

These are the two most common use cases of an STS:

Security Token Services are defined formally within the OASIS [WS-Trust specification](#). They help immensely in decoupling authentication and authorization maintenance from the web service clients and providers that need

that information. Using the STS eliminates the need for the Web Service Provider (WSP) and Web Service Clients (WSC) to have a direct trust relationship, freeing WSPs from needing to maintain WSC UsernameToken passwords or X509 certificates from acceptable clients. Instead, it is just necessary for the WSP to trust the STS and for the STS to be able to validate the WSC's credentials prior to making the STS call.

A client can communicate with the STS via a protocol defined in the WS-Trust specification. The SOAP Body of the request contains a "RequestSecurityToken" element as follows:

```
<wst:RequestSecurityToken Context="..." xmlns:wst="...">
  <wst:TokenType>...</wst:TokenType>
  <wst:RequestType>...</wst:RequestType>
  <wst:SecondaryParameters>...</wst:SecondaryParameters>
  ...
</wst:RequestSecurityToken>
```

The Apache CXF STS implementation supports a wide range of parameters that are passed in the RequestSecurityToken element. The SOAP Body of the response from the STS will contain a "RequestSecurityTokenResponse(Collection)" element, e.g.:

```
<wst:RequestSecurityTokenResponseCollection xmlns:wst="...">
  <wst:RequestSecurityTokenResponse>
    ...
  </wst:RequestSecurityTokenResponse>
</wst:RequestSecurityTokenResponseCollection>
```

## 1.1.1. A sample request/response for issuing a Security Token

A sample client request is given here, where the client wants the STS to issue a Security Assertion Markup Language (SAML) 2.0 token for a service hosted at `http://cxf.apache.org:8080/service`:

```
<wst:RequestSecurityToken Context="..." xmlns:wst="...">
  <wst:TokenType>
    http://docs.oasis-open.org/wss/oasis-wss-saml-token-profile-1.1#SAMLV2.0
  </wst:TokenType>
  <wst:RequestType>
    http://docs.oasis-open.org/ws-sx/ws-trust/200512/Issue
  </wst:RequestType>
  <wsp:AppliesTo>http://cxf.apache.org:8080/service</wsp:AppliesTo>
</wst:RequestSecurityToken>
```

The STS responds with:

```
<wst:RequestSecurityTokenResponseCollection xmlns:wst="...">
  <wst:RequestSecurityTokenResponse>
    <wst:TokenType>
      http://docs.oasis-open.org/wss/oasis-wss-saml-token-profile-1.1#SAMLV2.0
    </wst:TokenType>
    <wst:RequestedSecurityToken>
      <saml2:Assertion xmlns:saml2="..." ... />
    </wst:RequestedSecurityToken>
  </wst:RequestSecurityTokenResponse>
```

```
</wst:RequestSecurityTokenResponseCollection>
```

## 1.2. The STS provider framework in Apache CXF

The first support for an STS in Apache CXF appeared in the 2.4.0 release with the addition of an STS provider framework in the WS-Security module. This is essentially an API that can be used to create your own STS implementation. As the STS implementation shipped in CXF 2.5 is based on this provider framework, it makes sense to examine it in more detail.

The SEI (Service Endpoint Interface) is available here. It contains the following methods that are relevant to the STS features discussed above:

- `RequestSecurityTokenResponseCollectionType issue(RequestSecurityTokenType request)` - to issue a security token
- `RequestSecurityTokenResponseType issueSingle(RequestSecurityTokenType request)` - to issue a security token that is not contained in a "Collection" wrapper (for legacy applications)
- `RequestSecurityTokenResponseType cancel(RequestSecurityTokenType request)` - to cancel a security token
- `RequestSecurityTokenResponseType validate(RequestSecurityTokenType request)` - to validate a security token
- `RequestSecurityTokenResponseType renew(RequestSecurityTokenType request)` - to renew a security token

The SEI implementation handles each request by delegating it to a particular operation, which is just an interface that must be implemented by the provider framework implementation. Finally, a JAX-WS provider is available, which dispatches a request to the appropriate operation.

# Chapter 2. Security Token Service Architecture

## 2.1. The TokenProvider Interface

Security tokens are created in the Security Token Service via the [TokenProvider](#) interface. It has three methods:

- `boolean canHandleToken(String tokenType)` - Whether this `TokenProvider` implementation can provide a token of the given type
- `boolean canHandleToken(String tokenType, String realm)` - Whether this `TokenProvider` implementation can provide a token of the given type, in the given realm
- `TokenProviderResponse createToken(TokenProviderParameters tokenParameters)`  
- Create a token using the given parameters

A client can request a security token from the STS by either invoking the `issue` operation and supplying a desired token type, or else calling the "validate" operation and passing a (different) token type (token transformation). Assuming that the client request is authenticated and well-formed, the STS will iterate through a list of `TokenProvider` implementations to see if they can "handle" the received token type. If they can, then the implementation is used to create a security token, which is returned to the client. The second "canHandleToken" method which also takes a "realm" parameter.

So to support the issuing of a particular token type in an STS deployment, it is necessary to specify a `TokenProvider` implementation that can handle that token type. The STS currently ships with two `TokenProvider` implementations, one for generating `SecurityContextTokens`, and one for generating SAML Assertions. Before we look at these two implementations, let's take a look at the "createToken" operation in more detail. This method takes a [TokenProviderParameters](#) instance.

## 2.2. TokenProvider Parameters

The `TokenProviderParameters` class is nothing more than a collection of configuration properties to use in creating the token, which are populated by the STS operations using information collated from the request, or static configuration, etc. The properties of the `TokenProviderParameters` are:

- `STSPropertiesMBean` `stsProperties` - A configuration MBean that holds the configuration for the STS as a whole, such as information about the private key to use to sign issued tokens, etc.
- `EncryptionProperties` `encryptionProperties` - A properties object that holds encryption information relevant to the intended recipient of the token.
- `Principal` `principal` - The current client Principal object. This can be used as the "subject" of the generated token.
- `WebServiceContext` `webServiceContext` - The current web service context object. This allows access to the client request.
- `RequestClaimCollection` `requestedClaims` - The requested claims in the token.
- `KeyRequirements` `keyRequirements` - A set of configuration properties relating to keys.
- `TokenRequirements` `tokenRequirements` - A set of configuration properties relating to the token.
- `String` `appliesToAddress` - The URL that corresponds to the intended recipient of the token.
- `ClaimsManager` `claimsManager` - An object that can manage claims.
- `Map<String, Object>` `additionalProperties` - Any additional (custom) properties that might be used by a `TokenProvider` implementation.
- `TokenStore` `tokenStore` - A cache used to store tokens.
- `String` `realm` - The realm to create the token in (this should be the same as the realm passed to "canHandleToken").

If this looks complicated then remember that the STS will take care of populating all of these properties from the request and some additional configuration. You only need to worry about the `TokenProviderParameters` object if you are creating your own `TokenProvider` implementation.

## 2.3. TokenProviderResponse

The "createToken" method returns an object of type `TokenProviderResponse`. Similar to the `TokenProviderParameters` object, this just holds a collection of objects that is parsed by the STS operation to construct a response to the client. The properties are:

- `Element` `token` - The (DOM) token that was created by the `TokenProvider`.
- `String` `tokenId` - The ID of the token
- `long` `lifetime` - The lifetime of the token
- `byte[]` `entropy` - Any entropy associated with the token
- `long` `keySize` - The key size of a secret key associated with the token.
- `boolean` `computedKey` - Whether a computed key algorithm was used in generating a secret key.



- `TokenReference attachedReference` - An object which gives information how to refer to the token when it is "attached".
- `TokenReference unAttachedReference` - An object which gives information how to refer to the token when it is "unattached".

Most of these properties are optional as far as the STS operation is concerned, apart from the token and token ID. The `TokenReference` object contains information about how to refer to the token (direct reference vs. Key Identifier, etc.), that is used by the STS to generate the appropriate reference to return to the client.

## 2.4. The SCTProvider

Now that we've covered the `TokenProvider` interface, let's look at an implementation that is shipped with the STS. The `SCTProvider` is used to provide a token known as a `SecurityContextToken`, that is defined in the [WS-SecureConversation](#) specification. A `SecurityContextToken` essentially consists of a `String` Identifier which is associated with a particular secret key. If a service provider receives a SOAP message with a digital signature which refers to a `SecurityContextToken` in the `KeyInfo` of the signature, then the service provider knows that it must somehow obtain a secret key associated with that particular Identifier to verify the signature. How this is done is "out of band".

To request a `SecurityContextToken`, the client must use one of the following Token Types:

- `http://schemas.xmlsoap.org/ws/2005/02/sc/sct`
- `http://docs.oasis-open.org/ws-sx/ws-secureconversation/200512`

Two properties can be configured on the `SCTProvider` directly:

- `long lifetime` - The lifetime of the generated SCT. The default is 30 minutes.
- `boolean returnEntropy` - Whether to return any entropy bytes to the client or not. The default is true.

The `SCTProvider` generates a secret key using the `KeyRequirements` object that was supplied, and constructs a `SecurityContextToken` with a random Identifier. It creates a `CXF SecurityToken` object that wraps this information, and stores it in the supplied cache using the given lifetime. The `SecurityContextToken` element is then returned, along with the appropriate references, lifetime element, entropy, etc.

When requesting a token from an STS, the client will typically present some entropy along with a computed key algorithm. The STS will generate some entropy of its own, and combine it with the client entropy using the computed key algorithm to generate the secret key. Alternatively, the client will present no entropy, and the STS will supply all of the entropy. Any entropy the STS generates is then returned to the client, who can recreate the secret key using its own entropy, the STS entropy, and the computed key algorithm.

This secret key is then used for the SCT use-case to encrypt/sign some part of a message. The `SecurityContextToken` is placed in the security header of the message, and referred to in the `KeyInfo` element of the signed/encrypted structure. As noted earlier, the service provider must obtain somehow the secret key corresponding to the `SecurityContextToken` identifier. Perhaps the service provider shares a (secured) distributed cache with an STS instance. Or perhaps the service provider sends the SCT to an STS instance to "validate" it, and receives a SAML token in response with the embedded (encrypted) secret key.

## 2.5. Token caching in the TokenProvider

Finally, we will cover token caching in a `TokenProvider` implementation. The `SCTProvider` is essentially useless without a cache, as otherwise there is no way for a third-party to know the secret key corresponding to a

SecurityContextToken. Any TokenProvider implementation can cache a generated token in the [TokenStore](#) object supplied as part of the TokenProviderParameters.

The SCTProvider creates a SecurityToken with the ID of the SCT, the secret key associated with the SCT and the client principal. If a "realm" is passed through, then this is recorded as a property of the SecurityToken (keyed via [STSConstants.TOKEN\\_REALM](#)). Finally, the STS ships with two TokenStore implementations, an in-memory implementation based on eh-cache, and an [implementation](#) that uses Hazelcast.

## 2.6. The SAMLTokenProvider

The [SAMLTokenProvider](#) can issue SAML 1.1 and SAML 2.0 tokens. To request a SAML 1.1 token, the client must use one of the following Token Types:

- `http://docs.oasis-open.org/wss/oasis-wss-saml-token-profile-1.1#SAMLV1.1`
- `urn:oasis:names:tc:SAML:1.0:assertion`

To request a SAML 2.0 token, the client must use one of the following Token Types:

- `http://docs.oasis-open.org/wss/oasis-wss-saml-token-profile-1.1#SAMLV2.0`
- `urn:oasis:names:tc:SAML:2.0:assertion`

The following properties can be configured on the SAMLTokenProvider directly:

- `List<AttributeStatementProvider>` attributeStatementProviders - A list of objects that can add attribute statements to the token.
- `List<AuthenticationStatementProvider>` authenticationStatementProviders - A list of objects that can add authentication statements to the token.
- `List<AuthDecisionStatementProvider>` authDecisionStatementProviders - A list of objects that can add authorization decision statements to the token.
- [SubjectProvider](#) subjectProvider - An object used to add a Subject to the token.
- [ConditionsProvider](#) conditionsProvider - An object used to add a Conditions statement to the token.
- boolean signToken - Whether to sign the token or not. The default is true.
- `Map<String, SAMLRealm>` realmMap - A map of realms to SAMLRealm objects.

We will explain each of these properties in more detail in the next few sections.

## 2.7. Realms in the Token Providers

As explained in the previous section, the TokenProvider interface has a method that takes a realm parameter:

- boolean `canHandleToken(String tokenType, String realm)` - Whether this TokenProvider implementation can provide a token of the given type, in the given realm

In other words, the TokenProvider implementation is being asked whether it can supply a token corresponding to the Token Type in a particular realm. How the STS knows what the desired realm is will be covered subsequently. However, we will explain how the realm is handled by the TokenProviders here. The SCTProvider ignores the realm in the `canHandleToken` method. In other words, the SCTProvider can issue a SecurityContextToken in any

realm. If a realm is passed through via the `TokenProviderParameters` when creating the token, the `SCTProvider` will cache the token with the associated realm as a property.

Unlike the `SCTProvider`, the `SAMLTokenProvider` does not ignore the realm parameter to the `canHandleToken` method. Recall that the `SAMLTokenProvider` has a property `"Map<String, SAMLRealm> realmMap"`. The `canHandleToken` method checks to see if the given realm is null, and if it is not null then the `realmMap` must contain a key which matches the given realm. So if the STS implementation is designed to issue tokens in different realms, then the `realmMap` of the `SAMLTokenProvider` must contain the corresponding realms in the key-set of the map.

The `realmMap` property maps realm Strings to `SAMLRealm` objects. Among other properties, the `SAMLRealm` class contains the following settings:

- String `issuer` - the Issuer String to use in this realm
- String `signatureAlias` - the keystore alias to use to retrieve the private key the `SAMLTokenProvider` uses to sign the generated token

If the `SAMLTokenProvider` is "realm aware", then it can issue tokens with an issuer name and signing key specific to a given realm. `SAMLRealms` also contain cryptographic and `CallbackHandler` settings to allow for configuring realm-specific keystores if desired. If no realm is passed to the `SAMLTokenProvider`, then these properties are obtained from the "system wide" properties defined in the `STSPropertiesMBean` object passed as part of the `TokenProviderParameters`, which can be set via the following methods:

- `void setSignatureUsername(String signatureUsername)`
- `void setIssuer(String issuer)`

Two additional properties are required when signing SAML Tokens. A password is required to access the private key in the keystore, which is supplied by a `CallbackHandler` instance. A `WSS4J "Crypto"` instance is also required which controls access to the keystore. These are both set on the `STSPropertiesMBean` object via:

- `void setCallbackHandler(CallbackHandler callbackHandler)`
- `void setSignatureCrypto(Crypto signatureCrypto)`

Note that the signature of generated SAML Tokens can be disabled, by setting the `"signToken"` property of the `SAMLTokenProvider` to `"false"`. As per the `SCTProvider`, the generated SAML tokens are stored in the cache with the associated realm stored as a property.

## 2.8. Populating SAML Tokens

In the previous section we covered how a generated SAML token is signed, how to configure the key used to sign the assertion, and how to set the Issuer of the Assertion. In this section we will describe how to populate the SAML Token itself. The `SAMLTokenProvider` is designed to be able to issue a wide range of SAML Tokens. It does this by re-using the SAML abstraction `library` that ships with Apache WSS4J, which defines a collection of beans that are configured and then assembled in a `CallbackHandler` to create a SAML assertion.

### 2.8.1. Configure a Conditions statement

The `SAMLTokenProvider` has a `"ConditionsProvider conditionsProvider"` property, which can be used to configure the generated Conditions statement which is added to the SAML Assertion. The `ConditionsProvider` has a method to return a `ConditionsBean` object, and a method to return a lifetime in seconds. The `ConditionsBean` holds properties such as the not-before and not-after dates, etc. The `SAMLTokenProvider` ships with a

default `ConditionsProvider` implementation that is used to insert a `Conditions` statement in every SAML token that is generated. This [implementation](#) uses a default lifetime of 30 minutes, and set the Audience Restriction URI of the Conditions Statement to be the received "AppliesTo" address, which is obtained from the `TokenProviderParameters` object.

The `DefaultConditionsProvider` can be configured to change the lifetime of the issued token. If you want to remove the `ConditionsProvider` altogether from the generation assertion, or implement a custom `Conditions` statement, then you must implement an instance of the `ConditionsProvider` interface, and set it on the `SAMLTokenProvider`.

## 2.8.2. Configure a Subject

The `SAMLTokenProvider` has a "`SubjectProvider` subjectProvider" property, which can be used to configure the Subject of the generated token, regardless of the version of the token. The `SubjectProvider` interface defines a single method to return a `SubjectBean`, given the token provider parameters, the parent Document of the assertion, and a secret key to use (if any). The `SubjectBean` contains the Subject name, name-qualifier, confirmation method, and `KeyInfo` element, amongst other properties. The `SAMLTokenProvider` ships with a default `SubjectProvider` implementation that is used to insert a Subject into every SAML Token that is generated.

The `DefaultSubjectProvider` has a single configuration method to set the subject name qualifier. It creates a subject confirmation method by checking the received key type. The subject name is the name of the principal obtained from `TokenProviderParameters`. Finally, a `KeyInfo` element is set on the `SubjectBean` under the following conditions:

- If a "SymmetricKey" Key Type algorithm is specified by the client, then the secret key passed through to the `SubjectProvider` is encrypted with the `X509Certificate` of the recipient, and added to the `KeyInfo` element. How the provider knows the public key of the recipient will be covered subsequently.
- If a "PublicKey" KeyType algorithm is specified by the client, the `X509Certificate` that is received as part of the "UseKey" request is inserted into the `KeyInfo` element of the Subject.

If a "Bearer" KeyType algorithm is specified by the client, then no `KeyInfo` element is added to the Subject. For the "SymmetricKey" Key Type case, the `SAMLTokenProvider` creates a secret key using a `SymmetricKeyHandler` instance. The `SymmetricKeyHandler` first checks the key size that is supplied as part of the `KeyRequirements` object, by checking that it fits in between a minimum and maximum key size that can be configured. It also checks any client entropy that is supplied, as well as the computed key algorithm. It then creates some entropy and a secret key.

To add a custom Subject element to an assertion, you must create your own `SubjectProvider` implementation, and set it on the `SAMLTokenProvider`.

## 2.8.3. Adding Attribute Statements

The `SAMLTokenProvider` has a "`List<AttributeStatementProvider>` attributeStatementProviders" property, which can be used to add AttributeStatements to the generated assertion. Each object in the list adds a single Attribute statement. The `AttributeStatementProvider` contains a single method to return an `AttributeStatementBean` given the `TokenProviderParameters` object. This contains a `SubjectBean` (for SAML 1.1 assertions), and a list of `AttributeBeans`. The `AttributeBean` object holds the attribute name/qualified-name/name-format, and a list of attribute values, amongst other properties.

If no statement provider is configured in the `SAMLTokenProvider`, then the `DefaultAttributeStatementProvider` is invoked to create an Attribute statement to add to the assertion. It creates a default "authenticated" attribute, and also creates separate Attributes for any "OnBehalfOf" or "ActAs" elements that were received in the request. If the received `OnBehalfOf/ActAs` element was a `UsernameToken`, then the username is added as an Attribute. If the received element was a SAML Assertion, then the subject name is added as an Attribute.

## 2.8.4. Adding Authentication Statements

The `SAMLTokenProvider` has a `List<AuthenticationStatementProvider>` `authenticationStatementProviders` property, which can be used to add `AuthenticationStatements` to the generated assertion. Each object in the list adds a single `AuthenticationStatement`. The `AuthenticationStatementProvider` contains a single method to return an `AuthenticationStatementBean` given the `TokenProviderParameters` object. This contains a `SubjectBean` (for SAML 1.1 assertions), an authentication instant, authentication method, and other properties. No default implementation of the `AuthenticationStatementProvider` interface is provided in the STS, so if you want to issue `AuthenticationStatements` you will have to write your own.

## 2.8.5. Adding Authorization Decision Statements

The `SAMLTokenProvider` has a `List<AuthDecisionStatementProvider>` `authDecisionStatementProviders` property, which can be used to add `AuthzDecisionStatements` to the generated assertion. Each object in the list adds a single statement. The `AuthDecisionStatementProvider` contains a single method to return an `AuthDecisionStatementBean` given the `TokenProviderParameters` object. This contains a `SubjectBean` (for SAML 1.1 assertions), the decision (permit/indeterminate/deny), the resource URI, a list of `ActionBeans`, amongst other properties. No default implementation of the `AuthDecisionStatementProvider` interface is provided in the STS.

Note that for SAML 1.1 tokens, the `Subject` is embedded in one of the `Statements`. When creating a SAML 1.1 Assertion, if a given `Authentication/Attribute/AuthzDecision` statement does not have a subject, then the standalone `Subject` is inserted into the statement. Finally, once a SAML token has been created, it is stored in the cache (if one is configured), with a lifetime corresponding to that of the `Conditions` statement. A `TokenProviderResponse` object is created with the DOM representation of the SAML Token, the SAML Token ID, lifetime, entropy bytes, references, etc.

# 2.9. Token Validation

## 2.9.1. The TokenValidator interface

`SecurityTokens` are validated in the STS via the `TokenValidator` interface. It is very similar to the `TokenProvider` interface. It has three methods:

- `boolean canHandleToken(ReceivedToken validateTarget)` - Whether this `TokenValidator` implementation can validate the given token
- `boolean canHandleToken(ReceivedToken validateTarget, String realm)` - Whether this `TokenValidator` implementation can validate the given token in the given realm
- `TokenValidatorResponse validateToken(TokenValidatorParameters tvp)` - Validate a token using the given parameters.

A client can validate a security token via the STS by invoking the "validate" operation. Assuming that the client request is authenticated and well-formed, the STS will iterate through a list of `TokenValidator` implementations to see if one can "handle" the received token. If one can, then that implementation is used to validate the received security token, and the validation result is returned to the client. The second "canHandleToken" method also takes a "realm" parameter.

So to support the validation of a particular token type in an STS deployment, it is necessary to specify a `TokenValidator` implementation that can handle that token. The STS currently ships with four

TokenValidator implementations, to validate SecurityContextTokens, SAML Assertions, UsernameTokens, and BinarySecurityTokens. Before we look at these implementations, let's take a look at the "validateToken" operation in more detail. This method takes a [TokenValidatorParameters](#) instance.

## 2.9.2. TokenValidatorParameters

The TokenValidatorParameters class is a collection of configuration properties to use in validating the token, which are populated by the STS operations using information collated from the request, or static configuration, etc. The properties of the TokenValidatorParameters are:

- [STSPropertiesMBean](#) stsProperties - A configuration MBean that holds the configuration for the STS as a whole.
- Principal principal - The current client Principal object
- WebServiceContext webServiceContext - The current web service context object. This allows access to the client request.
- [KeyRequirements](#) keyRequirements - A set of configuration properties relating to keys.
- [TokenRequirements](#) tokenRequirements - A set of configuration properties relating to the token.
- [TokenStore](#) tokenStore - A cache used to retrieve tokens.
- String realm - The realm to validate the token in (this should be the same as the realm passed to "canHandleToken").
- ReceivedToken token - Represents the token that was received for validation.

If this looks complicated then remember that the STS will take care of populating all of these properties from the request and some additional configuration. You only need to worry about the TokenValidatorParameters object if you are creating your own TokenValidator implementation.

## 2.9.3. TokenValidatorResponse

The "validateToken" method returns an object of type [TokenValidatorResponse](#). Similar to the TokenValidatorParameters object, this just holds a collection of objects that is parsed by the STS operation to construct a response to the client. The properties are:

- ReceivedToken token - Represents the token that was received for validation. If the token is determined valid, then the ReceivedToken will be given a valid state ReceivedToken.STATE.VALID, otherwise STATE.INVALID or STATE.EXPIRED
- Principal principal - A principal corresponding to the validated token.
- Map<String, Object> additionalProperties - Any additional properties associated with the validated token.
- String realm - The realm of the validated token.

## 2.9.4. The SCTValidator

Now that we've covered the TokenValidator interface, let's look at an implementation that is shipped with the STS. The [SCTValidator](#) is used to validate a token known as a SecurityContextToken, that is defined

in the [WS-SecureConversation](#) specification. The `SCTProvider` was covered in earlier in this chapter. A `SecurityContextToken` essentially consists of a String Identifier which is associated with a particular secret key. If a service provider receives a SOAP message with a digital signature which refers to a `SecurityContextToken` in the `KeyInfo` of the signature, then the service provider knows that it must somehow obtain a secret key associated with that particular Identifier to verify the signature.

One way to do this would be if the service provider shares a (secured) distributed cache with an STS instance. An alternative solution would be for the service provider to send the SCT to an STS for validation, and to receive a SAML token in response with the embedded (encrypted) secret key. The `SCTValidator` can accommodate this latter scenario, albeit indirectly as will be explained shortly.

The `SCTValidator` can validate a `SecurityContextToken` in either of the following namespaces:

- <http://schemas.xmlsoap.org/ws/2005/02/sc/sct>
- <http://docs.oasis-open.org/ws-sx/ws-secureconversation/200512>

The `SCTValidator` validates a received `SecurityContextToken` by checking to see whether it is stored in the cache. Therefore it is a requirement to configure a cache for the STS if you want to validate `SecurityContextTokens`. If the `SecurityContextToken` is stored in the cache (for example, by the `SCTProvider`), then the received `SecurityToken` is taken to be valid. The secret associated with the `SecurityContextToken` is also retrieved from the cache, and set as an "additional property" in the `TokenValidatorResponse` using the key "sct-validator-secret". If the cached token has a stored principal, then this is also returned in the `TokenValidatorResponse`.

If you want to support the scenario of returning the secret key associated with the `SecurityContextToken` to the client (of the STS), then it is possible to do so via token transformation. This is where the client sends an additional Token Type (in this case for a SAML Token). After the token is validated, the `SAMLTokenProvider` is called with the additional properties map obtained from the `SCTValidator`. The `SAMLTokenProvider` then has access to the secret key via the "sct-validator-secret" tag, which it can insert into the Assertion using a custom `AttributeProvider`.

## 2.9.5. The X509TokenValidator

Another `TokenValidator` implementation that ships with the STS is the `X509TokenValidator`. This class validates an X.509 V.3 certificate (received as a `BinarySecurityToken`). The `BinarySecurityToken` must use Base-64 encoding. The received cert must be known (or trusted) by the STS crypto object, that is set on the `STSPropertiesMBean` object. The `X509TokenValidator` has a single property that can be configured:

- `void setValidator(Validator validator)` - Set the WSS4J [Validator](#) instance to use to validate the received certificate. The default is [SignatureTrustValidator](#).

No proof-of-possession is done with the received certificate. The subject principal of the certificate is set on the response, if validation is successful. Note that no caching is used in this `TokenValidator` implementation.

## 2.9.6. The UsernameTokenValidator

The `UsernameTokenValidator` is used to validate WS-Security UsernameTokens. Two properties can be set directly on the `UsernameTokenValidator`:

- `void setValidator(Validator validator)` - Set the WSS4J [Validator](#) instance to use to validate the received UsernameToken. The default is the [UsernameTokenValidator](#) (note that this is in WSS4J and not the same as the `UsernameTokenValidator` in the STS!).
- `void setUsernameTokenRealmCodec(UsernameTokenRealmCodec uTRC)` - Set the [UsernameTokenRealmCodec](#) instance to use to return a realm from a validated token.

The UsernameToken is first checked to make sure that it is well-formed. If it has no password element then it is rejected. If a cache is configured, then it sees if the UsernameToken has been previously stored in the cache (searching by wsu:Id). If it is, the CXF STS checks the wsu:Id-independent hashcode of the UsernameToken, and searches for the String representation of this hash in the TokenStore. If a SecurityToken is retrieved, a second check that the stored hash of the SecurityToken matches the hash of the received token. Note that the CXF STS does not have a UsernameTokenProvider as of yet, so for this use-case perhaps the cache is shared with a custom TokenProvider.

If the token is not stored in the cache, then the WSS4J Validator instance is used to validate the received UsernameToken. As stated above, the default implementation that is used is the [UsernameTokenValidator](#) in WSS4J. This implementation uses a CallbackHandler to supply a password to validate the UsernameToken. This CallbackHandler implementation is supplied by the STSPropertiesMBean object. WSS4J also ships with an [implementation](#) that validates a UsernameToken via a JAAS LoginModule, which can be plugged in to the STS UsernameTokenValidator. If validation is successful, then a principal is created from the received UsernameToken and set on the response.

## 2.9.7. Realms in the TokenValidators

Recall that the TokenValidator interface has a method that takes a realm parameter:

- `boolean canHandleToken(ReceivedToken validateTarget, String realm)` - Whether this TokenValidator implementation can validate the given token in the given realm

Realms are handled in a slightly different way in TokenValidators compared to TokenProviders. Recall that for TokenProviders, the implementation is essentially asked whether it can provide a token in a given realm. For the SCTProvider, the realm is ignored in this method. However, when creating a token, the SCTProvider will store the given realm as a property associated with that token in the cache. The SAMLTokenProvider checks to see if the given realm is null, and if it is not null then the realmMap must contain a key which matches the given realm.

There is a subtle distinction between the realm passed to "canHandleToken" for TokenValidators and the realm returned after a token is validated as part of the TokenValidatorResponse object. The realm passed to "canHandleToken" is the realm to validate the token in. So for example, you could have two TokenValidator instances registered to validate the same token, but in different realms. All of the TokenValidator implementations that ship with the STS ignore the realm as part of this method. However, the method signature gives the user the option to validate tokens in different realms in a more flexible manner.

The realm that is returned as part of the TokenValidatorResponse is the realm that the validated token is in (if any). This can be different to the realm the token was validated in. The X509TokenValidator ignores this parameter altogether. The SCTValidator checks to see whether the SecurityToken that was stored in the cache has a realm property, and if so sets this on the TokenValidatorResponse. The UsernameTokenValidator and SAMLTokenValidator handle realms in a more sophisticated manner. Recall that the UsernameTokenValidator has the following method:

- `void setUsernameTokenRealmCodec(UsernameTokenRealmCodec uTRC)` - Set the [UsernameTokenRealmCodec](#) instance to use to return a realm from a validated token.

The UsernameTokenRealmCodec has a single method:

- `String getRealmFromToken(UsernameToken usernameToken)` - Get the realm associated with the UsernameToken parameter.

No UsernameTokenRealmCodec implementation is set by default on the UsernameTokenValidator, hence no realm is returned in TokenValidatorResponse. If an implementation is specified, then the UsernameTokenValidator will retrieve a realm from the UsernameTokenRealmCodec implementation corresponding to the validated UsernameToken. If a cache is configured, and the UsernameToken was already stored in the cache, then the realm is compared to the realm of the cached token, stored under the tag `org.apache.cxf.sts.token.realm`. If they do not match then validation fails.



## 2.9.8. The SAMLTokenValidator

The [SAMLTokenValidator](#) is used to validate SAML (1.1 and 2.0) tokens. The following properties can be set directly on the SAMLTokenValidator:

- `void setValidator(Validator validator)` - Set the WSS4J [Validator](#) instance to use to validate the received certificate. The default is [SignatureTrustValidator](#).
- `void setSamlRealmCodec(SAMLRealmCodec samlRealmCodec)` - Set the SAMLRealmCodec instance to use to return a realm from a validated token.
- `void setSubjectConstraints(List<String> subjectConstraints)` - Set a list of Strings corresponding to regular expression constraints on the subject DN of a certificate that was used to sign an Assertion.

These methods are covered in more detail below. The Assertion is first checked to make sure that it is well-formed. If a cache is defined, then the hashcode of the Assertion is checked against the hash of all assertions in the cache. If a match is found in the cache, then the Assertion is taken to be valid. If a match is not found, then the Assertion is validated.

### 2.9.8.1. Validating a received SAML Assertion

If the token is not stored in the cache then it must be validated. Firstly a check is performed to make sure that the Assertion is signed, if it is not then it is rejected. The signature of the Assertion is then validated using the Crypto object retrieved from the [STSPropertiesMBean](#) passed in the TokenValidatorParameters. Finally, trust is verified in the certificate/public-key used to sign the Assertion. This is done using the [Validator](#) object that can be configured via "setValidator". The default Validator is the WSS4J [SignatureTrustValidator](#), which checks that the received certificate is known (or trusted) by the STS Crypto object.

Recall that a List of Strings can be set on the SAMLTokenValidator via the "setSubjectConstraints" method. These Strings correspond to regular expression constraints on the subject DN of a certificate that was used to sign an Assertion. This provides additional flexibility to validate a received SAML Assertion. For example, the Assertion could be signed by an entity that has a certificate issued by a particular CA, which in turn is trusted by the STS Crypto object. However, one might want to restrict the list of "valid" entities who can sign a SAML Assertion. This can be done by adding a list of regular expressions that match the Subject DN of all acceptable certificates that might be used to sign a valid SAML Assertion. This matching is done by the [CertConstraintsParser](#).

### 2.9.8.2. Realm handling in the SAMLTokenValidator

Recall that the SAMLTokenValidator has the following method:

- `void setSamlRealmCodec(SAMLRealmCodec samlRealmCodec)` - Set the SAMLRealmCodec instance to use to return a realm from a validated token.

The SAMLRealmCodec has a single method:

- `String getRealmFromToken(AssertionWrapper assertion)` - Get the realm associated with the (SAML Assertion) parameter.

No SAMLRealmCodec implementation is set by default on the SAMLTokenValidator, hence no realm is returned in TokenValidatorResponse. If an implementation is specified, then the SAMLTokenValidator will retrieve a realm from the SAMLRealmCodec implementation corresponding to the validated Assertion. If a cache is configured,

and the Assertion was already stored in the cache, then the realm is compared to the realm of the cached token, stored under the tag "org.apache.cxf.sts.token.realm". If they do not match then validation fails.

## 2.10. Token Renewal

### 2.10.1. The TokenRenewer interface

Security tokens are renewed in the STS via the [TokenRenewer](#) interface. It has the following methods:

- `void setVerifyProofOfPossession(boolean verifyProofOfPossession)` - A boolean switch to enable or disable the proof of possession requirement.
- `void setAllowRenewalAfterExpiry(boolean allowRenewalAfterExpiry)` - A switch to enable or disable the ability to renew tokens after they have expired.
- `boolean canHandleToken(ReceivedToken renewTarget)` - Whether this [TokenRenewer](#) implementation can renew the given token.
- `boolean canHandleToken(ReceivedToken renewTarget, String realm)` - Whether this [TokenRenewer](#) implementation can renew the given token in the given realm.
- `TokenRenewerResponse renewToken(TokenRenewerParameters tokenParameters)` - Renew the token using the given parameters

A client can request that the STS renew a security token by invoking the "renew" operation and supplying a token under the "RenewTarget" Element. Assuming that the client request is authenticated and well-formed, the STS will first iterate through a list of [TokenValidator](#) implementations to see if they can "handle" the received token. If they can, then the implementation is used to validate the received security token. If no [TokenValidator](#) is found that can handle the [RenewTarget](#) that was received, then an exception is thrown. Note that this means that for token renewal, it is necessary to configure both a [TokenValidator](#) and [TokenRenewer](#) implementation that can handle the given token.

After the successful validation of a token, the state of the token is checked. If the state is not valid or expired, then an exception is thrown. The STS then iterates through the configured list of [TokenRenewer](#) implementations to see which can renew the given (validated) token. The token is then renewed and returned to the client.

The [TokenRenewerParameters](#) class is nothing more than a collection of configuration properties to use in renewing the token, which are populated by the STS operations using information collated from the request, or static configuration, etc. The [TokenRenewerResponse](#) class holds the results from the (successful) token renewal, including the DOM representation of the renewed token, the token Id, the new lifetime of the renewed token, and references to the renewed token.

#### 2.10.1.1. The SAMLTokenRenewer

The [SAMLTokenRenewer](#) can renew valid or expired SAML 1.1 and SAML 2.0 tokens. The following properties can be configured on the [SAMLTokenRenewer](#) directly:

- `boolean signToken` - Whether to sign the renewed token or not. The default is true.
- `ConditionsProvider conditionsProvider` - An object used to add a Conditions statement to the token.

- `Map<String, SAMLRealm> realmMap` - A map of realms to `SAMLRealm` objects.
- `long maxExpiry` - how long a token is allowed to be expired (in seconds) before renewal. The default is 30 minutes.

The `SAMLTokenRenewer` first checks that the token it extracts from the `TokenRenewerParameters` is in an expired or valid state, if not it throws an exception. It then retrieves the cached token that corresponds to the token to be renewed. A cache must be configured to use the `SAMLTokenRenewer`, and the token to be renewed must be in the cache before renewal takes place, for reasons that will become clear in the next section.

### 2.10.1.2. Token validation

Before the received SAML token can be renewed, a number of validation steps (that are specific to renewing SAML tokens) takes place. Two boolean properties are retrieved from the properties of the cached token:

- `org.apache.cxf.sts.token.renewing.allow` - Whether the token is allowed to be renewed or not.
- `org.apache.cxf.sts.token.renewing.allow.after.expiry` - Whether the token is allowed to be renewed or not after it has expired.

These two properties are set in the `SAMLTokenProvider` based on a received `<wst:Renewing/>` element when the user is requesting a SAML token via the issue binding. If a user omits a `<wst:Renewing/>` element, or sends `<wst:Renewing/>` or `<wst:Renewing Allow="true"/>`, then the token is allowed to be renewed. However, only if the user sends `<wst:Renewing OK="true"/>`, will the token be allowed to be renewed after expiry. This explains why a `TokenStore` is required for token renewal, as without access to these two properties it is impossible for the `SAMLTokenRenewer` to figure out whether the issuer of the token intended for the token to be renewed (after expiry) or not.

If the state of the token is expired, and if the token is allowed to be renewed after expiry, a final check is done against the boolean set via the `setAllowRenewalAfterExpiry` method of `TokenRenewer`. If this is set to false (the default), then an exception is thrown. So to support token renewal after expiry, you must explicitly define this behavior on the `TokenRenewer` implementation. Finally, a check is done on how long ago the SAML Token expired. If it is greater than the value configured in the `maxExpiry` property (30 minutes by default), then an exception is thrown.

The next validation step is to check proof of possession, if this is enabled (true by default). The `Subject KeyInfo` of the Assertion must contain a `PublicKey` or `X509Certificate` that corresponds to either the client certificate if TLS is used, or to the private key that was used to sign some part of the request. Finally, if an `AppliesTo URI` is sent as part of the request, the `SAMLTokenRenewer` checks that the received Assertion contains at least one `AudienceRestrictionURI` that matches that address, otherwise it throws an Exception.

### 2.10.1.3. Renewing the SAML Assertion

After the validation steps outlined above have passed, the token is renewed in the following way:

- A new ID is generated for the token.
- A new `IssueInstant` is set on the token.
- A new Conditions Element replaces the old Conditions Element of the token, using the configured `ConditionsProvider`.
- The Assertion is (re)-signed if the `signToken` property is true.

The old token is removed from the cache, and the new token is added. Finally, the token is set on the `TokenRenewerResponse`, along with the token Id, and Lifetime.

## 2.10.1.4. SAML Token Renewal in action

Finally, let's take a look at a system test in CXF that shows how to renew a SAML Token issued by an STS. The [wsdl](#) of the service provider defines a number of endpoints which use the transport binding, with a (endorsing) supporting token requirement which has an IssuedToken policy that requires a SAML token. In other words, the client must request a SAML token from an STS and send it to the service provider over TLS, and optionally use the secret associated with the SAML token to sign the message Timestamp (if an EndorsingSupportingToken policy is specified in the wsdl).

The STS spring configuration is available [here](#). The SAMLTokenRenewer is configured with proof-of-possession enabled, and tokens are allowed to be renewed after they have expired. Let's look at the test [code](#) and client [configuration](#). All of the tests follow the same pattern. The client requests a SAML Token from the STS (as per the IssuedToken policy), with a TTL (time-to-live) value of 8 seconds. The client then uses this issued token to make a successful request to the service provider. The test code then sleeps for 8 seconds to expire the token, and tries to invoke on the service provider again. The IssuedTokenInterceptorProvider in the WS-Security runtime in CXF recognizes that the token has expired, and sends it to the STS for renewal. The returned (renewed) token is then sent to the service provider.

## 2.11. Token Cancellation

### 2.11.1. The TokenCanceller interface

SecurityTokens are cancelled in the STS via the [TokenCanceller](#) interface. This interface is very similar to the TokenProvider and TokenValidator interfaces. It contains three methods:

- `void setVerifyProofOfPossession(boolean verifyProofOfPossession)` - Whether to enable or disable proof-of-possession verification.
- `boolean canHandleToken(ReceivedToken cancelTarget)` - Whether this TokenCanceller implementation can cancel the given token
- `TokenCancellerResponse cancelToken(TokenCancellerParameters tokenParameters)` - Cancel a token using the given parameters

A client can cancel a security token via the STS by invoking the "cancel" operation. Assuming that the client request is authenticated and well-formed, the STS will iterate through a list of TokenCanceller implementations to see if they can "handle" the received token. If they can, then the implementation is used to cancel the received security token, and the cancellation result is returned to the client. The STS currently ships with a single TokenCanceller implementation, which can cancel SecurityContextTokens that were issued by the STS. Before we look at this implementation, let's look at the "cancelToken" operation in more detail. This method takes a [TokenCancellerParameters](#) instance, and returns a [TokenCancellerResponse](#) object.

### 2.11.2. TokenCancellerParameters and TokenCancellerResponse

The TokenCancellerParameters class is nothing more than a collection of configuration properties to use in cancelling the token, which are populated by the STS operations using information collated from the request, or static configuration, etc. The properties of the TokenCancellerParameters are:

- [STSPropertiesMBean](#) stsProperties - A configuration MBean that holds the configuration for the STS as a whole.

- `Principal principal` - The current client `Principal` object
- `WebServiceContext webServiceContext` - The current web service context object. This allows access to the client request.
- [KeyRequirements](#) `keyRequirements` - A set of configuration properties relating to keys.
- [TokenRequirements](#) `tokenRequirements` - A set of configuration properties relating to the token.
- [TokenStore](#) `tokenStore` - A cache used to retrieve tokens.
- `ReceivedToken token` - Represents the token that was received for cancellation.

The "cancelToken" method returns an object of type [TokenCancellerResponse](#). Similar to the `TokenCancellerParameters` object, this just holds a collection of objects that is parsed by the STS operation to construct a response to the client. It currently only has a single property:

- `ReceivedToken token` - Represents the token that was received for cancellation. Its state will be `STATE.CANCELLED` if token cancellation was successful.

### 2.11.3. The SCTCanceller

The STS ships with a single implementation of the `TokenCanceller` interface, namely the [SCTCanceller](#). The `SCTCanceller` is used to cancel a token known as a `SecurityContextToken`, that is defined in the [WS-SecureConversation](#) specification. The `SCTProvider` and the `SCTValidator` were covered previously. A `SecurityContextToken` essentially consists of a `String` Identifier which is associated with a particular secret key. The `SCTCanceller` can cancel a `SecurityContextToken` in either of the following namespaces:

- <http://schemas.xmlsoap.org/ws/2005/02/sc/sct>
- <http://docs.oasis-open.org/ws-sx/ws-secureconversation/200512>

Recall that the `SCTValidator` validates a received `SecurityContextToken` by checking to see whether it is stored in the cache. Therefore it is a requirement to configure a cache for the STS if you want to validate `SecurityContextTokens`. The same applies for the `SCTCanceller`. A received `SecurityContextToken` is successfully cancelled only if it is stored in the cache and is removed from the cache without any errors. This generally implies that the STS must have previously issued the `SecurityContextToken` and stored it in the cache, unless the STS is sharing a distributed cache with other STS instances.

#### 2.11.3.1. Enforcing proof-of-possession

Recall that the `TokenCanceller` interface has a method "setVerifyProofOfPossession" which defines whether proof-of-possession is required or not to cancel a security token. The default value for the `SCTCanceller` is "true". This means that for the client to successfully cancel a `SecurityContextToken` it must prove to the STS that it knows the secret key associated with that `SecurityContextToken`. The client must do this by signing some portion of the request with the same secret key that the `SCTCanceller` retrieves from the security token stored in the cache.

## 2.12. Generic Token Handling

This chapter so far has discussed how tokens are provided, validated, and cancelled in the STS. These operations are (at least in theory) relatively independent of WS-Trust. For example, they could be used as an API to provide/

validate/process, etc. tokens. In this section we'll be exploring the larger picture of how this internal token handling functionality works in the context of a client invocation. In this section we will cover some common functionality that is used by all of the WS-Trust operations in the STS implementation.

## 2.12.1. AbstractOperation

Earlier in this chapter the STS provider framework in Apache CXF was introduced. A number of interfaces were defined for each of the [operations](#) that can be invoked on the STS. Before looking at the implementations of these interfaces that ship with the STS, we will look a base class that all of the operations extend, namely the [AbstractOperation](#) class. This class defines a number of properties that are shared with any subclasses, and can be accessed via set/get methods:

- [STSPropertiesMBean](#) `stsProperties` - A configuration MBean that holds the configuration for the STS as a whole, such as information about the private key to use to sign issued tokens, etc.
- boolean `encryptIssuedToken` - Whether to encrypt an issued token or not. The default is false.
- List<[ServiceMBean](#)> `services` - A list of ServiceMBean objects, which correspond to "known" services.
- List<[TokenProvider](#)> - A list of TokenProvider implementations to use to issue tokens.
- boolean `returnReferences` - Whether to return SecurityTokenReference elements to the client or not, that point to the issued token. The default is true.
- [TokenStore](#) `tokenStore` - A cache used to store/retrieve tokens.
- List<[TokenValidator](#)> `tokenValidators` - A list of TokenValidator implementations to use to validate tokens.
- ClaimsManager `claimsManager` - An object that is used to handle claims.

Several of the properties refer to issuing tokens - this is because this functionality is shared between the issuing and validating operations. At least one TokenProvider implementation must be configured, if the STS is to support issuing a token. Some of these properties have been discussed previously, for example the TokenStore cache covered earlier. This cache could be shared across a number of different operations, or else kept separate. AbstractOperation also contains some common functionality to parse requests, encrypt tokens, create references to return to the client, etc.

### 2.12.1.1. STSPropertiesMBean

The AbstractOperation object must be configured with an [STSPropertiesMBean](#) object. This is an interface that encapsulates some configuration common to a number of different operations of the STS:

- void `configureProperties()` - load and process the properties
- void `setCallbackHandler(CallbackHandler callbackHandler)` - Set a CallbackHandler object. This is used in the TokenProviders/TokenValidators to retrieve passwords for various purposes.
- void `setSignatureCrypto(Crypto signatureCrypto)` - Set a WSS4J Crypto object to use to sign tokens, or validate signed requests, etc.
- void `setSignatureUsername(String signatureUsername)` - Set the default signature username to use (e.g. corresponding to a keystore alias)
- void `setEncryptionCrypto(Crypto encryptionCrypto)` - Set a WSS4J Crypto object to use to encrypt issued tokens.

- `void setEncryptionUsername(String encryptionUsername)` - Set the default encryption username to use (e.g. corresponding to a keystore alias)
- `void setIssuer(String issuer)` - Set the default issuer name of the STS
- `void setSignatureProperties(SignatureProperties signatureProperties)` - Set the SignatureProperties object corresponding to the STS.
- `void setRealmParser(RealmParser realmParser)` - Set the object used to define what realm a request is in.
- `void setIdentityMapper(IdentityMapper identityMapper)` - Set the object used to map identities across realms.

The STS ships with a single implementation of the STSPropertiesMBean interface - [StaticSTSProperties](#). This class has two additional methods:

- `void setSignaturePropertiesFile(String signaturePropertiesFile)`
- `void setEncryptionPropertiesFile(String encryptionPropertiesFile)`

If no Crypto objects are supplied to StaticSTSProperties, then it will try to locate a properties file using these values, and create a WSS4J Crypto object internally from the properties that are parsed.

### 2.12.1.2. SignatureProperties

A [SignatureProperties](#) object can be defined on the STSPropertiesMBean. Note that this is unrelated to the signaturePropertiesFile property of StaticSTSProperties. This class provides some configuration relating to the signing of an issued token, as well as symmetric key generation. It has the following properties:

- `boolean useKeyValue` - Whether to use a KeyValue or not to refer to a certificate in a signature. The default is false.
- `long keySize` - The (default) key size to use when generating a symmetric key. The default is 256 bits.
- `long minimumKeySize` - The minimum key size to use when generating a symmetric key. The requestor can specify a KeySize value to use. The default is 128 bits.
- `long maximumKeySize` - The maximum key size to use when generating a symmetric key. The requestor can specify a KeySize value to use. The default is 512 bits.
- `signatureAlgorithm` - Signature algorithm preferred by the client. Default value is rsa-sha1
- `acceptedSignatureAlgorithms` - Alternative signature algorithms that may be used by the STS.
- `c14nAlgorithm` - Canonicalization algorithm (default c14n-excl-omit-comments) preferred by the client.
- `acceptedC14nAlgorithms` - Alternative canonicalization algorithms that may be used by the STS.

For example, when the client sends a "KeySize" element to the STS when requesting a SAML Token (and sending a SymmetricKey KeyType URI), the SAMLTokenProvider will check that the requested keysize falls in between the minimum and maximum key sizes defined above. If it does not, then the default key size is used.

## 2.12.2. Request Parsing

The first thing any of the AbstractOperation implementations do on receiving a request is to call some functionality in AbstractOperation to parse the request. This parsing is done by the [RequestParser](#) object, which iterates

through the objects of the JAXB RequestSecurityTokenType. The request is parsed into two components, [TokenRequirements](#) and [KeyRequirements](#), which are available on the RequestParser object and are subsequently passed to the desired TokenProvider/TokenValidator/etc objects.

### 2.12.2.1. TokenRequirements

The [TokenRequirements](#) class holds a set of properties that have been extracted and parsed by RequestParser. These properties loosely relate to the token itself, rather than anything to do with keys. The properties that can be set by RequestParser are:

- String tokenType - The desired TokenType URI. This is required if a token is to be issued.
- Element appliesTo - The AppliesTo element that was received in the request. This normally holds a URL that indicates who the recipient of the issued token will be.
- String context - The context attribute of the request.
- [ReceivedToken](#) validateTarget - This object holds the contents of a received "ValidateTarget" element, i.e. a token to validate.
- [ReceivedToken](#) onBehalfOf - This object holds the contents of a received "OnBehalfOf" element.
- [ReceivedToken](#) actAs - This object holds the contents of a received "ActAs" element.
- [ReceivedToken](#) cancelTarget - This object holds the contents of a received "CancelTarget" element, i.e. a token to cancel.
- [Lifetime](#) lifetime - The requested lifetime of the issued token. This just holds created and expires Strings, that are parsed from the request.
- [RequestClaimCollection](#) claims - A collection of requested claims that are parsed from the request.
- Renewing renewing - Holds the wst:Renewing semantics that were received (if any) as part of the request.

The ReceivedToken class mentioned above parses a received token object, which can be a JAXBElement<?> or a DOM Element. If it is a JAXBElement then it must be either a UsernameToken, SecurityTokenReference, or BinarySecurityToken. If it is a reference to a security token in the security header of the request, then this token is retrieved and set as the ReceivedToken instead.

### 2.12.2.2. KeyRequirements

The [KeyRequirements](#) class holds a set of properties that have been extracted and parsed by RequestParser. These properties contain everything to do with key handling or creation. The properties that can be set by RequestParser are:

- String authenticationType - An optional authentication type URI. This is currently not used in the STS.
- String keyType - The desired KeyType URI.
- long keySize - The requested KeySize to use when generating symmetric keys.
- String signatureAlgorithm - The requested signature algorithm to use when signing an issued token.
- String encryptionAlgorithm - The requested encryption algorithm to use when encrypting an issued token.
- String c14nAlgorithm - The requested canonicalization algorithm to use when signing an issued token.



- String `computedKeyAlgorithm` - The computed key algorithm to use when creating a symmetric key.
- String `keywrapAlgorithm` - The requested `KeyWrap` algorithm to use when encrypting a symmetric key.
- X509Certificate `certificate` - A certificate that has been extracted from a "UseKey" element, for use in the SAML case when a `PublicKey` `KeyType` URI is specified.
- [Entropy](#) `entropy` - This object holds entropy information extracted from the client request for use in generating a symmetric key. Only `BinarySecret` elements are currently supported.

### 2.12.2.3. SecondaryParameters

`RequestParser` also supports parsing a "SecondaryParameters" element that might be in the request. This could be extracted from the WSDL of a service provider that specifies an `IssuedToken` policy by the client and sent to the STS as part of the `RequestSecurityToken` request. Only `KeySize`, `TokenType`, `KeyType` and `Claims` child elements are currently parsed.

## 2.12.3. The TokenIssueOperation

The [TokenIssueOperation](#) is an extension of `AbstractOperation` that is used to issue tokens. It implements the [IssueOperation](#) and [IssueSingleOperation](#) interfaces in the STS provider framework.

Recall that `AbstractOperation` uses the [RequestParser](#) to parse a client request into [TokenRequirements](#) and [KeyRequirements](#) objects. `TokenIssueOperation` populates a [TokenProviderParameters](#) object with values extracted from the `TokenRequirements` and `KeyRequirements` objects. A number of different processing steps then occur before a `TokenProvider` implementation is used to retrieve the desired token, comprising of realm parsing, claims handling, and `AppliesTo` parsing.

### 2.12.3.1. Realm Parsing

We have earlier shown how realms are used with `TokenProviders` to provide tokens, and also how they work with `TokenValidators` to validate a given token. However, we did not cover how realms are defined in the first place. Recall that the [STSPropertiesMBean](#) configuration object defined on `AbstractOperation` has a [RealmParser](#) property. The `RealmParser` is an interface which defines a pluggable way of defining a realm for the current request. It has a single method:

- String `parseRealm(WebServiceContext context)` - Return the realm of the current request given a `WebServiceContext` object.

Therefore if you wish to issue tokens in multiple realms, it is necessary to create an implementation of the `RequestParser` which will return a realm `String` given a context object. For example, different realms could be returned based on the endpoint URL or a HTTP parameter. This realm will then get used to select a `TokenProvider` implementation to use to issue a token of the desired type. It will also be used for token validation in a similar way.

### 2.12.3.2. AppliesTo parsing

An `AppliesTo` element contains an address that refers to the recipient of the issued token. If an `AppliesTo` element was sent as part of the request then the CXF STS requires that it be explicitly handled. This is done by the list

of [ServiceMBean](#) objects that can be configured on `AbstractOperation`. The `ServiceMBean` interface represents a service, and has the following methods (among others):

- `boolean isAddressInEndpoints(String address)` - Return true if the supplied address corresponds to a known address for this service.
- `void setEndpoints(List<String> endpoints)` - Set the list of endpoint addresses that correspond to this service.

The STS ships with a single implementation of this interface, the [StaticService](#). For the normal use-case of handling an `AppliesTo` element, the user creates a `StaticService` object and calls `setEndpoints` with a set of Strings that correspond to a list of regular expressions that match the allowable set of token recipients (by address). The `TokenIssueOperation` will extract the URL address from the `EndpointReference` child of the received `AppliesTo` element, and then iterate through the list of `ServiceMBean` objects and ask each one whether the given address is known to that `ServiceMBean` object. If an `AppliesTo` address is received, and no `ServiceMBean` is configured that can deal with that URL, then an exception is thrown.

The `ServiceMBean` also defines a number of optional configuration options, such as the default `KeyType` and `TokenType` Strings to use for that Service, if the client does not supply them. It also allows the user to set a custom [EncryptionProperties](#) object, which defines a set of acceptable encryption algorithms to use to encrypt issued tokens for that service.

### 2.12.3.3. Token creation and response

Once the `TokenIssuerOperation` has processed the client request, it iterates through the list of defined `TokenProvider` implementations to see if each "can handle" the desired token type in the configured realm (if any). If no `TokenProvider` is defined, or if no `TokenProvider` can handle the desired token type, then an exception is thrown. Otherwise, a token is created, and a response object is constructed containing the following items:

- The context attribute (if any was specified).
- The Token Type.
- The requested token (possibly encrypted, depending on configuration).
- A number of references to that token (can be disabled by configuration).
- The received `AppliesTo` address (if any).
- The `RequestedProofToken` (if a `Computed Key Algorithm` was used).
- The Entropy generated by the STS (if any, can be encrypted).
- The lifetime of the generated token.
- The `KeySize` that was used (if any).

### 2.12.3.4. TokenIssueOperation Example

Finally, it's time to look at an example of how to spring-load the STS so that it can issue tokens. This particular [example](#) uses a security [policy](#) that requires a `UsernameToken` over the symmetric binding. As the STS is a web service, we first define an endpoint:

```

<jaxws:endpoint id="UTSTS"
  implementor="#utSTSTProviderBean"
  address="http://.../SecurityTokenService/UT"
  wsdlLocation=".../ws-trust-1.4-service.wsdl"
  xmlns:ns1="http://docs.oasis-open.org/ws-sx/ws-trust/200512/"
  serviceName="ns1:SecurityTokenService"
  endpointName="ns1:UT_Port">
  <jaxws:properties>
    <entry key="ws-security.callback-handler" value="..."/>

    <entry key="ws-security.signature.properties"
      value="stsKeystore.properties"/>
  </jaxws:properties>
</jaxws:endpoint>

```

The `jaxws:properties` are required to parse the incoming message. The `CallbackHandler` is used to validate the `UsernameToken` and provide the password required to access the private key defined in the signature properties parameter. The "implementor" of the `jaxws:endpoint` is the `SecurityTokenServiceProvider` class defined in the STS provider framework:

```

<bean id="utSTSTProviderBean"
  class="org.apache.cxf.ws.security.sts.provider.SecurityTokenServiceProvider">
  <property name="issueOperation" ref="utIssueDelegate"/>

  ...
</bean>

```

This bean supports the Issue Operation via a `TokenIssueOperation` instance:

```

<bean id="utIssueDelegate"
  class="org.apache.cxf.sts.operation.TokenIssueOperation">
  <property name="tokenProviders" ref="utSamlTokenProvider"/>
  <property name="services" ref="utService"/>

  <property name="stsProperties" ref="utSTSTProperties"/>
</bean>

```

This `TokenIssueOperation` instance has a single `TokenProvider` configured to issue SAML Tokens (with a default Subject and Attribute statement):

```

<bean id="utSamlTokenProvider"
  class="org.apache.cxf.sts.token.provider.SAMLTokenProvider">
</bean>

```

The `TokenIssueOperation` also refers to a single `StaticService` implementation, which in turn defines a single URL expression to use to compare any received `AppliesTo` addresses:

```

<bean id="utService"
  class="org.apache.cxf.sts.service.StaticService">
  <property name="endpoints" ref="utEndpoints"/>
</bean>

```

```

<util:list id="utEndpoints">
  <value>http://localhost:(\d)*/(doubleit|metrowsp)/services/doubleit //
  (UT|.*symmetric.*|.*)</value>

```

```
</util:list>
```

Finally, the `TokenIssueOperation` is configured with a `StaticSTSProperties` object. This class contains properties that define what private key to use to sign issued SAML tokens, as well as the Issuer name to use in the generated token.

```
<bean id="utSTSProperties"
  class="org.apache.cxf.sts.StaticSTSProperties">
  <property name="signaturePropertiesFile" value="stsKeystore.properties"/>
  <property name="signatureUsername" value="mystskey"/>
  <property name="callbackHandlerClass" value="..." />

  <property name="issuer" value="DoubleItSTSIssuer"/>
  ...
</bean>
```

## 2.12.4. The TokenCancelOperation

The `TokenCancelOperation` class is used to cancel tokens in the STS. It implements the `CancelOperation` interface in the STS provider framework. In addition to the properties that it inherits from `AbstractOperation`, it has a single property that can be configured:

- List<`TokenCanceller`> tokencancellers - A list of `TokenCanceller` implementations to use to cancel tokens.

Recall that `AbstractOperation` uses the `RequestParser` to parse a client request into `TokenRequirements` and `KeyRequirements` objects. `TokenCancelOperation` first checks that a "CancelTarget" token was received and successfully parsed (if so it will be stored in the `TokenRequirements` object). If no token was received then an exception is thrown.

The `TokenCancelOperation` then populates a `TokenCancellerParameters` object with values extracted from the `TokenRequirements` and `KeyRequirements` objects. It iterates through the list of defined `TokenCanceller` implementations to see if any "can handle" the received token. If no `TokenCanceller` is defined, or if no `TokenCanceller` can handle the received token, then an exception is thrown. Otherwise, the received token is cancelled. If there is an error in cancelling the token, then an exception is also thrown. A response is constructed with the context attribute (if applicable), and the cancelled token type.

## 2.13. Claims Handling in the STS

A typical scenario for WS-Trust is when the client requires a particular security token from an STS to access a service provider. The service provider can let the client know what the requirements are for the security token in an `IssuedToken` policy embedded in the WSDL of the service. In particular, the service provider can advertise the claims that the security token must contain in the policy (either directly as a child element of `IssuedToken`, or else as part of the `RequestSecurityTokenTemplate`). An [example](#) is contained in the STS systems:

```
<sp:RequestSecurityTokenTemplate>
  <t:TokenType>http://...#SAMLV1.1</t:TokenType>
  <t:KeyType>http://.../PublicKey</t:KeyType>
  <t:Claims Dialect="http://.../identity">

    <ic:ClaimType Uri="http://.../claims/role"/>
  </t:Claims>
```

```
</sp:RequestSecurityTokenTemplate>
```

This template specifies that a SAML 1.1 Assertion is required with an embedded X509 Certificate in the subject of the Assertion. The issued Assertion must also contain a "role" claim. The template is sent verbatim by the client to the STS when requesting a security token.

## 2.13.1. Parsing claims

The [RequestParser](#) object parses the client request into [TokenRequirements](#) and [KeyRequirements](#) objects. As part of this processing it converts a received [Claims](#) element into a [RequestClaimCollection](#) object. The [RequestClaimCollection](#) is just a list of [RequestClaim](#) objects, along with a dialect URI. The [RequestClaim](#) object holds the [claimType](#) URI as well as a boolean indicating whether the claim is optional or not.

## 2.13.2. The ClaimsHandler

The [ClaimsHandler](#) is an interface that the user must implement to be able to "handle" a requested claim. It has two methods:

- `List<URI> getSupportedClaimTypes()` - Return the list of [ClaimType](#) URIs that this [ClaimHandler](#) object can handle.
- `ClaimCollection retrieveClaimValues (Principal p, RequestClaimCollection rcc)` - Return the claim values associated with the requested claims (and client principal).

The [ClaimCollection](#) object that is returned is just a list of [Claim](#) objects. This object represents a [Claim](#) that has been processed by a [ClaimsHandler](#) instance. It essentially contains a number of properties that the [ClaimsHandler](#) implementation will set, e.g.:

- `URI claimType` - The [claimtype](#) URI as received from the client.
- `String value` - The claim value

Each [Claim](#) object in a [ClaimCollection](#) corresponds to a [RequestClaim](#) object in the [RequestClaimCollection](#), and contains the [Claim](#) value corresponding to the requested claim. The STS ships with a single [ClaimsHandler](#) implementation, the [LDAPClaimsHandler](#), which can retrieve claims from an LDAP store. A simpler [example](#) is available in the unit tests.

## 2.13.3. The ClaimsManager

The [ClaimsManager](#) defined on [AbstractOperation](#) holds a list of [ClaimsHandler](#) objects. So to support claim handling in the STS, it is necessary to implement one or more [ClaimsHandler](#) objects for whatever [Claim](#) URIs you wish to support, and register them with a [ClaimsManager](#) instance, which will be configured on the [TokenIssueOperation](#) object.

As detailed in the previous article, the [TokenIssueOperation](#) gets the realm of the current request, and does some processing of the [AppliesTo](#) address, after the [RequestParser](#) has finished parsing the request. The [RequestClaimCollection](#) object that has been constructed by the [RequestParser](#) is then processed. For each [RequestClaim](#) in the collection, it checks to see whether the [ClaimsManager](#) has a [ClaimsHandler](#) implementation registered that can "handle" that [Claim](#) (by checking the URIs). If it does not, and if the requested claim is not optional, then an exception is thrown.

If a ClaimsHandler implementation is registered with the ClaimsManager that can handle the desired claim, then the claims are passed through to the TokenProvider implementation, which is expected to be able to invoke the relevant ClaimHandler object, and insert the processed Claim into the generated security token. How this is done is entirely up to the user. For example, for the use-case given above of a SAML 1.1 token containing a "role" claim, the user could implement a custom [AttributeStatementProvider](#) instance that evaluates the claim values (via a custom ClaimsHandler implementation registered with the ClaimsManager) and constructs a set of Attributes accordingly in an AttributeStatement. An [example](#) of how to do this is given in the CXF unit tests.

## 2.14. The TokenValidateOperation

[TokenValidateOperation](#) is an extension of [AbstractOperation](#) used to validate tokens in the STS. It implements the [ValidateOperation](#) interface in the STS provider framework. For validation, the below property from [AbstractOperation](#) can be configured:

- List<[TokenValidator](#)> tokenValidators - A list of [TokenValidator](#) implementations to use to validate tokens.

Recall that [AbstractOperation](#) uses the [RequestParser](#) to parse a client request into [TokenRequirements](#) and [KeyRequirements](#) objects. [TokenValidateOperation](#) first checks that a "ValidateTarget" token was received and successfully parsed (if so it will be stored in the [TokenRequirements](#) object). If no token was received then an exception is thrown.

### 2.14.1. Token validation and response

[TokenValidateOperation](#) then populates a [TokenValidatorParameters](#) object with values extracted from the [TokenRequirements](#) and [KeyRequirements](#) objects. It iterates through the list of defined [TokenValidator](#) implementations to see if any "can handle" the received token. If no [TokenValidator](#) is defined, or if no [TokenValidator](#) can handle the received token, then an exception is thrown. Otherwise, the received token is validated. The [TokenValidateOperation](#) then checks to see whether token transformation is required.

#### 2.14.1.1. Token Transformation

If the received token is successfully validated, and if the client supplies a [TokenType](#) in the request that does not correspond to the WS-Trust "status" namespace, then the [TokenValidateOperation](#) attempts to transform the validated token into a token of the requested type. Token transformation works in a similar way to token issuing, as detailed previously. A [TokenProviderParameters](#) object is constructed and the same processing steps (Realm parsing, [AppliesTo](#) parsing) are followed as for token issuing.

One additional processing step occurs before the token is transformed. If the [TokenValidatorResponse](#) object has a principal that was set by the [TokenValidator](#) implementation, then it is set as the principal of the [TokenProviderParameters](#) object. However, it is possible that the token is being issued in a different realm to that of the validated token, and the principal might also need to be transformed. Recall that the [STSPropertiesMBean](#) configuration object defined on [AbstractOperation](#) has an [IdentityMapper](#) property. This interface is used to map identities across realms. It has a single method:

- `Principal mapPrincipal(String sourceRealm, Principal sourcePrincipal, String targetRealm)` - Map a principal from a source realm to a target realm

If the source realm is not null (the realm of the validated token as returned in [TokenValidatorResponse](#)), and if it does not equal the target realm (as set by the [RealmParser](#)), then the identity mapper is used to map the principal to the target realm and this is stored in [TokenProviderParameters](#) for use in token generation. After the (optional)

identity mapping step, `TokenValidateOperation` iterates through the `TokenProvider` list to find an implementation that can "handle" the desired token type in the given (target) realm (if applicable). If no `TokenProvider` is defined, or if no `TokenProvider` can handle the desired token type, then an exception is thrown.

### 2.14.1.2. Token response

After token validation has been performed, and after any optional token transformation steps, a response object is constructed containing the following items:

- The context attribute (if any was specified).
- The received Token Type (if any was specified, or the "status" token type if validation was successful).
- Whether the received token was valid or not (status code & reason).
- If the received token was valid, and if token transformation successfully occurred:
  - The transformed token.
  - The lifetime of the transformed token.
  - A number of references to that token (can be disabled by configuration).

## 2.14.2. TokenValidateOperation example

Finally, it's time to look at an example of how to spring-load the STS so that it can validate tokens. This particular [example](#) uses a security policy that requires a `UsernameToken` over the transport binding (client auth is disabled). As the STS is a web service, we first define an endpoint:

```
<jaxws:endpoint id="transportSTS"
  implementor="#transportSTSPProviderBean"
  address="http://.../SecurityTokenService/Transport"
  wsdlLocation=".../ws-trust-1.4-service.wsdl"
  xmlns:ns1="http://docs.oasis-open.org/ws-sx/ws-trust/200512/"
  serviceName="ns1:SecurityTokenService"
  endpointName="ns1:Transport_Port">
  <jaxws:properties>
    <entry key="ws-security.callback-handler" value="..."/>
  </jaxws:properties>
</jaxws:endpoint>
```

The `CallbackHandler` JAX-WS property is used to validate the `UsernameToken`. The "implementor" of the `jaxws:endpoint` is the `SecurityTokenServiceProvider` class defined in the STS provider framework:

```
<bean id="transportSTSPProviderBean"
  class="org.apache.cxf.ws.security.sts.provider. //
    SecurityTokenServiceProvider">
  ...
  <property name="validateOperation" ref="transportValidateDelegate"/>
</bean>
```

This bean supports the `Validate Operation` via a `TokenValidateOperation` instance:

```
<bean id="transportValidateDelegate"
```

```
    class="org.apache.cxf.sts.operation.TokenValidateOperation">
    <property name="tokenValidators" ref="transportTokenValidators"/>
    <property name="stsProperties" ref="transportSTSProperties"/>
</bean>
```

This TokenValidateOperation instance has a number of different TokenValidator instances configured:

```
<util:list id="transportTokenValidators">

    <ref bean="transportSamlTokenValidator"/>
    <ref bean="transportX509TokenValidator"/>
    <ref bean="transportUsernameTokenValidator"/>
</util:list>

<bean id="transportX509TokenValidator"
    class="org.apache.cxf.sts.token.validator.X509TokenValidator"/>

<bean id="transportUsernameTokenValidator"
    class="org.apache.cxf.sts.token.validator.UsernameTokenValidator"/>

<bean id="transportSamlTokenValidator"
    class="org.apache.cxf.sts.token.validator.SAMLTokenValidator"/>
</bean>
```

Finally the STSPropertiesMBean object that is used is given as follows:

```
<bean id="transportSTSProperties"
    class="org.apache.cxf.sts.StaticSTSProperties">
    <property name="signaturePropertiesFile" value="..."/>
    <property name="signatureUsername" value="mystskey"/>

    <property name="callbackHandlerClass" value="..."/>
    <property name="encryptionPropertiesFile" value="..."/>
    <property name="issuer" value="DoubleItSTSIssuer"/>
    <property name="encryptionUsername" value="myservicekey"/>
</bean>
```



## Chapter 3. Using STS with the Talend Runtime

This chapter describes the deployment and configuration of STS with a Talend Runtime container, how to configure the Data Services to use the STS. It also discusses creating keys and certificates for STS and clients.



### Note

We use the term `<Talend.runtime.dir>` for the directory where Talend Runtime is installed. This is typically the full path of either `Runtime_ESBSE` or `Talend-ESB-V5.1.x`, depending on the version of the software that is being used. Please substitute appropriately.

### 3.1. Deploying the STS into the Talend Runtime container



### Warning

For production use, the sample keys used here will need to be replaced with your project's own keys, usually signed by a third-party CA.

To enable Security Token Service (STS) in the Talend Runtime, we need to deploy it into a Talend Runtime container:

1. Replace the STS' sample keystore/truststore called `stsstore.jks` located in the `<Talend.runtime.dir>/container/etc/keystores` folder with your own keystore. See [Section 3.3, “Security Token Service \(STS\) Configuration”](#) for more information.

2. `cd <Talend.runtime.dir>/container/bin` directory, enter **trun** to start Talend Runtime, a Talend Runtime container (Karaf) console window will open.
3. In the console, type **features:install tesb-sts** to install the Security Token Service component.
4. Type **list | grep STS** in the console. You should see the output:

```
ID State Blueprint Spring Level Name
[ 203] [Active ] [ ] [started ] [ 60] Apache
CXF STS Core (2.5.0)
Fragments: 204
[ 204] [Resolved ] [ ] [ ] [ 60] Talend ::
ESB :: STS :: CONFIG (5.1.0)
```

The above shows that Security Token Service (STS) component is enabled in the Talend Runtime container. The Fragment Bundle `204: Talend :: ESB :: STS :: CONFIG (5.1.0)` provides the custom configuration about the Security Token Service (STS), which will be described in [Section 3.3, “Security Token Service \(STS\) Configuration”](#).

## 3.2. Deploying the STS into a Servlet Container (Tomcat)



### Warning

For production use, the sample keys used here will need to be replaced with your project's own keys, usually signed by a third-party CA.

To enable Security Token Service (STS) using a servlet container (here we are using Tomcat as an example) follow the below steps:

1. Extract the `<Talend.runtime.dir>/add-ons/sts/SecurityTokenService.war` file and replace the `stsstore.jks` STS sample keystore/truststore with your own keystore. Alter the `stsKeystore.properties` file with any different configuration information based on your new keystore. Recompress the extracted WAR into a new WAR file.
2. Deploy the new WAR file created in the previous step into the Tomcat container.
3. Start Tomcat and open a browser with the follow url: `http://{tomcat}host:port/SecurityTokenService/`. You'll see several Security Token Services available, such as Username Token service (UT), X.509 Token service, etc.
4. Enter URL: `http://{tomcat host}:port/SecurityTokenService/UT?wsdl`, the displayed WSDL file will describe the details about the Security Token Service.

## 3.3. Security Token Service (STS) Configuration

The Security Token Service provides the following methods as described in the below snippet, which is defined in `SecurityTokenService.war/WEB-INF/wsdl/ws-trust-1.4-service.wsdl`

```

<wsdl:service name="SecurityTokenService">
  <wsdl:port name="UT_Port" binding="tns:UT_Binding">
    <soap:address location="http://localhost:8080/SecurityTokenService/UT"/>
  </wsdl:port>
  <wsdl:port name="X509_Port" binding="tns:X509_Binding">
    <soap:address location="http://localhost:8080/SecurityTokenService/X509"/>
  </wsdl:port>
  <wsdl:port name="Transport_Port" binding="tns:Transport_Binding">
    <soap:address location="/Transport"/>
  </wsdl:port>
  <wsdl:port name="UTEncrypted_Port" binding="tns:UTEncrypted_Binding">
    <soap:address location="/UTEncrypted"/>
  </wsdl:port>
</wsdl:service>

```

As above snippet shows, the Security Token Service can issue (or validate) UserName Token or X509 Token, etc.

In Talend Runtime container, the configuration of Security Token Service (STS) can be defined in the file:

```
<Talend.runtime.dir>/etc/org.talend.esb.sts.server.cfg
```

```

stsServiceUrl=/SecurityTokenService/UT
jaasContext=karaf
signatureProperties=file:${tesb.home}/etc/keystores/stsKeystore.properties
signatureUsername=mystskey
bspCompliant=false

```

By default STS is configured to use JAAS interface to verify the user credentials and perform authentication. As shown above, STS uses *karaf* JAAS Context which is the default context configured for Talend Runtime container and uses *PropertiesLoginModule* of Karaf. This login module uses *users.properties* file located in */etc/users.properties* which contains a list of users and their passwords, hence the users which are needed to be authenticated via the STS should be listed here. A different login module can be configured for the STS by updating the *jaasContext* parameter in the above configuration. A Talend Runtime container comes with several login modules that can be used to integrate into your environment, the modules are listed below:

- PropertiesLoginModule
- OsgiConfigLoginModule
- JDBCLoginModule
- LDAPLoginModule

The *signatureProperties* file, which is located in: */etc/keystores/stsKeystore.properties*, defines the signature configuration as shown below:

```

org.apache.ws.security.crypto.merlin.keystore.type=jks
org.apache.ws.security.crypto.merlin.keystore.password=stsspass
org.apache.ws.security.crypto.merlin.keystore.alias=mystskey
org.apache.ws.security.crypto.merlin.keystore.file=stsstore.jks

```

The keystore file name can be changed by altering its value in the *stsKeystore.properties* file. With the default configuration as shown above, the Talend Runtime container will expect the STS' private key to have the alias of *mystskey*, this can be changed by altering the *alias* and *signatureUsername* values in the two configuration files listed above.

## 3.4. Data Service Configuration for using STS

In the Talend Runtime container, the configuration used by Data Service Consumers for using Security Token Service (STS) can be defined in the file: `<Talend.runtime.dir>/container/etc/org.talend.esb.job.client.sts.cfg`

```
#STS endpoint configuration
sts.wsdl.location = \
    http://localhost:8040/services/SecurityTokenService/UT?wsdl
sts.namespace = http://docs.oasis-open.org/ws-sx/ws-trust/200512/
sts.service.name = SecurityTokenService
sts.endpoint.name = UT_Port

#STS properties configuration
ws-security.sts.token.username = myclientkey
ws-security.sts.token.usecert = true
ws-security.is-bsp-compliant = false
ws-security.sts.token.properties = \
    file:${tesb.home}/etc/keystores/clientKeystore.properties
```

The STS endpoint used by the consumer is defined by `sts.wsdl.location`. This configuration should be changed in case the STS service is running on a different host and port. The keystore configuration described above is used for signing the timestamp sent in the request by the consumer to the provider. The Talend ESB-supplied sample keystores and certificates above are not meant for production use. Be sure to use your own keys (with different passwords) and configure them as discussed below.

A Data Service consumer can use two types of authentication mechanisms: Username token and SAML token.

- When using Username token, the consumer sends the credentials as a part of the request to the provider and authentication is performed on the provider side. The policy used by the consumer for Username token authentication is defined in the file `<Talend.runtime.dir>/etc/org.talend.esb.job.token.policy`.
- For SAML tokens, the consumer makes a SAML token issue request to the STS passing its credentials and on successful authentication the STS issues a SAML token. This SAML token is sent as a part of the request to the provider and the provider verifies the validity of the SAML token. The policy used by the consumer for SAML token authentication is defined in the file `<Talend.runtime.dir>/etc/org.talend.esb.job.saml.policy`.

When using Username tokens, a Data Service provider receives credentials from the consumer and performs authentication locally. By default a Data Service provider is configured with JAAS authentication handler and uses the default JAAS context `karaf` configured for the Talend Runtime container. The login module configured for this context uses `users.properties` file located in `/etc/users.properties` which contains a list of users and their passwords. Thus, the user which needs to be authenticated should be listed here.

In the case of a SAML token, the provider locally verifies the integrity of the token using a certificate, the configuration for it is defined in the file `<Talend.runtime.dir>/etc/org.talend.esb.job.service.cfg`.

```
ws-security.signature.properties = \
    file:${tesb.home}/etc/keystores/serviceKeystore.properties
ws-security.signature.username = myservicekey
ws-security.signature.password = skpass
```

## 3.5. Creating keys for the Security Token Service

This section describes how to create keys for the Security Token Service. We highly recommend that you use third-party signed CA's (certificate authorities) or create your own Certificate Authority, but the following instructions can be used to create self-signed keys.

### 3.5.1. Using OpenSSL to create certificates

First, create the keys.



#### Note

Replace “<PW-Sk>”, “<PW-Sk>”, “<PW-Cs>” and “<PW-Ck>” in the example below with your own passwords.

#### 3.5.1.1. Creating the service keystore

Note: given the `rm` commands below, it is probably best to create a new directory and navigate to it before running these commands from a terminal window.

```
rm *.p12 *.pem *.jks *.cer
openssl req -x509 -days 3650 -newkey rsa:1024 -keyout servicekey.pem -out
  servicecert.pem -passout pass:<PW-Sk>
```

When running this `openssl` command, enter any geographic and company information desired, the key password in `passout`, and a common name of your choice (perhaps `servicecn` for the service and `clientcn` for the client).

```
openssl pkcs12 -export -inkey servicekey.pem -in servicecert.pem -out
  service.p12 -name myservicekey -passin pass:<PW-Sk> -passout
  pass:<PW-Sk>
```

This creates a `pkcs12` certificate. Note the `<PW-Sk>` value will be used both for the keystore and the private key itself.

```
keytool -importkeystore -destkeystore servicestore.jks -deststorepass <PW-Sk>
  -deststoretype jks -srckeystore service.p12 -srcstorepass <PW-Sk>
  -srcstoretype pkcs12 # See Note 3
```

This places the certificate in a new JKS keystore. The keystore's password is changed here to `<PW-Sk>`, but the private key's password retains the earlier value of `<PW-Sk>`. Also note we're using Java 6 instead of Java 5 `keytool` commands (see [changes](#) between the two.)

```
keytool -list -keystore servicestore.jks -storepass <PW-Sk> -v
```

The `list` command is just to show the keys presently in the keystore.

```
keytool -exportcert -alias myservicekey -storepass <PW-Sk> -keystore
  servicestore.jks -file service.cer
keytool -printcert -file service.cer
rm *.pem *.p12
```

### 3.5.1.2. Creating the client keystore

```
openssl req -x509 -days 3650 -newkey rsa:1024 -keyout clientkey.pem
  -out clientcert.pem -passout pass:<PW-Cs>
openssl pkcs12 -export -inkey clientkey.pem -in clientcert.pem
  -out client.p12
  -name myclientkey -passin pass:<PW-Cs> -passout pass: <PW-Ck>
keytool -importkeystore -destkeystore clientstore.jks -deststorepass <PW-Cs>
  -deststoretype jks -srckeystore client.p12
  -srcstorepass <PW-Ck>-srcstoretype pkcs12
keytool -list -keystore clientstore.jks -storepass <PW-Cs> -v
keytool -exportcert -alias myclientkey -storepass <PW-Cs> -keystore
  clientstore.jks -file client.cer
keytool -printcert -file client.cer
rm *.pem *.p12
```

### 3.5.2. Deploying and Using a Security Token Service (STS)

You have created the service and client keystores as in the previous section. Now create the STS keystore as follows:



#### Note

Replace <PW-Ts>, <PW-Tk> in the example below with your own passwords.

```
openssl req -x509 -days 3650 -newkey rsa:1024 -keyout stskey.pem -out
  stscert.pem -passout pass:<PW-Ts>
openssl pkcs12 -export -inkey stskey.pem -in stscert.pem -out sts.p12
  -name mystskey -passin pass:<PW-Ts> -passout pass:<PW-Tk>
keytool -importkeystore -destkeystore stsstore.jks -deststorepass <PW-Ts>
  -srckeystore sts.p12 -srcstorepass <PW-Tk> -srcstoretype pkcs12
keytool -list -keystore stsstore.jks -storepass <PW-Ts>
keytool -exportcert -alias mystskey -storepass <PW-Ts> -keystore
  stsstore.jks -file sts.cer
keytool -printcert -file sts.cer
rm *.pem *.p12
```

To fix any issues with fixed paths to the keystore and truststore locations within the WSDLs, the source code download uses Maven resource filtering to allow for a relative path to the project base directory to be used instead.

Next, the service keystore will need to have the STS public key added so it trusts it, and vice-versa. Also, the client will need to have the STS' and WSP's certificates added to its truststore, as it relies on symmetric binding to encrypt the SOAP requests it makes to both:

```
keytool -keystore servicestore.jks -storepass <PW-Sk> -import -noprompt
  -trustcacerts -alias mystskey -file sts.cer
keytool -keystore stsstore.jks -storepass <PW-Ts> -import -noprompt
  -trustcacerts -alias myservicekey -file service.cer
keytool -keystore clientstore.jks -storepass <PW-Cs> -import -noprompt
  -trustcacerts -alias mystskey -file sts.cer
keytool -keystore clientstore.jks -storepass <PW-Cs> -import -noprompt
  -trustcacerts -alias myservicekey -file service.cer
```

If you plan on using X.509 authentication of the WSC to the STS (instead of UsernameToken), the former's public key will need to be in the latter's truststore. This can be done with the following commands:

```
keytool -exportcert -alias myclientkey -storepass <PW-Cs> -keystore  
clientstore.jks -file client.cer  
keytool -keystore stsstore.jks -storepass <PW-Ts> -import -noprompt  
-trustcacerts -alias myclientkey -file client.cer
```

Since the service does not directly trust the client (the purpose for our use of the STS to begin with), we will not add the client's public certificate to the service's truststore as normally done with message-layer encryption.

# Chapter 4. Secure Token Service (STS) Client Configuration

## 4.1. STS Client Behavior

A simple example of how a CXF client can obtain a security token from the STS is shown in the CXF's basic STS system test "[IssueUnitTest](#)". This test starts an instance of the new CXF STS and obtains a number of different security tokens, all done completely programmatically, i.e. with no Spring configuration. The STS instance that is used for the test cases is configured with a number of different endpoints that use different security bindings (defined in the [wsdl](#) of the STS). For the purposes of this test, the Transport binding is used:

```
<wsp:Policy wsu:Id="Transport_policy">
  <wsp:ExactlyOne>
    <wsp:All>
      <sp:TransportBinding
xmlns:sp="http://docs.oasis-open.org/ws-sx/ws-securitypolicy/200702">
        <wsp:Policy>
          <sp:TransportToken>
            <wsp:Policy>
              <sp:HttpsToken RequireClientCertificate="false"/>
            </wsp:Policy>
          </sp:TransportToken>
          <sp:AlgorithmSuite>
            <wsp:Policy>
              <sp:Basic128 />
            </wsp:Policy>
          </sp:AlgorithmSuite>
          <sp:Layout>
            <wsp:Policy>
```



```

        <sp:Lax />
      </wsp:Policy>
    </sp:Layout>
    <sp:IncludeTimestamp />
  </wsp:Policy>
</sp:TransportBinding>
<sp:SignedSupportingTokens
xmlns:sp="http://docs.oasis-open.org/ws-sx/ws-securitypolicy/200702">
  <wsp:Policy>
    <sp:UsernameToken
      sp:IncludeToken=".../AlwaysToRecipient">
      <wsp:Policy>
        <sp:WssUsernameToken10 />
      </wsp:Policy>
    </sp:UsernameToken>
  </wsp:Policy>
</sp:SignedSupportingTokens>
  ...
</wsp:All>
</wsp:ExactlyOne>
</wsp:Policy>

```

In other words, this security policy requires that a one-way TLS connection must be used to communicate with the STS, and that authentication is performed via a Username Token in the SOAP header.

The object that communicates with an STS in CXF is the [STSCient](#). Typically, the user constructs an STSCient instance (normally via Spring), sets it with certain properties such as the WSDL location of the STS, what service/port to use, various crypto properties, etc, and then stores this object on the message context using the [SecurityConstants](#) tag "ws-security.sts.client". This object is then controlled by the [IssuedTokenInterceptorProvider](#) in the ws-security runtime in CXF. This interceptor provider is triggered by the "IssuedToken" policy assertion, which is typically in the WSDL of the service provider. This policy assertion informs the client that it must obtain a particular security token from an STS and include it in the service request. The IssuedTokenInterceptorProvider takes care of using the STSCient to get a Security Token from the STS, and handles how long the security token should be cached, etc.

An example of a simple IssuedToken policy that might appear in the WSDL of a service provider is as follows:

```

<sp:IssuedToken sp:IncludeToken=".../AlwaysToRecipient">
  <sp:RequestSecurityTokenTemplate>
    <t:TokenType>
      http://docs.oasis-open.org/wss/oasis-wss-saml-token-profile-1.1#SAMLV2.0
    </t:TokenType>
    <t:KeyType>
      http://docs.oasis-open.org/ws-sx/ws-trust/200512/Bearer
    </t:KeyType>
  </sp:RequestSecurityTokenTemplate>
  ...
</sp:IssuedToken>

```

This policy states that the client should include a SAML 2.0 Assertion of subject confirmation method "Bearer" in the request. The client must know how to communicate with an STS to obtain such a token. This is done by providing the STSCient object with the appropriate information.

The IssueUnitTest referred to above uses the STSCient programmatically to obtain a security token. Let's look at the "requestSecurityToken" method called by the tests. An STSCient is instantiated via the CXF bus, and the WSDL location of the STS, plus service and port names are configured:

```

STSCient stsClient = new STSCient(bus);
stsClient.setWsdllLocation("https://.../SecurityTokenService/Transport?wsdl");
stsClient.setServiceName("{...}SecurityTokenService");
stsClient.setEndpointName("{...}Transport_Port");

```

A map is then populated with various properties and set on the STSCient. It is keyed with a different number of [SecurityConstants](#) tags. A username is supplied for use as the "user" in the UsernameToken. A CallbackHandler class is supplied to get the password to use in the UsernameToken. Compliance of the Basic Security Profile 1.1 is turned off, this is to prevent CXF throwing an exception when receiving a non-spec compliant response from a non-CXF STS:

```

Map<String, Object> properties = new HashMap<String, Object>();
stsClient.setProperties(properties);
properties.put(SecurityConstants.USERNAME, "alice");
properties.put(
    SecurityConstants.CALLBACK_HANDLER,
    "org.apache.cxf.systest.sts.common.CommonCallbackHandler"
);
properties.put(SecurityConstants.IS_BSP_COMPLIANT, "false");

```

If the KeyType is a "PublicKey", then an X.509 Certificate is presented to the STS in the request to embed in the generated SAML Assertion. The X.509 Certificate is obtained from the keystore defined in "clientKeystore.properties", with the alias "myclientkey". Finally, the "useCertificateForConfirmationKeyInfo" property of the STSCient means that the entire certificate is to be included in the request, instead of a KeyValue (which is the default):

```

if (PUBLIC_KEY_KEYTYPE.equals(keyType)) {
    properties.put(SecurityConstants.STS_TOKEN_USERNAME, "myclientkey");
    properties.put(SecurityConstants.STS_TOKEN_PROPERTIES,
        "clientKeystore.properties");
    stsClient.setUseCertificateForConfirmationKeyInfo(true);
}

```

Finally, the token type is set on the STSCient (the type of token that is being requested), as well as the KeyType (specific to a SAML Assertion), and a security token is requested, passing the endpoint address which is sent to the STS in the "AppliesTo" element:

```

stsClient.setTokenType(tokenType);
stsClient.setKeyType(keyType);
return stsClient.requestSecurityToken(endpointAddress);

```

The returned [SecurityToken](#) object contains the received token as a DOM element, the ID of the received token, any reference elements that were returned - which show how to reference the token, any secret associated with the token, and the lifetime of the token.

## 4.2. Running the JAX-WS CXF WS-Trust Sample from Talend ESB

Talend ESB includes a `jaxws-cxf-sts` sample under the examples folder of the distribution. The STS and WSP portions of this example run on Apache Tomcat Version 7.



## Running on Tomcat 6

If you would like to use Tomcat 6, as discussed in this sample's README file, some changes to this sample are needed:

- In Tomcat 6's tomcat-users.xml file (discussed in the next section), instead of giving the tomcat user the "manager-script" and "manager-gui" roles, give him the Tomcat 6-specific "manager" role.
- Use the `-PTomcat6` setting when deploying either the STS or the Web Service Provider onto Tomcat

If not already done, configure Maven to be able to install and uninstall the WSP and the STS by following these instructions:

### 4.2.1. Download Tomcat and configure Tomcat-Maven integration

1. Download from <http://tomcat.apache.org/download-70.cgi> or <http://tomcat.apache.org/download-60.cgi> the latest release version of Tomcat and extract the zip or tar.gz file into a new directory.
2. Have an environment variable \$CATALINA\_HOME point to your expanded Tomcat application directory, e.g. for Linux (in your ~/.bashrc file): `export CATALINA_HOME=/usr/myapps/tomcat-<version>`
3. In the CATALINA\_HOME/conf/tomcat-users.xml file, we'll need to create a user with appropriate manager permissions. Create a new user with the role of manager-script or give the default "tomcat" user the manager-script role as shown below. This role allows for deploying web applications using scripting tools such as the Tomcat Maven Plugin we're using in this tutorial. Although not necessary for Tomcat deployment, The manager-gui role gives ability to access the browser-based Tomcat Manager HTML application, helpful for a quick authentication check. Depending on your security needs, you may or may not wish to do this in production.

```
<tomcat-users>
  ...other entries...
  <role rolename="manager-script"/>
  <role rolename="manager-gui"/>
  <user username="tomcat" password="????"
    roles="tomcat,manager-script,manager-gui"/>
</tomcat-users>
```



#### Note

For production it is best to grant manager roles to another username besides the easy-to-guess default "tomcat" user.

Change the "???" in user password line of tomcat-users configuration to another appropriate password and save.

4. Start Tomcat from a console window: `{prompt}% $CATALINA_HOME/bin/startup.sh`
5. If you granted the user the manager-gui role, confirm that you can log into the manager webapp at `http://localhost:8080/manager/html` using the username and password of the manager account.para

## 4.2.2. Configure Maven and Java Security Extension

1. Update (or create if not present) your Maven repository settings.xml file for Maven deployment plugin authorization.

Go to the .m2/settings.xml file of your operating system home directory (for Microsoft Windows, usually \Documents and Settings\<<windows-user>; Linux would be /home/<user>) and add:

```
<settings>
...
  <servers>
    <server>
      <id>myTomcat</id>
      <username>tomcat</username>
      <password>(defined in tomcat-users.xml configuration)</password>
    </server>
  </servers>
...
</settings>
```

Where "tomcat" above is the name of the user you granted the managerial role(s) to in the previous section.

2. Check if the Java Security Extension installed:

To prevent the "Illegal key size or default parameters" exception, update your Java SDK by downloading the Java(TM) Cryptography Extension (JCE) Unlimited Strength Jurisdiction Policy Files 6. Follow the README within that download for instructions on upgrading your JDK to support 256-bit encryption. (Another option is to reduce the encryption level of the sample to 128-bit by following the instructions in this sample's README file.) You can download the policy files from <http://www.oracle.com/technetwork/java/javase/downloads/index.html>.

## 4.2.3. Deployment and running

1. From the root `jaxws-cxf-sts` folder, run `mvn clean install`. If no errors, can then run `mvn tomcat:deploy` (or `tomcat:undeploy` or `tomcat:redploy` on subsequent runs as appropriate), either from the same folder (to deploy the STS and WSP at the same time) or separately, one at a time, from the `war` and `sts` folders.
2. Before proceeding to the next step, make sure you can view the following WSDLs: the CXF STS WSDL located at: `http://localhost:8080/DoubleItSTS/X509?wsdl` and the CXF WSP at `http://localhost:8080/doubleit/services/doubleitUT?wsdl`.
3. Navigate to the `client` folder and run `mvn clean install exec:exec`. You should see the results of three web service calls, with the client using X.509 authentication with the STS to get the SAML Assertion.