Progress FUSE™

FUSE™ ESB

Developing and Deploying JAX-WS Services [DRAFT]

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Developing and Deploying JAX-WS Services

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Chapter 1. Introduction

FUSE ESB provides a powerful environment for developing and deploying JAX-WS applications. Its JAX-WS implementation is supplied by FUSE Services Framework. It supports both HTTP/SOAP and JMS/SOAP endpoints. FUSE ESB's OSGi runtime makes packaging and deploying the applications easy.

Overview

Developing new services is an integral part of most software projects. FUSE ESB uses FUSE Services Framework to make it easy to develop and deploy services using standard JAX-WS programming techniques.

Working with the FUSE Services Framework involves three steps:

1. Implementing your application as annotated POJOs.
2. Adding the needed configuration to your application.
3. Packaging the configuration and required jars into an OSGi bundle for deployment.

Key features

The FUSE Services Framework integration with FUSE ESB provides the following features:

- automatic WSDL generation
- jsr181 support
- JAX-WS 2.1 Support
- JAXB 2.1 support
- MTOM support
- Java proxy support

Steps for working with the FUSE Services Framework service engine

Using the FUSE Services Framework service engine to develop a service usually involves the following steps:

1. Implementing the service's functionality using an annotated POJO.

If you want to start with Java code see "Developing a Service Using Java as a Starting Point" on page 17.

If you want to start with a WSDL contract see "Developing a Service Using WSDL as a Starting Point" on page 37.

2. Configure the service.

   See Part II on page 41.

3. Package the application as an OSGi bundle.

4. Deploying the application's bundle to the FUSE ESB container.

More information

For more information about developing services using FUSE Services Framework see the FUSE Services Framework library.[1].

[1] http://fusesource.com/documentation/fuse-service-framework-documentation

Part I. Developing JAX-WS Applications

JAX-WS provides a standardized programming model for developing applications using service oriented design. You can start from Java or from WSDL.

Chapter 2. Developing a Service Using Java as a Starting Point

Developing a service using a POJO is as simple as annotating your classes to add in the information needed to generate a WSDL contract.

Creating the SEI

Overview

The *service endpoint interface* (SEI) is the piece of Java code that is shared between a service implementation and the consumers that make requests on that service. The SEI defines the methods implemented by the service and provides details about how the service will be exposed as an endpoint. When starting with a WSDL contract, the SEI is generated by the code generators. However, when starting from Java, it is the developer's responsibility to create the SEI.

There are two basic patterns for creating an SEI:

- Green field development — In this pattern, you are developing a new service without any existing Java code or WSDL. It is best to start by creating the SEI. You can then distribute the SEI to any developers that are responsible for implementing the service providers and consumers that use the SEI.

  ### Note

  The recommended way to do green field service development is to start by creating a WSDL contract that defines the service and its interfaces. See : on page 37.

- Service enablement — In this pattern, you typically have an existing set of functionality that is implemented as a Java class, and you want to service enable it. This means that you must do two things:

  1. Create an SEI that contains **only** the operations that are going to be exposed as part of the service.

  2. Modify the existing Java class so that it implements the SEI.

Note

Although you can add the JAX-WS annotations to a Java class, it is not recommended.

Writing the interface

The SEI is a standard Java interface. It defines a set of methods that a class implements. It can also define a number of member fields and constants to which the implementing class has access.

In the case of an SEI the methods defined are intended to be mapped to operations exposed by a service. The SEI corresponds to a `wsdl:portType` element. The methods defined by the SEI correspond to `wsdl:operation` elements in the `wsdl:portType` element.

Tip

JAX-WS defines an annotation that allows you to specify methods that are not exposed as part of a service. However, the best practice is to leave those methods out of the SEI.

Example 2.1 on page 19 shows a simple SEI for a stock updating service.

Example 2.1. Simple SEI

```
package com.fusesource.demo;

public interface quoteReporter
{
  public Quote getQuote(String ticker);
}
```

Implementing the interface

Because the SEI is a standard Java interface, the class that implements it is a standard Java class. If you start with a Java class you must modify it to implement the interface. If you start with the SEI, the implementation class implements the SEI.

Example 2.2 on page 20 shows a class for implementing the interface in Example 2.1 on page 19.

Example 2.2. Simple Implementation Class

```
package com.fusesource.demo;

import java.util.*;

public class stockQuoteReporter implements quoteReporter
{
  ...
public Quote getQuote(String ticker)
  {
    Quote retVal = new Quote();
    retVal.setID(ticker);
    retVal.setVal(Board.check(ticker));[1]
    Date retDate = new Date();
    retVal.setTime(retDate.toString());
    return(retVal);
  }
}
```

[1] `Board` is an assumed class whose implementation is left to the reader.

Annotating the Code

JAX-WS relies on the annotation feature of Java 5. The JAX-WS annotations specify the metadata used to map the SEI to a fully specified service definition. Among the information provided in the annotations are the following:

- The target namespace for the service.
- The name of the class used to hold the request message
- The name of the class used to hold the response message
- If an operation is a one way operation
- The binding style the service uses
- The name of the class used for any custom exceptions
- The namespaces under which the types used by the service are defined

Tip

Most of the annotations have sensible defaults and it is not necessary to provide values for them. However, the more information you provide in the annotations, the better your service definition is specified. A well-specified service definition increases the likelihood that all parts of a distributed application will work together.

Required Annotations

Overview

In order to create a service from Java code you are only required to add one annotation to your code. You must add the `@WebService` annotation on both the SEI and the implementation class.

The @WebService annotation

The `@WebService` annotation is defined by the `javax.jws.WebService` interface and it is placed on an interface or a class that is intended to be used as a service. `@WebService` has the properties described in Table 2.1 on page 22

Table 2.1. `@WebService` Properties

Property	Description
name	Specifies the name of the service interface. This property is mapped to the `name` attribute of the `wsdl:portType` element that defines the service's interface in a WSDL contract. The default is to append `PortType` to the name of the implementation class. [a]
targetNamespace	Specifies the target namespace where the service is defined. If this property is not specified, the target namespace is derived from the package name.
serviceName	Specifies the name of the published service. This property is mapped to the `name` attribute of the `wsdl:service` element that defines the published service. The default is to use the name of the service's implementation class. [a]
wsdlLocation	Specifies the URL where the service's WSDL contract is stored. This must be specified using a relative URL. The default is the URL where the service is deployed.
endpointInterface	Specifies the full name of the SEI that the implementation class implements. This property is only specified when the attribute is used on a service implementation class.
portName	Specifies the name of the endpoint at which the service is published. This property is mapped to the `name` attribute of the `wsdl:port` element that specifies the endpoint details for a published service. The default is the append `Port` to the name of the service's implementation class.[a]

[a] When you generate WSDL from an SEI the interface's name is used in place of the implementation class' name.

Tip

It is not necessary to provide values for any of the `@WebService` annotation's properties. However, it is recommended that you provide as much information as you can.

Annotating the SEI

The SEI requires that you add the `@WebService` annotation. Because the SEI is the contract that defines the service, you should specify as much detail as possible about the service in the `@WebService` annotation's properties.

Example 2.3 on page 23 shows the interface defined in Example 2.1 on page 19 with the `@WebService` annotation.

Example 2.3. Interface with the `@WebService` Annotation

```
package com.fusesource.demo;

import javax.jws.*;

@WebService(name="quoteUpdater", ❶
            targetNamespace="http:\\demos.fusesource.com", ❷
         serviceName="updateQuoteService", ❸
            wsdlLocation="http:\\demos.fusesource.com\quoteExampleService?wsdl", ❹
            portName="updateQuotePort") ❺
public interface quoteReporter
{
  public Quote getQuote(String ticker);
}
```

The `@WebService` annotation in Example 2.3 on page 23 does the following:

❶ Specifies that the value of the `name` attribute of the `wsdl:portType` element defining the service interface is `quoteUpdater`.

❷ Specifies that the target namespace of the service is `http:\\demos.fusesource.com`.

❸ Specifies that the value of the `name` of the `wsdl:service` element defining the published service is `updateQuoteService`.

❹ Specifies that the service will publish its WSDL contract at `http:\\demos.fusesource.com\quoteExampleService?wsdl`.

❺ Specifies that the value of the `name` attribute of the `wsdl:port` element defining the endpoint exposing the service is `updateQuotePort`.

Annotating the service implementation

In addition to annotating the SEI with the `@WebService` annotation, you also must annotate the service implementation class with the `@WebService` annotation. When adding the annotation to the service implementation class you only need to specify the endpointInterface property. As shown in Example 2.4 on page 24 the property must be set to the full name of the SEI.

Example 2.4. Annotated Service Implementation Class

```
package org.eric.demo;

import javax.jws.*;

@WebService(endpointInterface="com.fusesource.demo.quoteReport
er")
public class stockQuoteReporter implements quoteReporter
{
public Quote getQuote(String ticker)
  {
  ...
  }
}
```

Optional Annotations

While the `@WebService` annotation is sufficient for service enabling a Java interface or a Java class, it does not fully describe how the service will be exposed as a service provider. The JAX-WS programming model uses a number of optional annotations for adding details about your service, such as the binding it uses, to the Java code. You add these annotations to the service's SEI.

Tip

The more details you provide in the SEI the easier it is for developers to implement applications that can use the functionality it defines. It also makes the WSDL documents generated by the tools more specific.

Defining the Binding Properties with Annotations

Overview

If you are using a SOAP binding for your service, you can use JAX-WS annotations to specify a number of the bindings properties. These properties correspond directly to the properties you can specify in a service's WSDL contract. Some of the settings, such as the parameter style, can restrict how you implement a method. These settings can also effect which annotations can be used when annotating method parameters.

The @SOAPBinding annotation

The `@SOAPBinding` annotation is defined by the `javax.jws.soap.SOAPBinding` interface. It provides details about the SOAP binding used by the service when it is deployed. If the `@SOAPBinding` annotation is not specified, a service is published using a wrapped doc/literal SOAP binding.

You can put the `@SOAPBinding` annotation on the SEI and any of the SEI's methods. When it is used on a method, setting of the method's `@SOAPBinding` annotation take precedence.

Table 2.2 on page 26 shows the properties for the `@SOAPBinding` annotation.

Table 2.2. `@SOAPBinding` Properties

Property	Values	Description
style	`Style.DOCUMENT` (default) `Style.RPC`	Specifies the style of the SOAP message. If `RPC` style is specified, each message part within the SOAP body is a parameter or return value and appears inside a wrapper element within the `soap:body` element. The message parts within the wrapper element correspond to operation parameters and must appear in the same order as the parameters in the operation. If `DOCUMENT` style is specified, the contents of the SOAP body must be a valid XML document, but its form is not as tightly constrained.
use	`Use.LITERAL` (default) `Use.ENCODED`[a]	Specifies how the data of the SOAP message is streamed.
parameterStyle[b]	`ParameterStyle.BARE` `ParameterStyle.WRAPPED` (default)	Specifies how the method parameters, which correspond to message parts in a WSDL contract, are placed into the SOAP message body. If `BARE` is specified, each parameter is placed into the message body as a child element of the message root. If `WRAPPED` is specified, all of the input parameters are wrapped into a single element on a

Property	Values	Description
		request message and all of the output parameters are wrapped into a single element in the response message.

[a] `Use.ENCODED` is not currently supported.

[b] If you set the style to `RPC` you must use the `WRAPPED` parameter style.

Document bare style parameters

Document bare style is the most direct mapping between Java code and the resulting XML representation of the service. When using this style, the schema types are generated directly from the input and output parameters defined in the operation's parameter list.

You specify you want to use bare document\literal style by using the `@SOAPBinding` annotation with its style property set to `Style.DOCUMENT`, and its parameterStyle property set to `ParameterStyle.BARE`.

To ensure that an operation does not violate the restrictions of using document style when using bare parameters, your operations must adhere to the following conditions:

- The operation must have no more than one input or input/output parameter.
- If the operation has a return type other than void, it must not have any output or input/output parameters.
- If the operation has a return type of void, it must have no more than one output or input/output parameter.

Note

Any parameters that are placed in the SOAP header using the `@WebParam` annotation or the `@WebResult` annotation are not counted against the number of allowed parameters.

Document wrapped parameters

Document wrapped style allows a more RPC like mapping between the Java code and the resulting XML representation of the service. When using this style, the parameters in the method's parameter list are wrapped into a single element by the binding. The disadvantage of this is that it introduces an extra-layer of indirection between the Java implementation and how the messages are placed on the wire.

To specify that you want to use wrapped document\literal style use the `@SOAPBinding` annotation with its style property set to `Style.DOCUMENT`, and its parameterStyle property set to `ParameterStyle.WRAPPED`.

You have some control over how the wrappers are generated by using the `@RequestWrapper` annotation and the `@ResponseWrapper` annotation.

Example

Example 2.5 on page 28 shows an SEI that uses document bare SOAP messages.

Example 2.5. Specifying a Document Bare SOAP Binding with the SOAP Binding Annotation

```
package org.eric.demo;

import javax.jws.*;
import javax.jws.soap.*;
import javax.jws.soap.SOAPBinding.*;

@WebService(name="quoteReporter")
@SOAPBinding(parameterStyle=ParameterStyle.BARE)
public interface quoteReporter
{
  ...
}
```

Defining Operation Properties with Annotations

Overview

When the runtime maps your Java method definitions into XML operation definitions it provides details such as:

- What the exchanged messages look like in XML
- If the message can be optimized as a one way message
- The namespaces where the messages are defined

The @WebMethod annotation

The `@WebMethod` annotation is defined by the `javax.jws.WebMethod` interface. It is placed on the methods in the SEI. The `@WebMethod` annotation provides the information that is normally represented in the `wsdl:operation` element describing the operation to which the method is associated.

Table 2.3 on page 29 describes the properties of the `@WebMethod` annotation.

Table 2.3. `@WebMethod` Properties

Property	Description
operationName	Specifies the value of the associated `wsdl:operation` element's `name`. The default value is the name of the method.
action	Specifies the value of the `soapAction` attribute of the `soap:operation` element generated for the method. The default value is an empty string.
exclude	Specifies if the method should be excluded from the service interface. The default is `false`.

The @RequestWrapper annotation

The `@RequestWrapper` annotation is defined by the `javax.xml.ws.RequestWrapper` interface. It is placed on the methods in the SEI. The `@RequestWrapper` annotation specifies the Java class implementing the wrapper bean for the method parameters of the request message starting a message exchange. It also specifies the element names, and namespaces, used by the runtime when marshalling and unmarshalling the request messages.

Table 2.4 on page 30 describes the properties of the `@RequestWrapper` annotation.

Table 2.4. `@RequestWrapper` Properties

Property	Description
localName	Specifies the local name of the wrapper element in the XML representation of the request message. The default value is either the name of the method, or the value of the `@WebMethod` annotation's operationName property.
targetNamespace	Specifies the namespace under which the XML wrapper element is defined. The default value is the target namespace of the SEI.
className	Specifies the full name of the Java class that implements the wrapper element.

Tip

Only the className property is required.

Important

If the method is also annotated with the `@SOAPBinding` annotation, and its parameterStyle property is set to `ParameterStyle.BARE`, this annotation is ignored.

The @ResponseWrapper annotation

The `@ResponseWrapper` annotation is defined by the `javax.xml.ws.ResponseWrapper` interface. It is placed on the methods in the SEI. The `@ResponseWrapper` specifies the Java class implementing the wrapper bean for the method parameters in the response message in the message exchange. It also specifies the element names, and namespaces, used by the runtime when marshaling and unmarshalling the response messages.

Table 2.5 on page 31 describes the properties of the `@ResponseWrapper` annotation.

Table 2.5. `@ResponseWrapper` Properties

Property	Description
localName	Specifies the local name of the wrapper element in the XML representation of the response message. The default value is either the name of the method with `Response` appended, or the value of the `@WebMethod` annotation's operationName property with `Response` appended.
targetNamespace	Specifies the namespace where the XML wrapper element is defined. The default value is the target namespace of the SEI.
className	Specifies the full name of the Java class that implements the wrapper element.

Tip

Only the className property is required.

Important

If the method is also annotated with the `@SOAPBinding` annotation and its parameterStyle property is set to `ParameterStyle.BARE`, this annotation is ignored.

The @WebFault annotation

The `@WebFault` annotation is defined by the `javax.xml.ws.WebFault` interface. It is placed on exceptions that are thrown by your SEI. The `@WebFault` annotation is used to map the Java exception to a `wsdl:fault` element. This information is used to marshall the exceptions into a representation that can be processed by both the service and its consumers.

Table 2.6 on page 31 describes the properties of the `@WebFault` annotation.

Table 2.6. `@WebFault` Properties

Property	Description
name	Specifies the local name of the fault element.
targetNamespace	Specifies the namespace under which the fault element is defined. The default value is the target namespace of the SEI.

Property	Description
faultName	Specifies the full name of the Java class that implements the exception.

Important

The name property is required.

The @Oneway annotation

The @Oneway annotation is defined by the javax.jws.Oneway interface. It is placed on the methods in the SEI that will not require a response from the service. The @Oneway annotation tells the run time that it can optimize the execution of the method by not waiting for a response and by not reserving any resources to process a response.

This annotation can only be used on methods that meet the following criteria:

- They return void
- They have no parameters that implement the Holder interface
- They do not throw any exceptions that can be passed back to a consumer

Example

Example 2.6 on page 32 shows an SEI with its methods annotated.

Example 2.6. SEI with Annotated Methods

```
package com.fusesource.demo;

import javax.jws.*;
import javax.xml.ws.*;

@WebService(name="quoteReporter")
public interface quoteReporter
{
  @WebMethod(operationName="getStockQuote")
  @RequestWrapper(targetNamespace="http://demo.fusesource.com/types",
                  className="java.lang.String")
  @ResponseWrapper(targetNamespace="http://demo.fusesource.com/types",
                   className="org.eric.demo.Quote")
  public Quote getQuote(String ticker);
}
```

Defining Parameter Properties with Annotations

Overview

The method parameters in the SEI correspond to the `wsdl:message` elements and their `wsdl:part` elements. JAX-WS provides annotations that allow you to describe the `wsdl:part` elements that are generated for the method parameters.

The @WebParam annotation

The `@WebParam` annotation is defined by the `javax.jws.WebParam` interface. It is placed on the parameters of the methods defined in the SEI. The `@WebParam` annotation allows you to specify the direction of the parameter, if the parameter will be placed in the SOAP header, and other properties of the generated `wsdl:part`.

Table 2.7 on page 33 describes the properties of the `@WebParam` annotation.

Table 2.7. `@WebParam` Properties

Property	Values	Description
name		Specifies the name of the parameter as it appears in the generated WSDL document. For RPC bindings, this is the name of the `wsdl:part` representing the parameter. For document bindings, this is the local name of the XML element representing the parameter. Per the JAX-WS specification, the default is `argN`, where *N* is replaced with the zero-based argument index (i.e., arg0, arg1, etc.).
targetNamespace		Specifies the namespace for the parameter. It is only used with document bindings where the parameter maps to an XML element. The default is to use the service's namespace.

mode	`Mode.IN` (default)[a]
	`Mode.OUT`
	`Mode.INOUT`
		Specifies the direction of the parameter.

header	`false` (default) `true`	Specifies if the parameter is passed as part of the SOAP header.

Property	Values	Description
partName		Specifies the value of the `name` attribute of the `wsdl:part` element for the parameter. This property is used for document style SOAP bindings.

[a] Any parameter that implements the `Holder` interface is mapped to `Mode.INOUT` by default.

The @WebResult annotation

The `@WebResult` annotation is defined by the `javax.jws.WebResult` interface. It is placed on the methods defined in the SEI. The `@WebResult` annotation allows you to specify the properties of the `wsdl:part` that is generated for the method's return value.

Table 2.8 on page 34 describes the properties of the `@WebResult` annotation.

Table 2.8. `@WebResult` Properties

Property	Description
name	Specifies the name of the return value as it appears in the generated WSDL document. For RPC bindings, this is the name of the `wsdl:part` representing the return value. For document bindings, this is the local name of the XML element representing the return value. The default value is `return`.
targetNamespace	Specifies the namespace for the return value. It is only used with document bindings where the return value maps to an XML element. The default is to use the service's namespace.
header	Specifies if the return value is passed as part of the SOAP header.
partName	Specifies the value of the `name` attribute of the `wsdl:part` element for the return value. This property is used for document style SOAP bindings.

Example

Example 2.7 on page 34 shows an SEI that is fully annotated.

Example 2.7. Fully Annotated SEI

```
package com.fusesource.demo;

import javax.jws.*;
import javax.xml.ws.*;
import javax.jws.soap.*;
import javax.jws.soap.SOAPBinding.*;
import javax.jws.WebParam.*;

@WebService(targetNamespace="http://demo.fusesource.com",
            name="quoteReporter")
@SOAPBinding(style=Style.RPC, use=Use.LITERAL)
public interface quoteReporter
{
  @WebMethod(operationName="getStockQuote")
  @RequestWrapper(targetNamespace="http://demo.fusesource.com/types",
                  className="java.lang.String")
  @ResponseWrapper(targetNamespace="http://demo.fusesource.com/types",
                   className="org.eric.demo.Quote")
  @WebResult(targetNamespace="http://demo.fusesource.com/types",
             name="updatedQuote")
  public Quote getQuote(
                        @WebParam(targetNamespace="http://demo.fusesource.com/types",
                                  name="stockTicker",
                                  mode=Mode.IN)
                        String ticker
  );
}
```

Chapter 3. Developing a Service Using WSDL as a Starting Point

FUSE ESB provides Maven tools that allow you to generate the required stub code from a WSDL file. You simply need to provide the application logic to implement your service.

Overview

When starting with a WSDL file, ,you need to generate the stub code for your service. You may also need to generate the starting point code for your service. To generate the required code you have two options:

- use the FUSE Services Framework **wsdl2java** tool
- use the **wsdl2java** goal of the Maven Apache CXF code generation plug-in

Once the stub code is generated, you can implement your service's logic and deploy it.

Using the FUSE Services Framework code generation tool

If you have a copy of FUSE Services Framework, or Apache CXF, installed on your system, you can use the **wsdl2java** tool to generate the stub code and the starting point code. Example 3.1 on page 37 shows the command and the options to use.

Example 3.1. FUSE Services Framework Code Generation Command

```
wsdl2java -impl -d outDir myService.wsdl
```

The `-impl` flag tells the tool to generate the starting point code for your implementation. The `-d outDir` flag tells the tool the name of the folder into which the generated code is written.

Important

FUSE ESB 4.1 only supports FUSE Services Framework 2.1.x or Apache CXF 2.1.x.

For more information about using the FUSE Services Framework tooling see the FUSE Services Framework library.[1].

Using the Maven tools

Even if you do not have FUSE Services Framework or Apache CXF installed, you can generate the required Java classes using the Maven tooling. You need to include the Apache CXF code generation plug-in in your project file and configure it to use the **wsdl2java** goal.

Example 3.2 on page 38 shows the XML needed to configure the Apache CXF code generation plug-in to generate the stubs and starting point code.

Example 3.2. Maven Configuration for Generating Starting Point Code From WSDL

```
<project xmlns="http://maven.apache.org/POM/4.0.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/maven-
v4_0_0.xsd">

  ...
  <build>
    <plugins>
       ...
       <plugin>
         <groupId>org.apache.cxf</groupId>
         <artifactId>cxf-codegen-plugin</artifactId> ❶
         <version>cxf-version</version> ❷
         <executions>
            <execution<
              <phase>generate-sources</phase> ❸
              <configuration>
                <sourceRoot>sourceDir</sourceRoot> ❹
                 <wsdlOptions>
                   <wsdlOption>
                     <wsdl>myService.wsdl</wsdl> ❺
                       <extraargs>
                         <extraarg>-impl</extraarg> ❻
                       </extraargs>
                   </wsdlOption>
                 </wsdlOptions>
              </configuration>
              <goals>
                <goal>wsdl2java</goal> ❼
              </goals>
             </execution>
```

[1] http://fusesource.com/documentation/fuse-service-framework-documentation

```
          </executions>
       </plugin>
      ...
    </plugins>
  </build>
</project>
```

The Maven POM fragment shown in Example 3.2 on page 38 does the following:

❶ Specifies that the Apache CXF code generation plug-in is to be loaded.

❷ Specifies the version of the Apache CXF code generation plug-in to use.

> **Important**
>
> FUSE ESB only supports version 2.1.x of Apache CXF.

❸ Specifies that the plug-in is run during the generate-sources phase of a project build. You evoke the generate-sources phases using the **mvn generate-sources** command.

❹ Specifies the directory into which the generated source files will be placed.

❺ Specifies the path to the WSDL file from which the source code will be generated.

❻ Specifies that a starting point implementation class is to be generated.

❼ Specifies that the Apache CXF code generation plug-in will use its **wsdl2java** goal.

Generated code

The implementation code consists of two files:

- `*portTypeName*.java` — The service interface(SEI) for the service.
- `*portTypeName*Impl.java` — The class you will use to implement the operations defined by the service.

Implement the operation's logic

To provide the business logic for your service's operations complete the stub methods in `*portTypeName*Impl.java`. You usually use standard Java to implement the business logic. If your service uses custom XML Schema types, you must use the generated classes for each type to manipulate them. There are also some FUSE Services Framework specific APIs that can be used to access some advanced features.

Part II. Configuring Your Applications

FUSE ESB uses Spring-based configuration to deploy JAX-WS services. Using the configuration, you can control the transport used by your application. You can also configure your application to take advantage of WS-Addressing, WS-RM, and other enterprise features.

Chapter 4. Configuring Service Endpoints

FUSE Services Framework service endpoints can be configured using one of two Spring elements. Which one you use depends on your use case.

FUSE Services Framework has two elements that can be used to configure a service endpoint:

- `jaxws:endpoint`
- `jaxws:server`

The differences between the two elements are largely internal to the runtime. The `jaxws:endpoint` element injects properties into the `org.apache.cxf.jaxws.EndpointImpl` object created to support a service endpoint. The `jaxws:server` element injects properties into the `org.apache.cxf.jaxws.support.JaxWsServerFactoryBean` object created to support the endpoint. The `EndpointImpl` object passes the configuration data to the `JaxWsServerFactoryBean` object. The `JaxWsServerFactoryBean` object is used to create the actual service object. So either configuration element will configure a service endpoint. You can choose based on the syntax you prefer.

Using the jaxws:endpoint Element

Overview

The `jaxws:endpoint` element is the default element for configuring JAX-WS service providers. Its attributes and children specify all of the information needed to instantiate a service provider. Many of the attributes map to information in the service's contract. The children are used to configure interceptors and other advanced features.

Identifying the endpoint being configured

For the runtime to apply the configuration to the proper service provider, it must be able to identify it. The basic means for identifying a service provider is to specify the class that implements the endpoint. This is done using the `jaxws:endpoint` element's `implementor` attribute.

For instances where different endpoint's share a common implementation, it is possible to provide different configuration for each endpoint. There are two approaches for distinguishing a specific endpoint in configuration:

- a combination of the `serviceName` attribute and the `endpointName` attribute

  The `serviceName` attribute specifies the `wsdl:service` element defining the service's endpoint. The `endpointName` attribute specifies the specific `wsdl:port` element defining the service's endpoint. Both attributes are specified as QNames using the format *`ns`*`:`*`name`*. *`ns`* is the namespace of the element and *`name`* is the value of the element's `name` attribute.

  ### Tip

  If the `wsdl:service` element only has one `wsdl:port` element, the `endpointName` attribute can be omitted.

- the `name` attribute

  The `name` attribute specifies the QName of the specific `wsdl:port` element defining the service's endpoint. The QName is provided in the format `{ns}localPart`. *ns* is the namespace of the `wsdl:port` element and *localPart* is the value of the `wsdl:port` element's `name` attribute.

Attributes

The attributes of the `jaxws:endpoint` element configure the basic properties of the endpoint. These properties include the address of the endpoint, the class that implements the endpoint, and the `bus` that hosts the endpoint.

Table 4.1 on page 45 describes the attribute of the `jaxws:endpoint` element.

*Table 4.1. Attributes for Configuring a JAX-WS Service Provider Using the **`jaxws:endpoint`** Element*

Attribute	Description
`id`	Specifies a unique identifier that other configuration elements can use to refer to the endpoint.
`implementor`	Specifies the class implementing the service. You can specify the implementation class using either the class name or an ID reference to a Spring bean configuring the implementation class. This class must be on the classpath.
`implementorClass`	Specifies the class implementing the service. This attribute is useful when the value provided to the `implementor` attribute is a reference to a bean that is wrapped using Spring AOP.
`address`	Specifies the address of an HTTP endpoint. This value overrides the value specified in the services contract.
`wsdlLocation`	Specifies the location of the endpoint's WSDL contract. The WSDL contract's location is relative to the folder from which the service is deployed.
`endpointName`	Specifies the value of the service's `wsdl:port` element's `name` attribute. It is specified as a QName using the format *`ns`*`:`*`name`* where *ns* is the namespace of the `wsdl:port` element.
`serviceName`	Specifies the value of the service's `wsdl:service` element's `name` attribute. It is specified as a QName using the format *`ns`*`:`*`name`* where *ns* is the namespace of the `wsdl:service` element.
`publish`	Specifies if the service should be automatically published. If this is set to `false`, the developer must explicitly publish the endpoint.
`bus`	Specifies the ID of the Spring bean configuring the bus used to manage the service endpoint. This is useful when configuring several endpoints to use a common set of features.
`bindingUri`	Specifies the ID of the message binding the service uses. A list of valid binding IDs is provided in Appendix B on page 163.

Attribute	Description
`name`	Specifies the stringified QName of the service's `wsdl:port` element. It is specified as a QName using the format `{ns}localPart`. *ns* is the namespace of the `wsdl:port` element and *localPart* is the value of the `wsdl:port` element's `name` attribute.
`abstract`	Specifies if the bean is an abstract bean. Abstract beans act as parents for concrete bean definitions and are not instantiated. The default is `false`. Setting this to `true` instructs the bean factory not to instantiate the bean.
`depends-on`	Specifies a list of beans that the endpoint depends on being instantiated before it can be instantiated.
`createdFromAPI`	Specifies that the user created that bean using FUSE Services Framework APIs, such as `Endpoint.publish()` or `Service.getPort()`. The default is `false`. Setting this to `true` does the following: • Changes the internal name of the bean by appending `.jaxws-endpoint` to its id • Makes the bean abstract

In addition to the attributes listed in Table 4.1 on page 45, you might need to use multiple `xmlns:shortName` attributes to declare the namespaces used by the `endpointName` and `serviceName` attributes.

Example

Example 4.1 on page 46 shows the configuration for a JAX-WS endpoint that specifies the address where the endpoint is published. The example assumes that you want to use the defaults for all other values or that the implementation has specified values in the annotations.

Example 4.1. Simple JAX-WS Endpoint Configuration

```
<beans ...
  xmlns:jaxws="http://cxf.apache.org/jaxws"
  ...
  schemaLocation="...
    http://cxf.apache.org/jaxws http://cxf.apache.org/schemas/jaxws.xsd
    ...">
  <jaxws:endpoint id="example"
                  implementor="org.apache.cxf.example.DemoImpl"
                  address="http://localhost:8080/demo" />
</beans>
```

Example 4.2 on page 47 shows the configuration for a JAX-WS endpoint whose contract contains two service definitions. In this case, you must specify which service definition to instantiate using the `serviceName` attribute.

Example 4.2. JAX-WS Endpoint Configuration with a Service Name

```
<beans ...
  xmlns:jaxws="http://cxf.apache.org/jaxws"
  ...
  schemaLocation="...
    http://cxf.apache.org/jaxws http://cxf.apache.org/schemas/jaxws.xsd
    ...">
  <jaxws:endpoint id="example2"
                  implementor="org.apache.cxf.example.DemoImpl"
                  serviceName="samp:demoService2"
                  xmlns:samp="http://org.apache.cxf/wsdl/example" />
                  </beans>
```

The `xmlns:samp` attribute specifies the namespace in which the WSDL `service` element is defined.

Using the jaxws:server Element

Overview

The jaxws:server element is an element for configuring JAX-WS service providers. It injects the configuration information into the org.apache.cxf.jaxws.support.JaxWsServerFactoryBean. This is a FUSE Services Framework specific object. If you are using a pure Spring approach to building your services, you will not be forced to use FUSE Services Framework specific APIs to interact with the service.

The attributes and children of the jaxws:server element specify all of the information needed to instantiate a service provider. The attributes specify the information that is required to instantiate an endpoint. The children are used to configure interceptors and other advanced features.

Identifying the endpoint being configured

In order for the runtime to apply the configuration to the proper service provider, it must be able to identify it. The basic means for identifying a service provider is to specify the class that implements the endpoint. This is done using the jaxws:server element's serviceBean attribute.

For instances where different endpoint's share a common implementation, it is possible to provide different configuration for each endpoint. There are two approaches for distinguishing a specific endpoint in configuration:

- a combination of the serviceName attribute and the endpointName attribute

  The serviceName attribute specifies the wsdl:service element defining the service's endpoint. The endpointName attribute specifies the specific wsdl:port element defining the service's endpoint. Both attributes are specified as QNames using the format *ns*:*name*. *ns* is the namespace of the element and *name* is the value of the element's name attribute.

  ### Tip

  If the wsdl:service element only has one wsdl:port element, the endpointName attribute can be omitted.

- the name attribute

  The name attribute specifies the QName of the specific wsdl:port element defining the service's endpoint. The QName is provided in the format `{ns}localPart`. *ns* is the namespace of the `wsdl:port` element and *localPart* is the value of the `wsdl:port` element's `name` attribute.

Attributes

The attributes of the `jaxws:server` element configure the basic properties of the endpoint. These properties include the address of the endpoint, the class that implements the endpoint, and the `bus` that hosts the endpoint.

Table 4.2 on page 49 describes the attribute of the `jaxws:server` element.

Table 4.2. Attributes for Configuring a JAX-WS Service Provider Using the `jaxws:server` Element

Attribute	Description
`id`	Specifies a unique identifier that other configuration elements can use to refer to the endpoint.
`serviceBean`	Specifies the class implementing the service. You can specify the implementation class using either the class name or an ID reference to a Spring bean configuring the implementation class. This class must be on the classpath.
`serviceClass`	Specifies the class implementing the service. This attribute is useful when the value provided to the `implementor` attribute is a reference to a bean that is wrapped using Spring AOP.
`address`	Specifies the address of an HTTP endpoint. This value will override the value specified in the services contract.
`wsdlLocation`	Specifies the location of the endpoint's WSDL contract. The WSDL contract's location is relative to the folder from which the service is deployed.
`endpointName`	Specifies the value of the service's `wsdl:port` element's `name` attribute. It is specified as a QName using the format *ns*:*name*, where *ns* is the namespace of the `wsdl:port` element.
`serviceName`	Specifies the value of the service's `wsdl:service` element's `name` attribute. It is specified as a QName using the format *ns*:*name*, where *ns* is the namespace of the `wsdl:service` element.
`start`	Specifies if the service should be automatically published. If this is set to `false`, the developer must explicitly publish the endpoint.
`bus`	Specifies the ID of the Spring bean configuring the bus used to manage the service endpoint. This is useful when configuring several endpoints to use a common set of features.
`bindingId`	Specifies the ID of the message binding the service uses. A list of valid binding IDs is provided in Appendix B on page 163.

Attribute	Description
`name`	Specifies the stringified QName of the service's `wsdl:port` element. It is specified as a QName using the format `{ns}localPart`, where *ns* is the namespace of the `wsdl:port` element and *localPart* is the value of the `wsdl:port` element's `name` attribute.
`abstract`	Specifies if the bean is an abstract bean. Abstract beans act as parents for concrete bean definitions and are not instantiated. The default is `false`. Setting this to `true` instructs the bean factory not to instantiate the bean.
`depends-on`	Specifies a list of beans that the endpoint depends on being instantiated before the endpoint can be instantiated.
`createdFromAPI`	Specifies that the user created that bean using FUSE Services Framework APIs, such as `Endpoint.publish()` or `Service.getPort()`. The default is `false`. Setting this to `true` does the following: • Changes the internal name of the bean by appending `.jaxws-endpoint` to its id • Makes the bean abstract

In addition to the attributes listed in Table 4.2 on page 49, you might need to use multiple `xmlns:shortName` attributes to declare the namespaces used by the `endpointName` and `serviceName` attributes.

Example

Example 4.3 on page 50 shows the configuration for a JAX-WS endpoint that specifies the address where the endpoint is published.

Example 4.3. Simple JAX-WS Server Configuration

```
<beans ...
  xmlns:jaxws="http://cxf.apache.org/jaxws"
  ...
  schemaLocation="...
    http://cxf.apache.org/jaxws http://cxf.apache.org/schemas/jaxws.xsd
    ...">
  <jaxws:server id="exampleServer"
                  serviceBean="org.apache.cxf.example.DemoImpl"
                  address="http://localhost:8080/demo" />
</beans>
```

Adding Functionality to Service Providers

Overview

The `jaxws:endpoint` and the `jaxws:server` elements provide the basic configuration information needed to instantiate a service provider. To add functionality to your service provider or to perform advanced configuration you must add child elements to the configuration.

Child elements allow you to do the following:

- Change the endpoint's logging behavior
- Add interceptors to the endpoint's messaging chain
- Enable WS-Addressing features
- Enable reliable messaging

Elements

Table 4.3 on page 51 describes the child elements that `jaxws:endpoint` supports.

Table 4.3. Elements Used to Configure JAX-WS Service Providers

Element	Description
`jaxws:handlers`	Specifies a list of JAX-WS `Handler` implementations for processing messages.
`jaxws:inInterceptors`	Specifies a list of interceptors that process inbound requests. For more information see .
`jaxws:inFaultInterceptors`	Specifies a list of interceptors that process inbound fault messages. For more information see .
`jaxws:outInterceptors`	Specifies a list of interceptors that process outbound replies. For more information see .
`jaxws:outFaultInterceptors`	Specifies a list of interceptors that process outbound fault messages. For more information see .
`jaxws:binding`	Specifies a bean configuring the message binding used by the endpoint. Message bindings are configured using implementations of the `org.apache.cxf.binding.BindingFactory` interface.[a]
`jaxws:dataBinding` [b]	Specifies the class implementing the data binding used by the endpoint. This is specified using an embedded bean definition.

Element	Description
`jaxws:executor`	Specifies a Java executor that is used for the service. This is specified using an embedded bean definition.
`jaxws:features`	Specifies a list of beans that configure advanced features of FUSE Services Framework. You can provide either a list of bean references or a list of embedded beans.
`jaxws:invoker`	Specifies an implementation of the `org.apache.cxf.service.Invoker` interface used by the service. [c]
`jaxws:properties`	Specifies a Spring map of properties that are passed along to the endpoint. These properties can be used to control features like enabling MTOM support.
`jaxws:serviceFactory`	Specifies a bean configuring the `JaxWsServiceFactoryBean` object used to instantiate the service.

[a] The SOAP binding is configured using the `soap:soapBinding` bean.

[b] The `jaxws:endpoint` element does not support the `jaxws:dataBinding` element.

[c] The `Invoker` implementation controls how a service is invoked. For example, it controls whether each request is handled by a new instance of the service implementation or if state is preserved across invocations.

Chapter 5. Configuring the HTTP Transport

The FUSE Services Framework HTTP transport is highly configurable.

Configuring a Consumer

HTTP consumer endpoints can specify a number of HTTP connection attributes including whether the endpoint automatically accepts redirect responses, whether the endpoint can use chunking, whether the endpoint will request a keep-alive, and how the endpoint interacts with proxies. In addition to the HTTP connection properties, an HTTP consumer endpoint can specify how it is secured.

A consumer endpoint can be configured using two mechanisms:

- Configuration
- WSDL

Using Configuration

Namespace

The elements used to configure an HTTP consumer endpoint are defined in the namespace `http://cxf.apache.org/transports/http/configuration`. It is commonly referred to using the prefix http-conf. In order to use the HTTP configuration elements you must add the lines shown in Example 5.1 on page 55 to the `beans` element of your endpoint's configuration file. In addition, you must add the configuration elements' namespace to the `xsi:schemaLocation` attribute.

Example 5.1. HTTP Consumer Configuration Namespace

```
<beans ...
       xmlns:http-conf="http://cxf.apache.org/transports/http/configuration
       ...
       xsi:schemaLocation="...
                           http://cxf.apache.org/transports/http/configuration
                              http://cxf.apache.org/schemas/configuration/http-conf.xsd
                          ...>
```

The conduit element

You configure an HTTP endpoint using the `http-conf:conduit` element and its children. The `http-conf:conduit` element takes a single attribute, `name`, that specifies the WSDL `port` element corresponding to the endpoint. The value for the `name` attribute takes the form *`portQName`*`.http-conduit`. Example 5.2 on page 55 shows the `http-conf:conduit` element that would be used to add configuration for an endpoint that is specified by the WSDL fragment <port binding="widgetSOAPBinding" name="widgetSOAPPort> when the endpoint's target namespace is `http://widgets.widgetvendor.net`.

Example 5.2. `http-conf:conduit` Element

```
...
  <http-conf:conduit name="{http://widgets/widgetvendor.net}widgetSOAPPort.http-conduit>
    ...
  </http-conf:conduit>
...
```

The `http-conf:conduit` element has child elements that specify configuration information. They are described in Table 5.1 on page 56.

Table 5.1. Elements Used to Configure an HTTP Consumer Endpoint

Element	Description
`http-conf:client`	Specifies the HTTP connection properties such as timeouts, keep-alive requests, content types, etc. See "The `client` element" on page 56.
`http-conf:authorization`	Specifies the parameters for configuring the basic authentication method that the endpoint uses preemptively. The preferred approach is to supply a Basic Authentication Supplier object.
`http-conf:proxyAuthorization`	Specifies the parameters for configuring basic authentication against outgoing HTTP proxy servers.
`http-conf:tlsClientParameters`	Specifies the parameters used to configure SSL/TLS.
`http-conf:basicAuthSupplier`	Specifies the bean reference or class name of the object that supplies the basic authentication information used by the endpoint, either preemptively or in response to a `401` HTTP challenge.
`http-conf:trustDecider`	Specifies the bean reference or class name of the object that checks the HTTP(S) `URLConnection` object to establish trust for a connection with an HTTPS service provider before any information is transmitted.

The client element

The `http-conf:client` element is used to configure the non-security properties of a consumer endpoint's HTTP connection. Its attributes, described in Table 5.2 on page 56, specify the connection's properties.

Table 5.2. HTTP Consumer Configuration Attributes

Attribute	Description
`ConnectionTimeout`	Specifies the amount of time, in milliseconds, that the consumer attempts to establish a connection before it times out. The default is `30000`. `0` specifies that the consumer will continue to send the request indefinitely.
`ReceiveTimeout`	Specifies the amount of time, in milliseconds, that the consumer will wait for a response before it times out. The default is `30000`. `0` specifies that the consumer will wait indefinitely.
`AutoRedirect`	Specifies if the consumer will automatically follow a server issued redirection. The default is `false`.
`MaxRetransmits`	Specifies the maximum number of times a consumer will retransmit a request to satisfy a redirect. The default is `-1` which specifies that unlimited retransmissions are allowed.

Attribute	Description
AllowChunking	Specifies whether the consumer will send requests using chunking. The default is true which specifies that the consumer will use chunking when sending requests. Chunking cannot be used if either of the following are true: • http-conf:basicAuthSupplier is configured to provide credentials preemptively. • AutoRedirect is set to true. In both cases the value of AllowChunking is ignored and chunking is disallowed.
Accept	Specifies what media types the consumer is prepared to handle. The value is used as the value of the HTTP Accept property. The value of the attribute is specified using multipurpose internet mail extensions (MIME) types.
AcceptLanguage	Specifies what language (for example, American English) the consumer prefers for the purpose of receiving a response. The value is used as the value of the HTTP AcceptLanguage property. Language tags are regulated by the International Organization for Standards (ISO) and are typically formed by combining a language code, determined by the ISO-639 standard, and country code, determined by the ISO-3166 standard, separated by a hyphen. For example, en-US represents American English.
AcceptEncoding	Specifies what content encodings the consumer is prepared to handle. Content encoding labels are regulated by the Internet Assigned Numbers Authority (IANA). The value is used as the value of the HTTP AcceptEncoding property.
ContentType	Specifies the media type of the data being sent in the body of a message. Media types are specified using multipurpose internet mail extensions (MIME) types. The value is used as the value of the HTTP ContentType property. The default is text/xml. For web services, this should be set to text/xml. If the client is sending HTML form data to a CGI script, this should be set to application/x-www-form-urlencoded. If the HTTP POST request is bound to a fixed payload format (as opposed to SOAP), the content type is typically set to application/octet-stream.
Host	Specifies the Internet host and port number of the resource on which the request is being invoked. The value is used as the value of the HTTP Host property. This attribute is typically not required. It is only required by certain DNS scenarios or application designs. For example, it indicates what host the client prefers for clusters (that is, for virtual servers mapping to the same Internet protocol (IP) address).
Connection	Specifies whether a particular connection is to be kept open or closed after each request/response dialog. There are two valid values:

Attribute	Description
	- Keep-Alive — Specifies that the consumer wants the connection kept open after the initial request/response sequence. If the server honors it, the connection is kept open until the consumer closes it. - close(default) — Specifies that the connection to the server is closed after each request/response sequence.
CacheControl	Specifies directives about the behavior that must be adhered to by caches involved in the chain comprising a request from a consumer to a service provider. See "Consumer Cache Control Directives" on page 61.
Cookie	Specifies a static cookie to be sent with all requests.
BrowserType	Specifies information about the browser from which the request originates. In the HTTP specification from the World Wide Web consortium (W3C) this is also known as the *user-agent*. Some servers optimize based on the client that is sending the request.
Referer	Specifies the URL of the resource that directed the consumer to make requests on a particular service. The value is used as the value of the HTTP Referer property. This HTTP property is used when a request is the result of a browser user clicking on a hyperlink rather than typing a URL. This can allow the server to optimize processing based upon previous task flow, and to generate lists of back-links to resources for the purposes of logging, optimized caching, tracing of obsolete or mistyped links, and so on. However, it is typically not used in web services applications. If the AutoRedirect attribute is set to true and the request is redirected, any value specified in the Referer attribute is overridden. The value of the HTTP Referer property is set to the URL of the service that redirected the consumer's original request.
DecoupledEndpoint	Specifies the URL of a decoupled endpoint for the receipt of responses over a separate provider->consumer connection. For more information on using decoupled endpoints see, "Using the HTTP Transport in Decoupled Mode" on page 68. You must configure both the consumer endpoint and the service provider endpoint to use WS-Addressing for the decoupled endpoint to work.
ProxyServer	Specifies the URL of the proxy server through which requests are routed.
ProxyServerPort	Specifies the port number of the proxy server through which requests are routed.
ProxyServerType	Specifies the type of proxy server used to route requests. Valid values are: - HTTP(default)

Attribute	Description
	• SOCKS

Example

Example 5.3 on page 59 shows the configuration of an HTTP consumer endpoint that wants to keep its connection to the provider open between requests, that will only retransmit requests once per invocation, and that cannot use chunking streams.

Example 5.3. HTTP Consumer Endpoint Configuration

```
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:http-conf="http://cxf.apache.org/transports/http/configuration"
       xsi:schemaLocation="http://cxf.apache.org/transports/http/configuration
                             http://cxf.apache.org/schemas/configuration/http-conf.xsd
                           http://www.springframework.org/schema/beans
                            http://www.springframework.org/schema/beans/spring-beans.xsd">


  <http-conf:conduit name="{http://apache.org/hello_world_soap_http}SoapPort.http-conduit">

    <http-conf:client Connection="Keep-Alive"
                      MaxRetransmits="1"
                      AllowChunking="false" />
  </http-conf:conduit>
</beans>
```

Using WSDL

Namespace

The WSDL extension elements used to configure an HTTP consumer endpoint are defined in the namespace `http://cxf.apache.org/transports/http/configuration`. It is commonly referred to using the prefix http-conf. In order to use the HTTP configuration elements you must add the line shown in Example 5.4 on page 60 to the `definitions` element of your endpoint's WSDL document.

Example 5.4. HTTP Consumer WSDL Element's Namespace

```
<definitions ...
       xmlns:http-conf="http://cxf.apache.org/transports/http/configuration
```

The client element

The `http-conf:client` element is used to specify the connection properties of an HTTP consumer in a WSDL document. The `http-conf:client` element is a child of the WSDL `port` element. It has the same attributes as the `client` element used in the configuration file. The attributes are described in Table 5.2 on page 56.

Example

Example 5.5 on page 60 shows a WSDL fragment that configures an HTTP consumer endpoint to specify that it does not interact with caches.

Example 5.5. WSDL to Configure an HTTP Consumer Endpoint

```
<service ...>
  <port ...>
    <soap:address ... />
    <http-conf:client CacheControl="no-cache" />
  </port>
</service>
```

Consumer Cache Control Directives

Table 5.3 on page 61 lists the cache control directives supported by an HTTP consumer.

Table 5.3. `http-conf:client` Cache Control Directives

Directive	Behavior
no-cache	Caches cannot use a particular response to satisfy subsequent requests without first revalidating that response with the server. If specific response header fields are specified with this value, the restriction applies only to those header fields within the response. If no response header fields are specified, the restriction applies to the entire response.
no-store	Caches must not store either any part of a response or any part of the request that invoked it.
max-age	The consumer can accept a response whose age is no greater than the specified time in seconds.
max-stale	The consumer can accept a response that has exceeded its expiration time. If a value is assigned to max-stale, it represents the number of seconds beyond the expiration time of a response up to which the consumer can still accept that response. If no value is assigned, the consumer can accept a stale response of any age.
min-fresh	The consumer wants a response that is still fresh for at least the specified number of seconds indicated.
no-transform	Caches must not modify media type or location of the content in a response between a provider and a consumer.
only-if-cached	Caches should return only responses that are currently stored in the cache, and not responses that need to be reloaded or revalidated.
cache-extension	Specifies additional extensions to the other cache directives. Extensions can be informational or behavioral. An extended directive is specified in the context of a standard directive, so that applications not understanding the extended directive can adhere to the behavior mandated by the standard directive.

Configuring a Service Provider

HTTP service provider endpoints can specify a number of HTTP connection attributes including if it will honor keep alive requests, how it interacts with caches, and how tolerant it is of errors in communicating with a consumer.

A service provider endpoint can be configured using two mechanisms:

- Configuration
- WSDL

Using Configuration

Namespace

The elements used to configure an HTTP provider endpoint are defined in the namespace `http://cxf.apache.org/transports/http/configuration`. It is commonly referred to using the prefix http-conf. In order to use the HTTP configuration elements you must add the lines shown in Example 5.6 on page 63 to the `beans` element of your endpoint's configuration file. In addition, you must add the configuration elements' namespace to the `xsi:schemaLocation` attribute.

Example 5.6. HTTP Provider Configuration Namespace

```
<beans ...
       xmlns:http-conf="http://cxf.apache.org/transports/http/configuration
       ...
       xsi:schemaLocation="...
                           http://cxf.apache.org/transports/http/configuration
                              http://cxf.apache.org/schemas/configuration/http-conf.xsd
                          ...>
```

The destination element

You configure an HTTP service provider endpoint using the `http-conf:destination` element and its children. The `http-conf:destination` element takes a single attribute, `name`, that specifies the WSDL `port` element that corresponds to the endpoint. The value for the `name` attribute takes the form *`portQName`*`.http-destination`. Example 5.7 on page 63 shows the `http-conf:destination` element that is used to add configuration for an endpoint that is specified by the WSDL fragment <port binding="widgetSOAPBinding" name="widgetSOAPPort> when the endpoint's target namespace is `http://widgets.widgetvendor.net`.

Example 5.7. `http-conf:destination` Element

```
...
  <http-conf:destination name="{http://widgets/widgetvendor.net}widgetSOAPPort.http-destin
ation>
    ...
  </http-conf:destination>
...
```

The `http-conf:destination` element has a number of child elements that specify configuration information. They are described in Table 5.4 on page 64.

Table 5.4. Elements Used to Configure an HTTP Service Provider Endpoint

Element	Description
`http-conf:server`	Specifies the HTTP connection properties. See "The `server` element" on page 64.
`http-conf:contextMatchStrategy`	Specifies the parameters that configure the context match strategy for processing HTTP requests.
`http-conf:fixedParameterOrder`	Specifies whether the parameter order of an HTTP request handled by this destination is fixed.

The server element

The `http-conf:server` element is used to configure the properties of a service provider endpoint's HTTP connection. Its attributes, described in Table 5.5 on page 64, specify the connection's properties.

Table 5.5. HTTP Service Provider Configuration Attributes

Attribute	Description
`ReceiveTimeout`	Sets the length of time, in milliseconds, the service provider attempts to receive a request before the connection times out. The default is `30000`. `0` specifies that the provider will not timeout.
`SuppressClientSendErrors`	Specifies whether exceptions are to be thrown when an error is encountered on receiving a request. The default is `false`; exceptions are thrown on encountering errors.
`SuppressClientReceiveErrors`	Specifies whether exceptions are to be thrown when an error is encountered on sending a response to a consumer. The default is `false`; exceptions are thrown on encountering errors.
`HonorKeepAlive`	Specifies whether the service provider honors requests for a connection to remain open after a response has been sent. The default is `false`; keep-alive requests are ignored.
`RedirectURL`	Specifies the URL to which the client request should be redirected if the URL specified in the client request is no longer appropriate for the requested resource. In this case, if a status code is not automatically set in the first line of the server response, the status code is set to `302` and the status description is set to `Object Moved`. The value is used as the value of the HTTP RedirectURL property.
`CacheControl`	Specifies directives about the behavior that must be adhered to by caches involved in the chain comprising a response from a service provider to a consumer. See "Service Provider Cache Control Directives" on page 67.

Attribute	Description
`ContentLocation`	Sets the URL where the resource being sent in a response is located.
`ContentType`	Specifies the media type of the information being sent in a response. Media types are specified using multipurpose internet mail extensions (MIME) types. The value is used as the value of the HTTP ContentType location.
`ContentEncoding`	Specifies any additional content encodings that have been applied to the information being sent by the service provider. Content encoding labels are regulated by the Internet Assigned Numbers Authority (IANA). Possible content encoding values include `zip`, `gzip`, `compress`, `deflate`, and `identity`. This value is used as the value of the HTTP ContentEncoding property. The primary use of content encodings is to allow documents to be compressed using some encoding mechanism, such as zip or gzip. FUSE Services Framework performs no validation on content codings. It is the user's responsibility to ensure that a specified content coding is supported at application level.
`ServerType`	Specifies what type of server is sending the response. Values take the form *`program-name/version`*; for example, `Apache/1.2.5`.

Example

Example 5.8 on page 65 shows the configuration for an HTTP service provider endpoint that honors keep-alive requests and suppresses all communication errors.

Example 5.8. HTTP Service Provider Endpoint Configuration

```
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:http-conf="http://cxf.apache.org/transports/http/configuration"
       xsi:schemaLocation="http://cxf.apache.org/transports/http/configuration
                             http://cxf.apache.org/schemas/configuration/http-conf.xsd
                           http://www.springframework.org/schema/beans
                            http://www.springframework.org/schema/beans/spring-beans.xsd">


  <http-conf:destination name="{http://apache.org/hello_world_soap_http}SoapPort.http-des
tination">
    <http-conf:server SuppressClientSendErrors="true"
                      SuppressClientReceiveErrors="true"
                      HonorKeepAlive="true" />
  </http-conf:destination>
</beans>
```

Using WSDL

Namespace

The WSDL extension elements used to configure an HTTP provider endpoint are defined in the namespace `http://cxf.apache.org/transports/http/configuration`. It is commonly referred to using the prefix http-conf. To use the HTTP configuration elements you must add the line shown in Example 5.9 on page 66 to the `definitions` element of your endpoint's WSDL document.

Example 5.9. HTTP Provider WSDL Element's Namespace

```
<definitions ...
       xmlns:http-conf="http://cxf.apache.org/transports/http/configuration
```

The server element

The `http-conf:server` element is used to specify the connection properties of an HTTP service provider in a WSDL document. The `http-conf:server` element is a child of the WSDL `port` element. It has the same attributes as the `server` element used in the configuration file. The attributes are described in Table 5.5 on page 64.

Example

Example 5.10 on page 66 shows a WSDL fragment that configures an HTTP service provider endpoint specifying that it will not interact with caches.

Example 5.10. WSDL to Configure an HTTP Service Provider Endpoint

```
<service ...>
  <port ...>
    <soap:address ... />
    <http-conf:server CacheControl="no-cache" />
  </port>
</service>
```

Service Provider Cache Control Directives

Table 5.6 on page 67 lists the cache control directives supported by an HTTP service provider.

Table 5.6. `http-conf:server` Cache Control Directives

Directive	Behavior
no-cache	Caches cannot use a particular response to satisfy subsequent requests without first revalidating that response with the server. If specific response header fields are specified with this value, the restriction applies only to those header fields within the response. If no response header fields are specified, the restriction applies to the entire response.
public	Any cache can store the response.
private	Public (*shared*) caches cannot store the response because the response is intended for a single user. If specific response header fields are specified with this value, the restriction applies only to those header fields within the response. If no response header fields are specified, the restriction applies to the entire response.
no-store	Caches must not store any part of the response or any part of the request that invoked it.
no-transform	Caches must not modify the media type or location of the content in a response between a server and a client.
must-revalidate	Caches must revalidate expired entries that relate to a response before that entry can be used in a subsequent response.
proxy-revalidate	Does the same as must-revalidate, except that it can only be enforced on shared caches and is ignored by private unshared caches. When using this directive, the public cache directive must also be used.
max-age	Clients can accept a response whose age is no greater that the specified number of seconds.
s-max-age	Does the same as max-age, except that it can only be enforced on shared caches and is ignored by private unshared caches. The age specified by s-max-age overrides the age specified by max-age. When using this directive, the proxy-revalidate directive must also be used.
cache-extension	Specifies additional extensions to the other cache directives. Extensions can be informational or behavioral. An extended directive is specified in the context of a standard directive, so that applications not understanding the extended directive can adhere to the behavior mandated by the standard directive.

Using the HTTP Transport in Decoupled Mode

Overview

In normal HTTP request/response scenarios, the request and the response are sent using the same HTTP connection. The service provider processes the request and responds with a response containing the appropriate HTTP status code and the contents of the response. In the case of a successful request, the HTTP status code is set to `200`.

In some instances, such as when using WS-RM or when requests take an extended period of time to execute, it makes sense to decouple the request and response message. In this case the service providers sends the consumer a `202 Accepted` response to the consumer over the back-channel of the HTTP connection on which the request was received. It then processes the request and sends the response back to the consumer using a new decoupled server->client HTTP connection. The consumer runtime receives the incoming response and correlates it with the appropriate request before returning to the application code.

Configuring decoupled interactions

Using the HTTP transport in decoupled mode requires that you do the following:

1. Configure the consumer to use WS-Addressing.

   See "Configuring an endpoint to use WS-Addressing" on page 68.

2. Configure the consumer to use a decoupled endpoint.

   See "Configuring the consumer" on page 69.

3. Configure any service providers that the consumer interacts with to use WS-Addressing.

   See "Configuring an endpoint to use WS-Addressing" on page 68.

Configuring an endpoint to use WS-Addressing

Specify that the consumer and any service provider with which the consumer interacts use WS-Addressing.

You can specify that an endpoint uses WS-Addressing in one of two ways:

- Adding the `wswa:UsingAddressing` element to the endpoint's WSDL `port` element as shown in Example 5.11 on page 69.

Example 5.11. Activating WS-Addressing using WSDL

```
...
<service name="WidgetSOAPService">
  <port name="WidgetSOAPPort" binding="tns:WidgetSOAPBinding">
    <soap:address="http://widgetvendor.net/widgetSeller" />
    <wswa:UsingAddressing xmlns:wswa="http://www.w3.org/2005/02/addressing/wsdl"/>
  </port>
</service>
...
```

- Adding the WS-Addressing policy to the endpoint's WSDL `port` element as shown in Example 5.12 on page 69.

Example 5.12. Activating WS-Addressing using a Policy

```
...
<service name="WidgetSOAPService">
  <port name="WidgetSOAPPort" binding="tns:WidgetSOAPBinding">
    <soap:address="http://widgetvendor.net/widgetSeller" />
    <wsp:Policy xmlns:wsp="http://www.w3.org/2006/07/ws-policy">
      <wsam:Addressing xmlns:wsam="http://www.w3.org/2007/02/addressing/metadata">
        <wsp:Policy/>
      </wsam:Addressing>
    </wsp:Policy>
  </port>
</service>
...
```

Note

The WS-Addressing policy supersedes the `wswa:UsingAddressing` WSDL element.

Configuring the consumer

Configure the consumer endpoint to use a decoupled endpoint using the `DecoupledEndpoint` attribute of the `http-conf:conduit` element.

Example 5.13 on page 70 shows the configuration for setting up the endpoint defined in Example 5.11 on page 69 to use use a decoupled endpoint. The consumer now receives all responses at `http://widgetvendor.net/widgetSellerInbox`.

Example 5.13. Configuring a Consumer to Use a Decoupled HTTP Endpoint

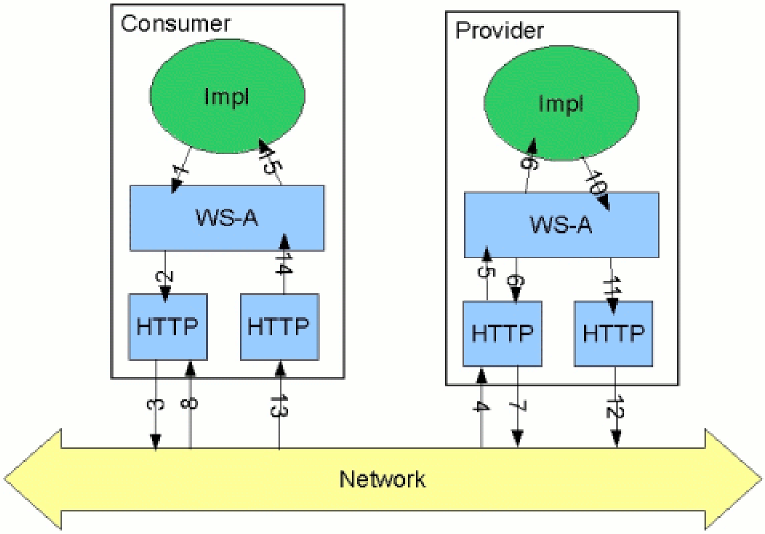
```
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:http="http://cxf.apache.org/transports/http/configuration"
       xsi:schemaLocation="http://cxf.apache.org/transports/http/configuration
                             http://cxf.apache.org/schemas/configuration/http-conf.xsd
                           http://www.springframework.org/schema/beans
                            http://www.springframework.org/schema/beans/spring-beans.xsd">


  <http:conduit name="{http://widgetvendor.net/services}WidgetSOAPPort.http-conduit">
    <http:client DecoupledEndpoint="http://widgetvendor.net:9999/decoupled_endpoint" />
  </http:conduit>
</beans>
```

How messages are processed

Using the HTTP transport in decoupled mode adds extra layers of complexity to the processing of HTTP messages. While the added complexity is transparent to the implementation level code in an application, it might be important to understand what happens for debugging reasons.

Figure 5.1 on page 71 shows the flow of messages when using HTTP in decoupled mode.

Figure 5.1. Message Flow in for a Decoupled HTTP Transport



A request starts the following process:

1. The consumer implementation invokes an operation and a request message is generated.
2. The WS-Addressing layer adds the WS-A headers to the message.

   When a decoupled endpoint is specified in the consumer's configuration, the address of the decoupled endpoint is placed in the WS-A ReplyTo header.
3. The message is sent to the service provider.

4. The service provider receives the message.

5. The request message from the consumer is dispatched to the provider's WS-A layer.

6. Because the WS-A ReplyTo header is not set to anonymous, the provider sends back a message with the HTTP status code set to `202`, acknowledging that the request has been received.

7. The HTTP layer sends a `202 Accepted` message back to the consumer using the original connection's back-channel.

8. The consumer receives the `202 Accepted` reply on the back-channel of the HTTP connection used to send the original message.

   When the consumer receives the `202 Accepted` reply, the HTTP connection closes.

9. The request is passed to the service provider's implementation where the request is processed.

10. When the response is ready, it is dispatched to the WS-A layer.

11. The WS-A layer adds the WS-Addressing headers to the response message.

12. The HTTP transport sends the response to the consumer's decoupled endpoint.

13. The consumer's decoupled endpoint receives the response from the service provider.

14. The response is dispatched to the consumer's WS-A layer where it is correlated to the proper request using the WS-A RelatesTo header.

15. The correlated response is returned to the client implementation and the invoking call is unblocked.

Chapter 6. Configuring the JMS Transport

The FUSE Services Framework JMS transport is highly configurable.

Basic Endpoint Configuration

JMS endpoints need to know certain basic information about how to establish a connection to the proper destination. This information can be provided in one of two places:

- Configuration
- WSDL

Using Configuration

Overview

JMS endpoints are configured using Spring configuration. You can configure the server-side and consumer-side transports independently.

The JMS address information is provided using the `jms:address` element and its child, the `jms:JMSNamingProperties` element. The `jms:address` element's attributes specify the information needed to identify the JMS broker and the destination. The `jms:JMSNamingProperties` element specifies the Java properties used to connect to the JNDI service.

> **Note**
>
> Information in the configuration file will override the information in the endpoint's WSDL file.

Configuration elements

You configure a JMS endpoint using one of the following configuration elements:

`jms:conduit`

The `jms:conduit` element contains the configuration for a consumer endpoint. It has one attribute, `name`, whose value takes the form `{`*`WSDLNamespace`*`}`*`WSDLPortName`*`.jms-conduit`.

`jms:destination`

The `jms:destination` element contains the configuration for a provider endpoint. It has one attribute, `name`, whose value takes the form `{`*`WSDLNamespace`*`}`*`WSDLPortName`*`.jms-destination`.

The address element

JMS connection information is specified by adding a `jms:address` child to the base configuration element. The `jms:address` element uses the attributes described in Table 6.1 on page 76 to configure the connection to the JMS broker.

Table 6.1. JMS Endpoint Attributes

Attribute	Description
`destinationStyle`	Specifies if the JMS destination is a JMS queue or a JMS topic.
`jndiConnectionFactoryName`	Specifies the JNDI name bound to the JMS connection factory to use when connecting to the JMS destination.
`jmsDestinationName`	Specifies the JMS name of the JMS destination to which requests are sent.
`jmsReplyDestinationName`	Specifies the JMS name of the JMS destinations where replies are sent. This attribute allows you to use a user defined destination for replies. For more details see "Using a Named Reply Destination" on page 80.
`jndiDestinationName`	Specifies the JNDI name bound to the JMS destination to which requests are sent.
`jndiReplyDestinationName`	Specifies the JNDI name bound to the JMS destinations where replies are sent. This attribute allows you to use a user defined destination for replies. For more details see "Using a Named Reply Destination" on page 80.
`connectionUserName`	Specifies the user name to use when connecting to a JMS broker.
`connectionPassword`	Specifies the password to use when connecting to a JMS broker.

The JMSNamingProperties element

To increase interoperability with JMS and JNDI providers, the `jms:address` element has a child element, `jms:JMSNamingProperties`, that allows you to specify the values used to populate the properties used when connecting to the JNDI provider. The `jms:JMSNamingProperties` element has two attributes: `name` and `value`. `name` specifies the name of the property to set. `value` attribute specifies the value for the specified property. `jms:JMSNamingProperties` element can also be used for specification of provider specific properties.

The following is a list of common JNDI properties that can be set:

1. `java.naming.factory.initial`
2. `java.naming.provider.url`
3. `java.naming.factory.object`
4. `java.naming.factory.state`

5. `java.naming.factory.url.pkgs`
6. `java.naming.dns.url`
7. `java.naming.authoritative`
8. `java.naming.batchsize`
9. `java.naming.referral`
10. `java.naming.security.protocol`
11. `java.naming.security.authentication`
12. `java.naming.security.principal`
13. `java.naming.security.credentials`
14. `java.naming.language`
15. `java.naming.applet`

For more details on what information to use in these attributes, check your JNDI provider's documentation and consult the Java API reference material.

Example

Example 6.1 on page 77 shows a FUSE Services Framework configuration entry for configuring the addressing information for a JMS consumer endpoint.

Example 6.1. Addressing Information in a FUSE Services Framework Configuration File

```
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:ct="http://cxf.apache.org/configuration/types"
       xmlns:jms="http://cxf.apache.org/transports/jms"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                           http://www.springframework.org/schema/beans/spring-beans.xsd"
                                               http://cxf.apache.org/jaxws ht
tp://cxf.apache.org/schemas/jaxws.xsd
                          http://cxf.apache.org/transports/jms http://cxf.apache.org/schem
as/configuration/jms.xsd">
  <jms:conduit name="{http://cxf.apache.org/jms_endpt}HelloWorldJMSPort.jms-conduit">
    <jms:address destinationStyle="queue"
                 jndiConnectionFactoryName="myConnectionFactory"
                 jndiDestinationName="myDestination"
                 jndiReplyDestinationName="myReplyDestination"
                 connectionUserName="testUser"
                 connectionPassword="testPassword">
      <jms:JMSNamingProperty name="java.naming.factory.initial"
                             value="org.apache.cxf.transport.jms.MyInitialContextFactory"
/>
      <jms:JMSNamingProperty name="java.naming.provider.url"
                             value="tcp://localhost:61616" />
    </jms:address>
  </jms:conduit>
</beans>
```

Using WSDL

Overview

If you prefer to configure your endpoint using WSDL, you can specify JMS endpoints as a part of a WSDL service definition. The `jms:address` element is a child of the WSDL `port` element.

Important

Information in the configuration file will override the information in the endpoint's WSDL file.

The address element

The basic configuration for a JMS endpoint is done by using a `jms:address` element as the child of your service's `port` element. The `jms:address` element used in WSDL is identical to the one used in the configuration file. Its attributes are listed in Table 6.1 on page 76. Like the `jms:address` element in the configuration file, the `jms:address` WSDL element also uses a `jms:JMSNamingProperties` child element to specify additional information needed to connect to a JNDI provider.

Example

Example 6.2 on page 79 shows an example of a JMS WSDL `port` specification.

Example 6.2. JMS WSDL Port Specification

```
<service name="JMSService">
  <port binding="tns:Greeter_SOAPBinding" name="SoapPort">
    <jms:address jndiConnectionFactoryName="ConnectionFactory"
                 jndiDestinationName="dynamicQueues/test.Celtix.jmstransport" >
      <jms:JMSNamingProperty name="java.naming.factory.initial"
                             value="org.activemq.jndi.ActiveMQInitialContextFactory" />
      <jms:JMSNamingProperty name="java.naming.provider.url"
                             value="tcp://localhost:61616" />
    </jms:address>
  </port>
</service>
```

Using a Named Reply Destination

Overview

By default, FUSE Services Framework endpoints using JMS create a temporary queue for sending replies back and forth. If you prefer to use named queues, you can configure the queue used to send replies as part of an endpoint's JMS configuration.

Setting the reply destination name

You specify the reply destination using either the `jmsReplyDestinationName` attribute or the `jndiReplyDestinationName` attribute in the endpoint's JMS configuration. A client endpoint will listen for replies on the specified destination and it will specify the value of the attribute in the `ReplyTo` field of all outgoing requests. A service endpoint will use the value of the `jndiReplyDestinationName` attribute as the location for placing replies if there is no destination specified in the request's `ReplyTo` field.

Example

Example 6.3 on page 80 shows the configuration for a JMS client endpoint.

Example 6.3. JMS Consumer Specification Using a Named Reply Queue

```
<jms:conduit name="{http://cxf.apache.org/jms_endpt}HelloWorldJMSPort.jms-conduit">
    <jms:address destinationStyle="queue"
                 jndiConnectionFactoryName="myConnectionFactory"
                 jndiDestinationName="myDestination"
                 jndiReplyDestinationName="myReplyDestination" >
      <jms:JMSNamingProperty name="java.naming.factory.initial"
                             value="org.apache.cxf.transport.jms.MyInitialContextFactory"
/>
      <jms:JMSNamingProperty name="java.naming.provider.url"
                             value="tcp://localhost:61616" />
    </jms:address>
  </jms:conduit>
```

Consumer Endpoint Configuration

JMS consumer endpoints specify the type of messages they use. JMS consumer endpoint can use either a JMS `ByteMessage` or a JMS `TextMessage`. When using an `ObjectMessage` the consumer endpoint uses a byte[] as the method for storing data into and retrieving data from the JMS message body. When messages are sent, the message data, including any formating information, is packaged into a byte[] and placed into the message body before it is placed on the wire. When messages are received, the consumer endpoint will attempt to unmarshall the data stored in the message body as if it were packed in a byte[].

When using a `TextMessage`, the consumer endpoint uses a string as the method for storing and retrieving data from the message body. When messages are sent, the message information, including any format-specific information, is converted into a string and placed into the JMS message body. When messages are received the consumer endpoint will attempt to unmarshall the data stored in the JMS message body as if it were packed into a string.

When native JMS applications interact with FUSE Services Framework consumers, the JMS application is responsible for interpreting the message and the formatting information. For example, if the FUSE Services Framework contract specifies that the binding used for a JMS endpoint is SOAP, and the messages are packaged as `TextMessage`, the receiving JMS application will get a text message containing all of the SOAP envelope information.

A consumer endpoint can be configured in one of two ways:

- Configuration
- WSDL

Tip

The recommended method is to place the consumer endpoint specific information into the FUSE Services Framework configuration file for the endpoint.

Using Configuration

Specifying the message type

Consumer endpoint configuration is specified using the `jms:conduit` element. Using this configuration element, you specify the message type supported by the consumer endpoint using the `jms:runtimePolicy` child element. The message type is specified using the `messageType` attribute. The `messageType` attribute has two possible values:

Table 6.2. `messageType` Values

`text`	Specifies that the data will be packaged as a `TextMessage`.
`binary`	specifies that the data will be packaged as an `ByteMessage`.

Example

Example 6.4 on page 82 shows a configuration entry for configuring a JMS consumer endpoint.

Example 6.4. Configuration for a JMS Consumer Endpoint

```
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:ct="http://cxf.apache.org/configuration/types"
       xmlns:jms="http://cxf.apache.org/transports/jms"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                            http://www.springframework.org/schema/beans/spring-beans.xsd"

                                              http://cxf.apache.org/jaxws ht
tp://cxf.apache.org/schemas/jaxws.xsd
                         http://cxf.apache.org/transports/jms http://cxf.apache.org/schem
as/configuration/jms.xsd">
   ...
  <jms:conduit name="{http://cxf.apache.org/jms_endpt}HelloWorldJMSPort.jms-conduit">
    <jms:address ... >
                    ...
    </jms:address>
                    ...
    <jms:runtimePolicy messageType="binary"/>
    ...
  </jms:conduit>
  ...
</beans>
```

Using WSDL

Specifying the message type

The type of messages accepted by a JMS consumer endpoint is configured using the optional `jms:client` element. The `jms:client` element is a child of the WSDL `port` element and has one attribute:

Table 6.3. JMS Client WSDL Extensions

`messageType`	Specifies how the message data will be packaged as a JMS message. `text` specifies that the data will be packaged as a `TextMessage`. `binary` specifies that the data will be packaged as an `ByteMessage`.

Example

Example 6.5 on page 83 shows the WSDL for configuring a JMS consumer endpoint.

Example 6.5. WSDL for a JMS Consumer Endpoint

```
<service name="JMSService">
  <port binding="tns:Greeter_SOAPBinding" name="SoapPort">
    <jms:address jndiConnectionFactoryName="ConnectionFactory"
                 jndiDestinationName="dynamicQueues/test.Celtix.jmstransport" >
      <jms:JMSNamingProperty name="java.naming.factory.initial"
                             value="org.activemq.jndi.ActiveMQInitialContextFactory" />
      <jms:JMSNamingProperty name="java.naming.provider.url"
                             value="tcp://localhost:61616" />
    </jms:address>
    <jms:client messageType="binary" />
  </port>
</service>
```

Provider Endpoint Configuration

JMS provider endpoints have a number of behaviors that are configurable. These include:

- how messages are correlated
- the use of durable subscriptions
- if the service uses local JMS transactions
- the message selectors used by the endpoint

Service endpoints can be configure in one of two ways:

- Configuration
- WSDL

Tip

The recommended method is to place the provider endpoint specific information into the FUSE Services Framework configuration file for the endpoint.

Using Configuration

Specifying configuration data

Provider endpoint configuration is specified using the `jms:destination` configuration element. Using this configuration element, you can specify the provider endpoint's behaviors using the `jms:runtimePolicy` element. When configuring a provider endpoint you can use the following `jms:runtimePolicy` attributes:

Table 6.4. Provider Endpoint Configuration

Attribute	Description
`useMessageIDAsCorrealationID`	Specifies whether the JMS broker will use the message ID to correlate messages. The default is `false`.
`durableSubscriberName`	Specifies the name used to register a durable subscription.
`messageSelector`	Specifies the string value of a message selector to use. For more information on the syntax used to specify message selectors, see the JMS 1.1 specification.
`transactional`	Specifies whether the local JMS broker will create transactions around message processing. The default is `false`.[a]

[a] Currently,setting the `transactional` attribute to `true` is not supported by the runtime.

Example

Example 6.6 on page 85 shows a FUSE Services Framework configuration entry for configuring a provider endpoint.

Example 6.6. Configuration for a Provider Endpoint

```
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:ct="http://cxf.apache.org/configuration/types"
       xmlns:jms="http://cxf.apache.org/transports/jms"
       xsi:schemaLocation="http://www.springframework.org/schema/beans
                          http://www.springframework.org/schema/beans/spring-beans.xsd"
                                               http://cxf.apache.org/jaxws ht
tp://cxf.apache.org/schemas/jaxws.xsd
                          http://cxf.apache.org/transports/jms http://cxf.apache.org/schem
as/configuration/jms.xsd">
   ...
  <jms:destination name="{http://cxf.apache.org/jms_endpt}HelloWorldJMSPort.jms-destination">

                    ...
```

```
    <jms:runtimePolicy messageSelector="cxf_message_selector"
                       useMessageIDAsCorrelationID="true"
                       transactional="true"
                       durableSubscriberName="cxf_subscriber" />
    ...
  </jms:destination>
  ...
</beans>
```

Using WSDL

Configuring the endpoint

Provider endpoint behaviors are configured using the optional jms:server element. The jms:server element is a child of the WSDL wsdl:port element and has the following attributes:

Table 6.5. JMS Provider Endpoint WSDL Extensions

Attribute	Description
useMessageIDAsCorrealationID	Specifies whether JMS will use the message ID to correlate messages. The default is false.
durableSubscriberName	Specifies the name used to register a durable subscription.
messageSelector	Specifies the string value of a message selector to use. For more information on the syntax used to specify message selectors, see the JMS 1.1 specification.
transactional	Specifies whether the local JMS broker will create transactions around message processing. The default is false. [a]

[a] Currently,setting the transactional attribute to true is not supported by the runtime.

Example

Example 6.7 on page 87 shows the WSDL for configuring a JMS provider endpoint.

Example 6.7. WSDL for a JMS Provider Endpoint

```
<service name="JMSService">
  <port binding="tns:Greeter_SOAPBinding" name="SoapPort">
    <jms:address jndiConnectionFactoryName="ConnectionFactory"
                 jndiDestinationName="dynamicQueues/test.Celtix.jmstransport" >
      <jms:JMSNamingProperty name="java.naming.factory.initial"
                             value="org.activemq.jndi.ActiveMQInitialContextFactory" />
      <jms:JMSNamingProperty name="java.naming.provider.url"
                             value="tcp://localhost:61616" />
    </jms:address>
    <jms:server messageSelector="cxf_message_selector"
                useMessageIDAsCorrelationID="true"
                transactional="true"
                durableSubscriberName="cxf_subscriber" />
  </port>
</service>
```

JMS Runtime Configuration

In addition to configuring the externally visible aspects of your JMS endpoint, you can also configure aspects of its internal runtime behavior. There are three types of runtime configuration:

- JMS session pool configuration on page 89
- Consumer specific configuration on page 90
- Provider specific configuration on page 91

JMS Session Pool Configuration

Overview

The JMS configuration allows you to specify the number of JMS sessions an endpoint will keep in a pool.

Configuration element

You use the `jms:sessionPool` element to specify the session pool configuration for a JMS endpoint. The `jms:sessionPool` element is a child of both the `jms:conduit` element and the `jms:destination` element.

The `jms:sessionPool` element's attributes, listed in Table 6.6 on page 89, specify the high and low water marks for the endpoint's JMS session pool.

Table 6.6. Attributes for Configuring the JMS Session Pool

Attribute	Description
`lowWaterMark`	Specifies the minimum number of JMS sessions pooled by the endpoint. The default is `20`.
`highWaterMark`	Specifies the maximum number of JMS sessions pooled by the endpoint. The default is `500`.

Example

Example 6.8 on page 89 shows an example of configuring the session pool for a FUSE Services Framework JMS provider endpoint.

Example 6.8. JMS Session Pool Configuration

```
...
<jms:destination name="{http://cxf.apache.org/jms_endpt}HelloWorldJMSPort.jms-destination>

  <jms:address ... >
    ...
  </jms:address>
  ...
  <jms:sessionPool lowWaterMark="10"
                   highWaterMark="5000" />
  ...
</jms:destination>
...
```

Consumer Specific Runtime Configuration

Overview

The JMS consumer configuration allows you to specify two runtime behaviors:

- the number of milliseconds the consumer will wait for a response.
- the number of milliseconds a request will exist before the JMS broker can remove it.

Configuration element

You configure consumer runtime behavior using the `jms:clientConfig` element. The `jms:clientConfig` element is a child of the `jms:conduit` element. It has two attributes that are used to specify the configurable runtime properties of a consumer endpoint.

Configuring the response timeout interval

You specify the interval, in milliseconds, a consumer endpoint will wait for a response before timing out using the `jms:clientConfig` element's `clientReceiveTimeout` attribute. The default timeout interval is 2000.

Configure the request time to live

You specify the interval, in milliseconds, that a request can remain unreceived before the JMS broker can delete it using the `jms:clientConfig` element's `messageTimeToLive` attribute. The default time to live interval is 0 which specifies that the request has an infinite time to live.

Example

Example 6.9 on page 90 shows a configuration fragment that sets the consumer endpoint's request lifetime to 500 milliseconds and its timeout value to 500 milliseconds.

Example 6.9. JMS Consumer Endpoint Runtime Configuration

```
...
<jms:conduit name="{http://cxf.apache.org/jms_endpt}HelloWorldJMSPort.jms-conduit">
  <jms:address ... >
    ...
  </jms:address>
  ...
  <jms:clientConfig clientReceiveTimeout="500"
                    messageTimeToLive="500" />
  ...
</jms:conduit>
...
```

Provider Specific Runtime Configuration

Overview

The provider specific configuration allows you to specify to runtime behaviors:

- the amount of time a response message can remain unreceived before the JMS broker can delete it.
- the client identifier used when creating and accessing durable subscriptions.

Configuration element

You configure provider runtime behavior using the `jms:serverConfig` element. The `jms:serverConfig` element is a child of the `jms:destination` element. It has two attributes that are used to specify the configurable runtime properties of a provider endpoint.

Configuring the response time to live

The `jms:serverConfig` element's `messageTimeToLive` attribute specifies the amount of time, in milliseconds, that a response can remain unread before the JMS broker is allowed to delete it. The default is `0` which specifies that the message can live forever.

Configuring the durable subscriber identifier

The `jms:serverConfig` element's `durableSubscriptionClientId` attribute specifies the client identifier the endpoint uses to create and access durable subscriptions.

Example

Example 6.10 on page 91 shows a configuration fragment that sets the provider endpoint's response lifetime to 500 milliseconds and its durable subscription client identifier to `jms-test-id`.

Example 6.10. Provider Endpoint Runtime Configuration

```
...
<jms:destination name="{http://cxf.apache.org/jms_endpt}HelloWorldJMSPort.jms-destination">

  <jms:address ... >
    ...
  </jms:address>
  ...
  <jms:serverConfig messageTimeToLive="500"
                    durableSubscriptionClientId="jms-test-id" />
  ...
</jms:destination>
...
```

Chapter 7. FUSE Services Framework Logging

This chapter describes how to configure logging in the FUSE Services Framework runtime.

Overview of FUSE Services Framework Logging

Overview

FUSE Services Framework uses the Java logging utility, `java.util.logging`. Logging is configured in a logging configuration file that is written using the standard `java.util.Properties` format. To run logging on an application, you can specify logging programmatically or by defining a property at the command that points to the logging configuration file when you start the application.

Default logging.properties file

FUSE Services Framework comes with a default `logging.properties` file, which is located in your *`InstallDir`*`/etc` directory. This file configures both the output destination for the log messages and the message level that is published. The default configuration sets the loggers to print message flagged with the `WARNING` level to the console. You can either use the default file without changing any of the configuration settings or you can change the configuration settings to suit your specific application.

Logging feature

FUSE Services Framework includes a logging feature that can be plugged into your client or your service to enable logging. Example 7.1 on page 94 shows the configuration to enable the logging feature.

Example 7.1. Configuration for Enabling Logging

```
<jaxws:endpoint...>
  <jaxws:features>
    <bean class="org.apache.cxf.feature.LoggingFeature"/>
  </jaxws:features>
</jaxws:endpoint>
```

For more information, see "Logging Message Content" on page 105.

Where to begin?

To run a simple example of logging follow the instructions outlined in a "Simple Example of Using Logging" on page 96.

For more information on how logging works in FUSE Services Framework, read this entire chapter.

More information on java.util.logging

The `java.util.logging` utility is one of the most widely used Java logging frameworks. There is a lot of information available online that describes how to use and extend this framework. As a starting point, however, the following documents gives a good overview of `java.util.logging`:

- http://java.sun.com/j2se/1.5.0/docs/guide/logging/overview.html
- http://java.sun.com/j2se/1.5.0/docs/api/java/util/logging/package-summary.html

Simple Example of Using Logging

Changing the log levels and output destination

To change the log level and output destination of the log messages in the wsdl_first sample application, complete the following steps:

1. Run the sample server as described in the *Running the demo using java* section of the `README.txt` file in the *`InstallDir`*`/samples/wsdl_first` directory. Note that the **server start** command specifies the default `logging.properties` file, as follows:

Platform	Command
Windows	**`start java -Djava.util.logging.config.file=%CXF_HOME%\etc\logging.properties demo.hw.server.Server`**
UNIX	**`java -Djava.util.logging.config.file=$CXF_HOME/etc/logging.properties demo.hw.server.Server &`**

   The default `logging.properties` file is located in the *`InstallDir`*`/etc` directory. It configures the FUSE Services Framework loggers to print `WARNING` level log messages to the console. As a result, you see very little printed to the console.

2. Stop the server as described in the `README.txt` file.

3. Make a copy of the default `logging.properties` file, name it `mylogging.properties` file, and save it in the same directory as the default `logging.properties` file.

4. Change the global logging level and the console logging levels in your `mylogging.properties` file to `INFO` by editing the following lines of configuration:

```
.level= INFO
java.util.logging.ConsoleHandler.level = INFO
```

5. Restart the server using the following command:

Platform	Command
Windows	`start java -Djava.util.logging.config.file=%CXF_HOME%\etc\mylogging.properties demo.hw.server.Server`
UNIX	`java -Djava.util.logging.config.file=$CXF_HOME/etc/mylogging.properties demo.hw.server.Server &`

Because you configured the global logging and the console logger to log messages of level `INFO`, you see a lot more log messages printed to the console.

Default `logging.properties` File

The default logging configuration file, `logging.properties`, is located in the *`InstallDir`*`/etc` directory. It configures the FUSE Services Framework loggers to print `WARNING` level messages to the console. If this level of logging is suitable for your application, you do not have to make any changes to the file before using it. You can, however, change the level of detail in the log messages. For example, you can change whether log messages are sent to the console, to a file or to both. In addition, you can specify logging at the level of individual packages.

Note

This section discusses the configuration properties that appear in the default `logging.properties` file. There are, however, many other `java.util.logging` configuration properties that you can set. For more information on the `java.util.logging` API, see the `java.util.logging` javadoc at: http://java.sun.com/j2se/1.5/docs/api/java/util/logging/package-summary.html.

Configuring Logging Output

The Java logging utility, `java.util.logging`, uses handler classes to output log messages. Table 7.1 on page 99 shows the handlers that are configured in the default `logging.properties` file.

Table 7.1. Java.util.logging Handler Classes

Handler Class	Outputs to
`ConsoleHandler`	Outputs log messages to the console
`FileHandler`	Outputs log messages to a file

! Important

The handler classes must be on the system classpath in order to be installed by the Java VM when it starts. This is done when you set the FUSE Services Framework environment.

Configuring the console handler

Example 7.2 on page 99 shows the code for configuring the console logger.

Example 7.2. Configuring the Console Handler

```
handlers= java.util.logging.ConsoleHandler
```

The console handler also supports the configuration properties shown in Example 7.3 on page 99.

Example 7.3. Console Handler Properties

```
java.util.logging.ConsoleHandler.level = WARNING ❶
java.util.logging.ConsoleHandler.formatter = java.util.logging.SimpleFormatter ❷
```

The configuration properties shown in Example 7.3 on page 99 can be explained as follows:

❶ The console handler supports a separate log level configuration property. This allows you to limit the log messages printed to the console while the global logging setting can be different (see "Configuring Logging Levels" on page 101). The default setting is `WARNING`.

❷ Specifies the `java.util.logging` formatter class that the console handler class uses to format the log messages. The default setting is the `java.util.logging.SimpleFormatter`.

Configuring the file handler

Example 7.4 on page 100 shows code that configures the file handler.

Example 7.4. Configuring the File Handler

```
handlers= java.util.logging.FileHandler
```

The file handler also supports the configuration properties shown in Example 7.5 on page 100.

Example 7.5. File Handler Configuration Properties

```
java.util.logging.FileHandler.pattern = %h/java%u.log ❶
java.util.logging.FileHandler.limit = 50000 ❷
java.util.logging.FileHandler.count = 1 ❸
java.util.logging.FileHandler.formatter = java.util.logging.XMLFormatter ❹
```

The configuration properties shown in Example 7.5 on page 100 can be explained as follows:

❶ Specifies the location and pattern of the output file. The default setting is your home directory.

❷ Specifies, in bytes, the maximum amount that the logger writes to any one file. The default setting is `50000`. If you set it to zero, there is no limit on the amount that the logger writes to any one file.

❸ Specifies how many output files to cycle through. The default setting is `1`.

❹ Specifies the `java.util.logging` formatter class that the file handler class uses to format the log messages. The default setting is the `java.util.logging.XMLFormatter`.

Configuring both the console handler and the file handler

You can set the logging utility to output log messages to both the console and to a file by specifying the console handler and the file handler, separated by a comma, as shown in Example 7.6 on page 100.

Example 7.6. Configuring Both Console Logging and File Logging

```
handlers= java.util.logging.FileHandler, java.util.logging.ConsoleHandler
```

Configuring Logging Levels

Logging levels

The java.util.logging framework supports the following levels of logging, from the least verbose to the most verbose:

- SEVERE
- WARNING
- INFO
- CONFIG
- FINE
- FINER
- FINEST

Configuring the global logging level

To configure the types of event that are logged across all loggers, configure the global logging level as shown in Example 7.7 on page 101.

Example 7.7. Configuring Global Logging Levels

```
.level= WARNING
```

Configuring logging at an individual package level

The java.util.logging framework supports configuring logging at the level of an individual package. For example, the line of code shown in Example 7.8 on page 101 configures logging at a SEVERE level on classes in the com.xyz.foo package.

Example 7.8. Configuring Logging at the Package Level

```
com.xyz.foo.level = SEVERE
```

Enabling Logging at the Command Line

Overview

You can run the logging utility on an application by defining a `java.util.logging.config.file` property when you start the application. You can either specify the default `logging.properties` file or a `logging.properties` file that is unique to that application.

Specifying the log configuration file on application start-up

To specify logging on application start-up add the flag shown in Example 7.9 on page 102 when starting the application.

Example 7.9. Flag to Start Logging on the Command Line

```
-Djava.util.logging.config.file=myfile
```

Logging for Subsystems and Services

You can use the `com.xyz.foo.level` configuration property described in "Configuring logging at an individual package level" on page 101 to set fine-grained logging for specified FUSE Services Framework logging subsystems.

FUSE Services Framework logging subsystems

Table 7.2 on page 103 shows a list of available FUSE Services Framework logging subsystems.

Table 7.2. FUSE Services Framework Logging Subsystems

Subsystem	Description
`com.iona.cxf.container`	FUSE Services Framework container
`org.apache.cxf.aegis`	Aegis binding
`org.apache.cxf.binding.coloc`	colocated binding
`org.apache.cxf.binding.http`	HTTP binding
`org.apache.cxf.binding.jbi`	JBI binding
`org.apache.cxf.binding.object`	Java Object binding
`org.apache.cxf.binding.soap`	SOAP binding
`org.apache.cxf.binding.xml`	XML binding
`org.apache.cxf.bus`	FUSE Services Framework bus
`org.apache.cxf.configuration`	configuration framework
`org.apache.cxf.endpoint`	server and client endpoints
`org.apache.cxf.interceptor`	interceptors
`org.apache.cxf.jaxws`	Front-end for JAX-WS style message exchange, JAX-WS handler processing, and interceptors relating to JAX-WS and configuration
`org.apache.cxf.jbi`	JBI container integration classes
`org.apache.cxf.jca`	JCA container integration classes
`org.apache.cxf.js`	JavaScript front-end

Subsystem	Description
`org.apache.cxf.transport.http`	HTTP transport
`org.apache.cxf.transport.https`	secure version of HTTP transport, using HTTPS
`org.apache.cxf.transport.jbi`	JBI transport
`org.apache.cxf.transport.jms`	JMS transport
`org.apache.cxf.transport.local`	transport implementation using local file system
`org.apache.cxf.transport.servlet`	HTTP transport and servlet implementation for loading JAX-WS endpoints into a servlet container
`org.apache.cxf.ws.addressing`	WS-Addressing implementation
`org.apache.cxf.ws.policy`	WS-Policy implementation
`org.apache.cxf.ws.rm`	WS-ReliableMessaging (WS-RM) implementation
`org.apache.cxf.ws.security.wss4j`	WSS4J security implementation

Example

The WS-Addressing sample is contained in the *`InstallDir`*`/samples/ws_addressing` directory. Logging is configured in the `logging.properties` file located in that directory. The relevant lines of configuration are shown in Example 7.10 on page 104.

Example 7.10. Configuring Logging for WS-Addressing

```
java.util.logging.ConsoleHandler.formatter = demos.ws_addressing.common.ConciseFormatter
...
org.apache.cxf.ws.addressing.soap.MAPCodec.level = INFO
```

The configuration in Example 7.10 on page 104 enables the snooping of log messages relating to WS-Addressing headers, and displays them to the console in a concise form.

For information on running this sample, see the `README.txt` file located in the *`InstallDir`*`/samples/ws_addressing` directory.

Logging Message Content

You can log the content of the messages that are sent between a service and a consumer. For example, you might want to log the contents of SOAP messages that are being sent between a service and a consumer.

Configuring message content logging

To log the messages that are sent between a service and a consumer, and vice versa, complete the following steps:

1. Add the logging feature to your endpoint's configuration.
2. Add the logging feature to your consumer's configuration.
3. Configure the logging system log `INFO` level messages.

Adding the logging feature to an endpoint

Add the logging feature your endpoint's configuration as shown in Example 7.11 on page 105.

Example 7.11. Adding Logging to Endpoint Configuration

```
<jaxws:endpoint ...>
  <jaxws:features>
    <bean class="org.apache.cxf.feature.LoggingFeature"/>
  </jaxws:features>
</jaxws:endpoint>
```

The example XML shown in Example 7.11 on page 105 enables the logging of SOAP messages.

Adding the logging feature to a consumer

Add the logging feature your client's configuration as shown in Example 7.12 on page 105.

Example 7.12. Adding Logging to Client Configuration

```
<jaxws:client ...>
   <jaxws:features>
      <bean class="org.apache.cxf.feature.LoggingFeature"/>
    </jaxws:features>
</jaxws:client>
```

The example XML shown in Example 7.12 on page 105 enables the logging of SOAP messages.

Set logging to log INFO level messages

Ensure that the `logging.properties` file associated with your service is configured to log `INFO` level messages, as shown in Example 7.13 on page 106.

Example 7.13. Setting the Logging Level to INFO

```
.level= INFO
java.util.logging.ConsoleHandler.level = INFO
```

Logging SOAP messages

To see the logging of SOAP messages modify the wsdl_first sample application located in the *`InstallDir`*`/samples/wsdl_first` directory, as follows:

1. Add the `jaxws:features` element shown in Example 7.14 on page 106 to the `cxf.xml` configuration file located in the wsdl_first sample's directory:

Example 7.14. Endpoint Configuration for Logging SOAP Messages

```
<jaxws:endpoint name="{http://apache.org/hello_world_soap_http}SoapPort"
                createdFromAPI="true">
  <jaxws:properties>
    <entry key="schema-validation-enabled" value="true" />
  </jaxws:properties>
  <jaxws:features>
    <bean class="org.apache.cxf.feature.LoggingFeature"/>
  </jaxws:features>
</jaxws:endpoint>
```

2. The sample uses the default `logging.properties` file, which is located in the *`InstallDir`*`/etc` directory. Make a copy of this file and name it `mylogging.properties`.

3. In the `mylogging.properties` file, change the logging levels to `INFO` by editing the `.level` and the `java.util.logging.ConsoleHandler.level` configuration properties as follows:

```
.level= INFO
java.util.logging.ConsoleHandler.level = INFO
```

4. Start the server using the new configuration settings in both the `cxf.xml` file and the `mylogging.properties` file as follows:

Platform	Command
Windows	**`start java -Djava.util.logging.config.file=%CXF_HOME%\etc\mylogging.properties demo.hw.server.Server`**
UNIX	**`java -Djava.util.logging.config.file=$CXF_HOME/etc/mylogging.properties demo.hw.server.Server &`**

5. Start the hello world client using the following command:

Platform	Command
Windows	**`java -Djava.util.logging.config.file=%CXF_HOME%\etc\mylogging.properties demo.hw.client.Client .\wsdl\hello_world.wsdl`**
UNIX	**`java -Djava.util.logging.config.file=$CXF_HOME/etc/mylogging.properties demo.hw.client.Client ./wsdl/hello_world.wsdl`**

The SOAP messages are logged to the console.

Chapter 8. Deploying WS-Addressing

FUSE Services Framework supports WS-Addressing for JAX-WS applications. This chapter explains how to deploy WS-Addressing in the FUSE Services Framework runtime environment.

Introduction to WS-Addressing

Overview

WS-Addressing is a specification that allows services to communicate addressing information in a transport neutral way. It consists of two parts:

- A structure for communicating a reference to a Web service endpoint
- A set of Message Addressing Properties (MAP) that associate addressing information with a particular message

Supported specifications

FUSE Services Framework supports both the WS-Addressing 2004/08 specification and the WS-Addressing 2005/03 specification.

Further information

For detailed information on WS-Addressing, see the 2004/08 submission at http://www.w3.org/Submission/ws-addressing/.

WS-Addressing Interceptors

Overview

In FUSE Services Framework, WS-Addressing functionality is implemented as interceptors. The FUSE Services Framework runtime uses interceptors to intercept and work with the raw messages that are being sent and received. When a transport receives a message, it creates a message object and sends that message through an interceptor chain. If the WS-Addressing interceptors are added to the application's interceptor chain, any WS-Addressing information included with a message is processed.

WS-Addressing Interceptors

The WS-Addressing implementation consists of two interceptors, as described in Table 8.1 on page 111.

Table 8.1. WS-Addressing Interceptors

Interceptor	Description
`org.apache.cxf.ws.addressing.MAPAggregator`	A logical interceptor responsible for aggregating the Message Addressing Properties (MAPs) for outgoing messages.
`org.apache.cxf.ws.addressing.soap.MAPCodec`	A protocol-specific interceptor responsible for encoding and decoding the Message Addressing Properties (MAPs) as SOAP headers.

Enabling WS-Addressing

Overview

To enable WS-Addressing the WS-Addressing interceptors must be added to the inbound and outbound interceptor chains. This is done in one of the following ways:

- FUSE Services Framework Features
- RMAssertion and WS-Policy Framework
- Using Policy Assertion in a WS-Addressing Feature

Adding WS-Addressing as a Feature

WS-Addressing can be enabled by adding the WS-Addressing feature to the client and the server configuration as shown in Example 8.1 on page 112 and Example 8.2 on page 112 respectively.

Example 8.1. client.xml—Adding WS-Addressing Feature to Client Configuration

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:jaxws="http://cxf.apache.org/jaxws"
       xmlns:wsa="http://cxf.apache.org/ws/addressing"
       xsi:schemaLocation="
       http://www.springframework.org/schema/beans ht
tp://www.springframework.org/schema/beans/spring-beans.xsd">

    <jaxws:client ...>
        <jaxws:features>
            <wsa:addressing/>
        </jaxws:features>
    </jaxws:client>
</beans>
```

Example 8.2. server.xml—Adding WS-Addressing Feature to Server Configuration

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:jaxws="http://cxf.apache.org/jaxws"
       xmlns:wsa="http://cxf.apache.org/ws/addressing"
       xsi:schemaLocation="
```

```
http://www.springframework.org/schema/beans http://www.spring
framework.org/schema/beans/spring-beans.xsd">

    <jaxws:endpoint ...>
        <jaxws:features>
            <wsa:addressing/>
        </jaxws:features>
    </jaxws:endpoint>
</beans>
```

Configuring WS-Addressing Attributes

Overview

The FUSE Services Framework WS-Addressing feature element is defined in the namespace http://cxf.apache.org/ws/addressing. It supports the two attributes described in Table 8.2 on page 114.

Table 8.2. WS-Addressing Attributes

Attribute Name	Value
`allowDuplicates`	A boolean that determines if duplicate MessageIDs are tolerated. The default setting is `true`.
`usingAddressingAdvisory`	A boolean that indicates if the presence of the `UsingAddressing` element in the WSDL is advisory only; that is, its absence does not prevent the encoding of WS-Addressing headers.

Configuring WS-Addressing attributes

Configure WS-Addressing attributes by adding the attribute and the value you want to set it to the WS-Addressing feature in your server or client configuration file. For example, the following configuration extract sets the `allowDublicates` attribute to `false` on the server endpoint:

```
<beans ... xmlns:wsa="http://cxf.apache.org/ws/addressing"
...>
    <jaxws:endpoint ...>
        <jaxws:features>
            <wsa:addressing allowDuplicates="false"/>
        </jaxws:features>
    </jaxws:endpoint>
</beans>
```

Using a WS-Policy assertion embedded in a feature

In Example 8.3 on page 114 an addressing policy assertion to enable non-anonymous responses is embedded in the `policies` element.

Example 8.3. Using the Policies to Configure WS-Addressing

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xmlns:wsa="http://cxf.apache.org/ws/addressing"
        xmlns:wsp="http://www.w3.org/2006/07/ws-policy"
        xmlns:policy="http://cxf.apache.org/policy-config"
        xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-
utility-1.0.xsd"
        xmlns:jaxws="http://cxf.apache.org/jaxws"
        xsi:schemaLocation="
http://www.w3.org/2006/07/ws-policy http://www.w3.org/2006/07/ws-policy.xsd
http://cxf.apache.org/ws/addressing http://cxf.apache.org/schema/ws/addressing.xsd
http://cxf.apache.org/jaxws http://cxf.apache.org/schemas/jaxws.xsd
http://www.springframework.org/schema/beans http://www.springframe
work.org/schema/beans/spring-beans.xsd">

    <jaxws:endpoint name="{http://cxf.apache.org/greeter_control}GreeterPort"
                    createdFromAPI="true">
        <jaxws:features>
            <policy:policies>
                <wsp:Policy xmlns:wsam="http://www.w3.org/2007/02/addressing/metadata">
                    <wsam:Addressing>
                        <wsp:Policy>
                            <wsam:NonAnonymousResponses/>
                        </wsp:Policy>
                    </wsam:Addressing>
                </wsp:Policy>
            <policy:policies>
        </jaxws:features>
    </jaxws:endpoint>
</beans>
```

Chapter 9. Enabling Reliable Messaging

FUSE Services Framework supports WS-Reliable Messaging(WS-RM). This chapter explains how to enable and configure WS-RM in FUSE Services Framework.

Introduction to WS-RM

Overview

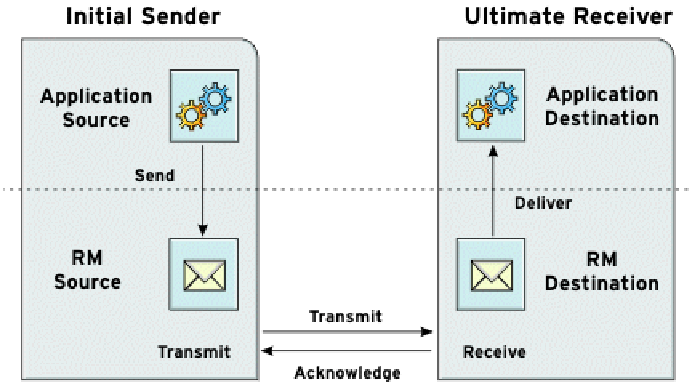
WS-ReliableMessaging (WS-RM) is a protocol that ensures the reliable delivery of messages in a distributed environment. It enables messages to be delivered reliably between distributed applications in the presence of software, system, or network failures.

For example, WS-RM can be used to ensure that the correct messages have been delivered across a network exactly once, and in the correct order.

How WS-RM works

WS-RM ensures the reliable delivery of messages between a source and a destination endpoint. The source is the initial sender of the message and the destination is the ultimate receiver, as shown in Figure 9.1 on page 118.

Figure 9.1. Web Services Reliable Messaging



The flow of WS-RM messages can be described as follows:

1. The RM source sends a `CreateSequence` protocol message to the RM destination. This contains a reference for the endpoint that receives acknowledgements (the `wsrm:AcksTo` endpoint).

2. The RM destination sends a `CreateSequenceResponse` protocol message back to the RM source. This message contains the sequence ID for the RM sequence session.

3. The RM source adds an RM `Sequence` header to each message sent by the application source. This header contains the sequence ID and a unique message ID.
4. The RM source transmits each message to the RM destination.
5. The RM destination acknowledges the receipt of the message from the RM source by sending messages that contain the RM `SequenceAcknowledgement` header.
6. The RM destination delivers the message to the application destination in an exactly-once-in-order fashion.
7. The RM source retransmits a message that it has not yet received an acknowledgement.

   The first retransmission attempt is made after a base retransmission interval. Successive retransmission attempts are made, by default, at exponential back-off intervals or, alternatively, at fixed intervals. For more details, see "Configuring WS-RM" on page 126.

This entire process occurs symmetrically for both the request and the response message; that is, in the case of the response message, the server acts as the RM source and the client acts as the RM destination.

WS-RM delivery assurances

WS-RM guarantees reliable message delivery in a distributed environment, regardless of the transport protocol used. Either the source or the destination endpoint logs an error if reliable delivery can not be assured.

Supported specifications

FUSE Services Framework supports the 2005/02 version of the WS-RM specification, which is based on the WS-Addressing 2004/08 specification.

Further information

For detailed information on WS-RM, see the specification at http://specs.xmlsoap.org/ws/2005/02/rm/ws-reliablemessaging.pdf.

WS-RM Interceptors

Overview

In FUSE Services Framework, WS-RM functionality is implemented as interceptors. The FUSE Services Framework runtime uses interceptors to intercept and work with the raw messages that are being sent and received. When a transport receives a message, it creates a message object and sends that message through an interceptor chain. If the application's interceptor chain includes the WS-RM interceptors, the application can participate in reliable messaging sessions. The WS-RM interceptors handle the collection and aggregation of the message chunks. They also handle all of the acknowledgement and retransmission logic.

FUSE Services Framework WS-RM Interceptors

The FUSE Services Framework WS-RM implementation consists of four interceptors, which are described in Table 9.1 on page 120.

Table 9.1. FUSE Services Framework WS-ReliableMessaging Interceptors

Interceptor	Description
`org.apache.cxf.ws.rm.RMOutInterceptor`	Deals with the logical aspects of providing reliability guarantees for outgoing messages. Responsible for sending the `CreateSequence` requests and waiting for their `CreateSequenceResponse` responses. Also responsible for aggregating the sequence properties—ID and message number—for an application message.
`org.apache.cxf.ws.rm.RMInInterceptor`	Responsible for intercepting and processing RM protocol messages and `SequenceAcknowledgement` messages that are piggybacked on application messages.
`org.apache.cxf.ws.rm.soap.RMSoapInterceptor`	Responsible for encoding and decoding the reliability properties as SOAP headers.

Interceptor	Description
`org.apache.cxf.ws.rm.RetransmissionInterceptor`	Responsible for creating copies of application messages for future resending.

Enabling WS-RM

The presence of the WS-RM interceptors on the interceptor chains ensures that WS-RM protocol messages are exchanged when necessary. For example, when intercepting the first application message on the outbound interceptor chain, the `RMOutInterceptor` sends a `CreateSequence` request and waits to process the original application message until it receives the `CreateSequenceResponse` response. In addition, the WS-RM interceptors add the sequence headers to the application messages and, on the destination side, extract them from the messages. It is not necessary to make any changes to your application code to make the exchange of messages reliable.

For more information on how to enable WS-RM, see "Enabling WS-RM" on page 122.

Configuring WS-RM Attributes

You control sequence demarcation and other aspects of the reliable exchange through configuration. For example, by default FUSE Services Framework attempts to maximize the lifetime of a sequence, thus reducing the overhead incurred by the out-of-band WS-RM protocol messages. To enforce the use of a separate sequence per application message configure the WS-RM source's sequence termination policy (setting the maximum sequence length to `1`).

For more information on configuring WS-RM behavior, see "Configuring WS-RM" on page 126.

Enabling WS-RM

Overview

To enable reliable messaging, the WS-RM interceptors must be added to the interceptor chains for both inbound and outbound messages and faults. Because the WS-RM interceptors use WS-Addressing, the WS-Addressing interceptors must also be present on the interceptor chains.

You can ensure the presence of these interceptors in one of two ways:

- Explicitly, by adding them to the dispatch chains using Spring beans
- Implicitly, using WS-Policy assertions, which cause the FUSE Services Framework runtime to transparently add the interceptors on your behalf.

Spring beans—explicitly adding interceptors

To enable WS-RM add the WS-RM and WS-Addressing interceptors to the FUSE Services Framework bus, or to a consumer or service endpoint using Spring bean configuration. This is the approach taken in the WS-RM sample that is found in the *InstallDir*/samples/ws_rm directory. The configuration file, ws-rm.cxf, shows the WS-RM and WS-Addressing interceptors being added one-by-one as Spring beans (see Example 9.1 on page 122).

Example 9.1. Enabling WS-RM Using Spring Beans

```
<?xml version="1.0" encoding="UTF-8"?>
❶<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xsi:schemaLocation="http://www.springframework.org/schema/
   beans http://www.springframework.org/schema/beans/spring-beans.xsd">
❷   <bean id="mapAggregator" class="org.apache.cxf.ws.addressing.MAPAggregator"/>
   <bean id="mapCodec" class="org.apache.cxf.ws.addressing.soap.MAPCodec"/>
❸   <bean id="rmLogicalOut" class="org.apache.cxf.ws.rm.RMOutInterceptor">
        <property name="bus" ref="cxf"/>
   </bean>
   <bean id="rmLogicalIn" class="org.apache.cxf.ws.rm.RMInInterceptor">
        <property name="bus" ref="cxf"/>
   </bean>
   <bean id="rmCodec" class="org.apache.cxf.ws.rm.soap.RMSoapInterceptor"/>
   <bean id="cxf" class="org.apache.cxf.bus.CXFBusImpl">
❹        <property name="inInterceptors">
            <list>
                <ref bean="mapAggregator"/>
                <ref bean="mapCodec"/>
                <ref bean="rmLogicalIn"/>
                <ref bean="rmCodec"/>
            </list>
        </property>
❺        <property name="inFaultInterceptors">
            <list>
                <ref bean="mapAggregator"/>
                <ref bean="mapCodec"/>
                <ref bean="rmLogicalIn"/>
                <ref bean="rmCodec"/>
            </list>
        </property>
❻        <property name="outInterceptors">
            <list>
                <ref bean="mapAggregator"/>
                <ref bean="mapCodec"/>
                <ref bean="rmLogicalOut"/>
                <ref bean="rmCodec"/>
            </list>
        </property>
❼        <property name="outFaultInterceptors">
            <list>
                <ref bean="mapAggregator">
                <ref bean="mapCodec"/>
                <ref bean="rmLogicalOut"/>
                <ref bean="rmCodec"/>
            </list>
        </property>
    </bean>
</beans>
```

The code shown in Example 9.1 on page 122 can be explained as follows:

❶ A FUSE Services Framework configuration file is a Spring XML file. You must include an opening Spring `beans` element that declares the namespaces and schema files for the child elements that are encapsulated by the `beans` element.

❷ Configures each of the WS-Addressing interceptors—`MAPAggregator` and `MAPCodec`. For more information on WS-Addressing, see "Deploying WS-Addressing" on page 109.

❸ Configures each of the WS-RM interceptors—`RMOutInterceptor`, `RMInInterceptor`, and `RMSoapInterceptor`.

❹ Adds the WS-Addressing and WS-RM interceptors to the interceptor chain for inbound messages.

❺ Adds the WS-Addressing and WS-RM interceptors to the interceptor chain for inbound faults.

❻ Adds the WS-Addressing and WS-RM interceptors to the interceptor chain for outbound messages.

❼ Adds the WS-Addressing and WS-RM interceptors to the interceptor chain for outbound faults.

WS-Policy framework—implicitly adding interceptors

The WS-Policy framework provides the infrastructure and APIs that allow you to use WS-Policy. It is compliant with the November 2006 draft publications of the Web Services Policy 1.5—Framework[1] and Web Services Policy 1.5—Attachment[2] specifications.

To enable WS-RM using the FUSE Services Framework WS-Policy framework, do the following:

1. Add the policy feature to your client and server endpoint. Example 9.2 on page 124 shows a reference bean nested within a `jaxws:feature` element. The reference bean specifies the `AddressingPolicy`, which is defined as a separate element within the same configuration file.

Example 9.2. Configuring WS-RM using WS-Policy

```
<jaxws:client>
    <jaxws:features>
      <ref bean="AddressingPolicy"/>
    </jaxws:features>
</jaxws:client>
<wsp:Policy wsu:Id="AddressingPolicy" xmlns:wsam="http://www.w3.org/2007/02/address
ing/metadata">
    <wsam:Addressing>
      <wsp:Policy>
        <wsam:NonAnonymousResponses/>
      </wsp:Policy>
    </wsam:Addressing>
</wsp:Policy>
```

2. Add a reliable messaging policy to the `wsdl:service` element—or any other WSDL element that can be used as an attachment point for policy or policy reference elements—to your WSDL file, as shown in Example 9.3 on page 125.

[1] http://www.w3.org/TR/2006/WD-ws-policy-20061117/
[2] http://www.w3.org/TR/2006/WD-ws-policy-attach-20061117/

Example 9.3. Adding an RM Policy to Your WSDL File

```
<wsp:Policy wsu:Id="RM"
   xmlns:wsp="http://www.w3.org/2006/07/ws-policy"
   xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-utility-
1.0.xsd">
    <wsam:Addressing xmlns:wsam="http://www.w3.org/2007/02/addressing/metadata">
        <wsp:Policy/>
    </wsam:Addressing>
    <wsrmp:RMAssertion xmlns:wsrmp="http://schemas.xmlsoap.org/ws/2005/02/rm/policy">
        <wsrmp:BaseRetransmissionInterval Milliseconds="10000"/>
    </wsrmp:RMAssertion>
</wsp:Policy>
...
<wsdl:service name="ReliableGreeterService">
    <wsdl:port binding="tns:GreeterSOAPBinding" name="GreeterPort">
        <soap:address location="http://localhost:9020/SoapContext/GreeterPort"/>
        <wsp:PolicyReference URI="#RM" xmlns:wsp="http://www.w3.org/2006/07/ws-policy"/>
    </wsdl:port>
</wsdl:service>
```

Configuring WS-RM

You can configure WS-RM by:

- Setting FUSE Services Framework-specific attributes that are defined in the FUSE Services Framework WS-RM manager namespace, http://cxf.apache.org/ws/rm/manager.
- Setting standard WS-RM policy attributes that are defined in the `http://schemas.xmlsoap.org/ws/2005/02/rm/policy` namespace.

Configuring FUSE Services Framework-Specific WS-RM Attributes

Overview

To configure the FUSE Services Framework-specific attributes, use the `rmManager` Spring bean. Add the following to your configuration file:

- The http://cxf.apache.org/ws/rm/manager namespace to your list of namespaces.
- An `rmManager` Spring bean for the specific attribute that your want to configure.

Example 9.4 on page 127 shows a simple example.

Example 9.4. Configuring FUSE Services Framework-Specific WS-RM Attributes

```
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:wsrm-mgr="http://cxf.apache.org/ws/rm/manager"
     xsi:schemaLocation="http://www.springframework.org/schema/beans http://www.springframe
work.org/schema/beans/spring-beans.xsd
 http://cxf.apache.org/ws/rm/manager http://cxf.apache.org/schemas/configuration/wsrm-man
ager.xsd">
...
<wsrm-mgr:rmManager>
<!--
  ...Your configuration goes here
-->
</wsrm-mgr:rmManager>
```

Children of the rmManager Spring bean

Table 9.2 on page 127 shows the child elements of the `rmManager` Spring bean, defined in the http://cxf.apache.org/ws/rm/manager namespace.

Table 9.2. Children of the rmManager Spring Bean

Element	Description
`RMAssertion`	An element of type RMAssertion
`deliveryAssurance`	An element of type DeliveryAssuranceType that describes the delivery assurance that should apply
`sourcePolicy`	An element of type SourcePolicyType that allows you to configure details of the RM source

Element	Description
`destinationPolicy`	An element of type DestinationPolicyType that allows you to configure details of the RM destination

Example

For an example, see "Maximum unacknowledged messages threshold" on page 135.

Configuring Standard WS-RM Policy Attributes

Overview

You can configure standard WS-RM policy attributes in one of the following ways:

- "RMAssertion in rmManager Spring bean"
- "Policy within a feature"
- "WSDL file"
- "External attachment"

WS-Policy RMAssertion Children

Table 9.3 on page 129 shows the elements defined in the http://schemas.xmlsoap.org/ws/2005/02/rm/policy namespace:

Table 9.3. Children of the WS-Policy RMAssertion Element

Name	Description
`InactivityTimeout`	Specifies the amount of time that must pass without receiving a message before an endpoint can consider an RM sequence to have been terminated due to inactivity.
`BaseRetransmissionInterval`	Sets the interval within which an acknowledgement must be received by the RM Source for a given message. If an acknowledgement is not received within the time set by the `BaseRetransmissionInterval`, the RM Source will retransmit the message.
`ExponentialBackoff`	Indicates the retransmission interval will be adjusted using the commonly known exponential backoff algorithm (Tanenbaum). For more information, see *Computer Networks*, Andrew S. Tanenbaum, Prentice Hall PTR, 2003.
`AcknowledgementInterval`	In WS-RM, acknowledgements are sent on return messages or sent stand-alone. If a return message is not available to send an acknowledgement, an RM Destination can wait for up to the acknowledgement interval before sending a

Name	Description
	stand-alone acknowledgement. If there are no unacknowledged messages, the RM Destination can choose not to send an acknowledgement.

More detailed reference information

For more detailed reference information, including descriptions of each element's sub-elements and attributes, please refer to http://schemas.xmlsoap.org/ws/2005/02/rm/wsrm-policy.xsd.

RMAssertion in rmManager Spring bean

You can configure standard WS-RM policy attributes by adding an RMAssertion within a FUSE Services Framework rmManager Spring bean. This is the best approach if you want to keep all of your WS-RM configuration in the same configuration file; that is, if you want to configure FUSE Services Framework-specific attributes and standard WS-RM policy attributes in the same file.

For example, the configuration in Example 9.5 on page 130 shows:

- A standard WS-RM policy attribute, BaseRetransmissionInterval, configured using an RMAssertion within an rmManager Spring bean.
- An FUSE Services Framework-specific RM attribute, intraMessageThreshold, configured in the same configuration file.

Example 9.5. Configuring WS-RM Attributes Using an RMAssertion in an rmManager Spring Bean

```
<beans xmlns:wsrm-policy="http://schemas.xmlsoap.org/ws/2005/02/rm/policy"
       xmlns:wsrm-mgr="http://cxf.apache.org/ws/rm/manager"
...>
<wsrm-mgr:rmManager id="org.apache.cxf.ws.rm.RMManager">
    <wsrm-policy:RMAssertion>
        <wsrm-policy:BaseRetransmissionInterval Milliseconds="4000"/>
    </wsrm-policy:RMAssertion>
    <wsrm-mgr:destinationPolicy>
        <wsrm-mgr:acksPolicy intraMessageThreshold="0" />
    </wsrm-mgr:destinationPolicy>
</wsrm-mgr:rmManager>
</beans>
```

Policy within a feature

You can configure standard WS-RM policy attributes within features, as shown in Example 9.6 on page 131.

Example 9.6. Configuring WS-RM Attributes as a Policy within a Feature

```
<xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xmlns:wsa="http://cxf.apache.org/ws/addressing"
        xmlns:wsp="http://www.w3.org/2006/07/ws-policy"
        xmlns:wsu="http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-
utility-1.0.xsd"
        xmlns:jaxws="http://cxf.apache.org/jaxws"
        xsi:schemaLocation="
http://www.w3.org/2006/07/ws-policy http://www.w3.org/2006/07/ws-policy.xsd
http://cxf.apache.org/ws/addressing http://cxf.apache.org/schema/ws/addressing.xsd
http://cxf.apache.org/jaxws http://cxf.apache.org/schemas/jaxws.xsd
http://www.springframework.org/schema/beans http://www.springframe
work.org/schema/beans/spring-beans.xsd">
    <jaxws:endpoint name="{http://cxf.apache.org/greeter_control}GreeterPort" created
FromAPI="true">
        <jaxws:features>
               <wsp:Policy>
                   <wsrm:RMAssertion xmlns:wsrm="http://schem
as.xmlsoap.org/ws/2005/02/rm/policy">
                     <wsrm:AcknowledgementInterval Milliseconds="200" />
                   </wsrm:RMAssertion>
                   <wsam:Addressing xmlns:wsam="http://www.w3.org/2007/02/address
ing/metadata">
                       <wsp:Policy>
                            <wsam:NonAnonymousResponses/>
                       </wsp:Policy>
                   </wsam:Addressing>
              </wsp:Policy>
        </jaxws:features>
    </jaxws:endpoint>
</beans>
```

WSDL file

If you use the WS-Policy framework to enable WS-RM, you can configure standard WS-RM policy attributes in a WSDL file. This is a good approach if you want your service to interoperate and use WS-RM seamlessly with consumers deployed to other policy-aware Web services stacks.

For an example, see "WS-Policy framework—implicitly adding interceptors" on page 124 where the base retransmission interval is configured in the WSDL file.

External attachment

You can configure standard WS-RM policy attributes in an external attachment file. This is a good approach if you cannot, or do not want to, change your WSDL file.

Example 9.7 on page 132 shows an external attachment that enables both WS-A and WS-RM (base retransmission interval of 30 seconds) for a specific EPR.

Example 9.7. Configuring WS-RM in an External Attachment

```
<attachments xmlns:wsp="http://www.w3.org/2006/07/ws-policy" xmlns:wsa="ht
tp://www.w3.org/2005/08/addressing">
    <wsp:PolicyAttachment>
        <wsp:AppliesTo>
           <wsa:EndpointReference>
                <wsa:Address>http://localhost:9020/SoapContext/GreeterPort</wsa:Address>
            </wsa:EndpointReference>
        </wsp:AppliesTo>
        <wsp:Policy>
            <wsam:Addressing xmlns:wsam="http://www.w3.org/2007/02/addressing/metadata">
                <wsp:Policy/>
            </wsam:Addressing>
          <wsrmp:RMAssertion xmlns:wsrmp="http://schemas.xmlsoap.org/ws/2005/02/rm/policy">

                <wsrmp:BaseRetransmissionInterval Milliseconds="30000"/>
            </wsrmp:RMAssertion>
        </wsp:Policy>
    </wsp:PolicyAttachment>
</attachments>/
```

WS-RM Configuration Use Cases

Overview

This subsection focuses on configuring WS-RM attributes from a use case point of view. Where an attribute is a standard WS-RM policy attribute, defined in the http://schemas.xmlsoap.org/ws/2005/02/rm/policy namespace, only the example of setting it in an `RMAssertion` within an `rmManager` Spring bean is shown. For details of how to set such attributes as a policy within a feature; in a WSDL file, or in an external attachment, see "Configuring Standard WS-RM Policy Attributes" on page 129.

The following use cases are covered:

- "Base retransmission interval"
- "Exponential backoff for retransmission"
- "Acknowledgement interval"
- "Maximum unacknowledged messages threshold"
- "Maximum length of an RM sequence"
- "Message delivery assurance policies"

Base retransmission interval

The `BaseRetransmissionInterval` element specifies the interval at which an RM source retransmits a message that has not yet been acknowledged. It is defined in the http://schemas.xmlsoap.org/ws/2005/02/rm/wsrm-policy.xsd schema file. The default value is 3000 milliseconds.

Example 9.8 on page 133 shows how to set the WS-RM base retransmission interval.

Example 9.8. Setting the WS-RM Base Retransmission Interval

```
<beans xmlns:wsrm-policy="http://schemas.xmlsoap.org/ws/2005/02/rm/policy
...>
<wsrm-mgr:rmManager id="org.apache.cxf.ws.rm.RMManager">
    <wsrm-policy:RMAssertion>
        <wsrm-policy:BaseRetransmissionInterval Milliseconds="4000"/>
    </wsrm-policy:RMAssertion>
```

```
</wsrm-mgr:rmManager>
</beans>
```

Exponential backoff for retransmission

The `ExponentialBackoff` element determines if successive retransmission attempts for an unacknowledged message are performed at exponential intervals.

The presence of the `ExponentialBackoff` element enables this feature. An exponential backoff ratio of `2` is used by default.

Example 9.9 on page 134 shows how to set the WS-RM exponential backoff for retransmission.

Example 9.9. Setting the WS-RM Exponential Backoff Property

```
<beans xmlns:wsrm-policy="http://schemas.xmlsoap.org/ws/2005/02/rm/policy
...>
<wsrm-mgr:rmManager id="org.apache.cxf.ws.rm.RMManager">
    <wsrm-policy:RMAssertion>
        <wsrm-policy:ExponentialBackoff="4"/>
    </wsrm-policy:RMAssertion>
</wsrm-mgr:rmManager>
</beans>
```

Acknowledgement interval

The `AcknowledgementInterval` element specifies the interval at which the WS-RM destination sends asynchronous acknowledgements. These are in addition to the synchronous acknowledgements that it sends on receipt of an incoming message. The default asynchronous acknowledgement interval is `0` milliseconds. This means that if the `AcknowledgementInterval` is not configured to a specific value, acknowledgements are sent immediately (that is, at the first available opportunity).

Asynchronous acknowledgements are sent by the RM destination only if both of the following conditions are met:

- The RM destination is using a non-anonymous `wsrm:acksTo` endpoint.
- The opportunity to piggyback an acknowledgement on a response message does not occur before the expiry of the acknowledgement interval.

Example 9.10 on page 135 shows how to set the WS-RM acknowledgement interval.

Example 9.10. Setting the WS-RM Acknowledgement Interval

```
<beans xmlns:wsrm-policy="http://schemas.xmlsoap.org/ws/2005/02/rm/policy
...>
<wsrm-mgr:rmManager id="org.apache.cxf.ws.rm.RMManager">
    <wsrm-policy:RMAssertion>
        <wsrm-policy:AcknowledgementInterval Milliseconds="2000"/>
    </wsrm-policy:RMAssertion>
</wsrm-mgr:rmManager>
</beans>
```

Maximum unacknowledged messages threshold

The `maxUnacknowledged` attribute sets the maximum number of unacknowledged messages that can accrue per sequence before the sequence is terminated.

Example 9.11 on page 135 shows how to set the WS-RM maximum unacknowledged messages threshold.

Example 9.11. Setting the WS-RM Maximum Unacknowledged Message Threshold

```
<beans xmlns:wsrm-mgr="http://cxf.apache.org/ws/rm/manager
...>
<wsrm-mgr:reliableMessaging>
    <wsrm-mgr:sourcePolicy>
        <wsrm-mgr:sequenceTerminationPolicy maxUnacknowledged="20" />
    </wsrm-mgr:sourcePolicy>
</wsrm-mgr:reliableMessaging>
</beans>
```

Maximum length of an RM sequence

The `maxLength` attribute sets the maximum length of a WS-RM sequence. The default value is `0`, which means that the length of a WS-RM sequence is unbound.

When this attribute is set, the RM endpoint creates a new RM sequence when the limit is reached, and after receiving all of the acknowledgements for the previously sent messages. The new message is sent using a newsequence.

Example 9.12 on page 135 shows how to set the maximum length of an RM sequence.

Example 9.12. Setting the Maximum Length of a WS-RM Message Sequence

```
<beans xmlns:wsrm-mgr="http://cxf.apache.org/ws/rm/manager
...>
```

```
<wsrm-mgr:reliableMessaging>
    <wsrm-mgr:sourcePolicy>
        <wsrm-mgr:sequenceTerminationPolicy maxLength="100" />
    </wsrm-mgr:sourcePolicy>
</wsrm-mgr:reliableMessaging>
</beans>
```

Message delivery assurance policies

You can configure the RM destination to use the following delivery assurance policies:

- `AtMostOnce` — The RM destination delivers the messages to the application destination only once. If a message is delivered more than once an error is raised. It is possible that some messages in a sequence may not be delivered.

- `AtLeastOnce` — The RM destination delivers the messages to the application destination at least once. Every message sent will be delivered or an error will be raised. Some messages might be delivered more than once.

- `InOrder` — The RM destination delivers the messages to the application destination in the order that they are sent. This delivery assurance can be combined with the `AtMostOnce` or `AtLeastOnce` assurances.

Example 9.13 on page 136 shows how to set the WS-RM message delivery assurance.

Example 9.13. Setting the WS-RM Message Delivery Assurance Policy

```
<beans xmlns:wsrm-mgr="http://cxf.apache.org/ws/rm/manager
...>
<wsrm-mgr:reliableMessaging>
    <wsrm-mgr:deliveryAssurance>
        <wsrm-mgr:AtLeastOnce />
    </wsrm-mgr:deliveryAssurance>
</wsrm-mgr:reliableMessaging>
</beans>
```

Configuring WS-RM Persistence

Overview

The FUSE Services Framework WS-RM features already described in this chapter provide reliability for cases such as network failures. WS-RM persistence provides reliability across other types of failure such as an RM source or an RM destination crash.

WS-RM persistence involves storing the state of the various RM endpoints in persistent storage. This enables the endpoints to continue sending and receiving messages when they are reincarnated.

FUSE Services Framework enables WS-RM persistence in a configuration file. The default WS-RM persistence store is JDBC-based. For convenience, FUSE Services Framework includes Derby for out-of-the-box deployment. In addition, the persistent store is also exposed using a Java API.

Important

WS-RM persistence is supported for oneway calls only, and it is disabled by default.

How it works

FUSE Services Framework WS-RM persistence works as follows:

- At the RM source endpoint, an outgoing message is persisted before transmission. It is evicted from the persistent store after the acknowledgement is received.
- After a recovery from crash, it recovers the persisted messages and retransmits until all the messages have been acknowledged. At that point, the RM sequence is closed.
- At the RM destination endpoint, an incoming message is persisted, and upon a successful store, the acknowledgement is sent. When a message is successfully dispatched, it is evicted from the persistent store.

- After a recovery from a crash, it recovers the persisted messages and dispatches them. It also brings the RM sequence to a state where new messages are accepted, acknowledged, and delivered.

Enabling WS-persistence

To enable WS-RM persistence, you must specify the object implementing the persistent store for WS-RM. You can develop your own or you can use the JDBC based store that comes with FUSE Services Framework.

The configuration shown in Example 9.14 on page 138 enables the JDBC-based store that comes with FUSE Services Framework.

Example 9.14. Configuration for the Default WS-RM Persistence Store

```
<bean id="RMTxStore" class="org.apache.cxf.ws.rm.persistence.jdbc.RMTxStore"/>
<wsrm-mgr:rmManager id="org.apache.cxf.ws.rm.RMManager">
    <property name="store" ref="RMTxStore"/>
</wsrm-mgr:rmManager>
```

Configuring WS-persistence

The JDBC-based store that comes with FUSE Services Framework supports the properties shown in Table 9.4 on page 138.

Table 9.4. JDBC Store Properties

Attribute Name	Type	Default Setting
driverClassName	String	`org.apache.derby.jdbc.EmbeddedDriver`
userName	String	null
passWord	String	null
url	String	`jdbc:derby:rmdb;create=true`

The configuration shown in Example 9.15 on page 138 enables the JDBC-based store that comes with FUSE Services Framework, while setting the driverClassName and url to non-default values.

Example 9.15. Configuring the JDBC Store for WS-RM Persistence

```
<bean id="RMTxStore" class="org.apache.cxf.ws.rm.persistence.jdbc.RMTxStore">
    <property name="driverClassName" value="com.acme.jdbc.Driver"/>
    <property name="url" value="jdbc:acme:rmdb;create=true"/>
</bean>
```

Chapter 10. Enabling High Availability

This chapter explains how to enable and configure high availability in the FUSE Services Framework runtime.

Introduction to High Availability

Overview

Scalable and reliable applications require high availability to avoid any single point of failure in a distributed system. You can protect your system from single points of failure using *replicated services*.

A replicated service is comprised of multiple instances, or *replicas*, of the same service. Together these act as a single logical service. Clients invoke requests on the replicated service, and FUSE Services Framework delivers the requests to one of the member replicas. The routing to a replica is transparent to the client.

HA with static failover

FUSE Services Framework supports high availability (HA) with static failover in which replica details are encoded in the service WSDL file. The WSDL file contains multiple ports, and can contain multiple hosts, for the same service. The number of replicas in the cluster remains static as long as the WSDL file remains unchanged. Changing the cluster size involves editing the WSDL file.

Enabling HA with Static Failover

Overview

To enable HA with static failover, you must do the following:

1. "Encode replica details in your service WSDL file"
2. "Add the clustering feature to your client configuration"

Encode replica details in your service WSDL file

You must encode the details of the replicas in your cluster in your service WSDL file. Example 10.1 on page 141 shows a WSDL file extract that defines a service cluster of three replicas.

Example 10.1. Enabling HA with Static Failover—WSDL File

```
❶<wsdl:service name="ClusteredService">
❷    <wsdl:port binding="tns:Greeter_SOAPBinding" name="Replica1">
        <soap:address location="http://localhost:9001/SoapContext/Replica1"/>
    </wsdl:port>

❸    <wsdl:port binding="tns:Greeter_SOAPBinding" name="Replica2">
        <soap:address location="http://localhost:9002/SoapContext/Replica2"/>
    </wsdl:port>

❹    <wsdl:port binding="tns:Greeter_SOAPBinding" name="Replica3">
        <soap:address location="http://localhost:9003/SoapContext/Replica3"/>
    </wsdl:port>

</wsdl:service>
```

The WSDL extract shown in Example 10.1 on page 141 can be explained as follows:

❶ Defines a service, `ClusterService`, which is exposed on three ports:

1. `Replica1`
2. `Replica2`
3. `Replica3`

❷ Defines `Replica1` to expose the `ClusterService` as a SOAP over HTTP endpoint on port `9001`.

❸ Defines `Replica2` to expose the `ClusterService` as a SOAP over HTTP endpoint on port `9002`.

❹ Defines `Replica3` to expose the `ClusterService` as a SOAP over HTTP endpoint on port `9003`.

Add the clustering feature to your client configuration

In your client configuration file, add the clustering feature as shown in Example 10.2 on page 142.

Example 10.2. Enabling HA with Static Failover—Client Configuration

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://www.springframework.org/schema/beans"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xmlns:jaxws="http://cxf.apache.org/jaxws"
       xmlns:clustering="http://cxf.apache.org/clustering"
         xsi:schemaLocation="http://cxf.apache.org/jaxws
         http://cxf.apache.org/schemas/jaxws.xsd
         http://www.springframework.org/schema/beans
         http://www.springframework.org/schema/beans/spring-beans.xsd">

    <jaxws:client name="{http://apache.org/hello_world_soap_http}Replica1"
                  createdFromAPI="true">
        <jaxws:features>
            <clustering:failover/>
        </jaxws:features>
    </jaxws:client>

    <jaxws:client name="{http://apache.org/hello_world_soap_http}Replica2"
                  createdFromAPI="true">
        <jaxws:features>
            <clustering:failover/>
        </jaxws:features>
    </jaxws:client>

    <jaxws:client name="{http://apache.org/hello_world_soap_http}Replica3"
                  createdFromAPI="true">
        <jaxws:features>
            <clustering:failover/>
        </jaxws:features>
    </jaxws:client>

</beans>
```

Configuring HA with Static Failover

Overview

By default, HA with static failover uses a sequential strategy when selecting a replica service if the original service with which a client is communicating becomes unavailable, or fails. The sequential strategy selects a replica service in the same sequential order every time it is used. Selection is determined by FUSE Services Framework's internal service model and results in a deterministic failover pattern.

Configuring a random strategy

You can configure HA with static failover to use a random strategy instead of the sequential strategy when selecting a replica. The random strategy selects a random replica service each time a service becomes unavailable, or fails. The choice of failover target from the surviving members in a cluster is entirely random.

To configure the random strategy, add the configuration shown in Example 10.3 on page 143 to your client configuration file.

Example 10.3. Configuring a Random Strategy for Static Failover

```
<beans ...>
❶    <bean id="Random" class="org.apache.cxf.clustering.RandomStrategy"/>

    <jaxws:client name="{http://apache.org/hello_world_soap_http}Replica3"
                  createdFromAPI="true">
        <jaxws:features>
            <clustering:failover>
❶               <clustering:strategy>
                    <ref bean="Random"/>
                </clustering:strategy>
            </clustering:failover>
        </jaxws:features>
    </jaxws:client>
</beans>
```

The configuration shown in Example 10.3 on page 143 can be explained as follows:

❶ Defines a `Random` bean and implementation class that implements the random strategy.

❷ Specifies that the random strategy is used when selecting a replica.

Part III. Packaging and Deploying Applications

FUSE Services Framework applications are packaged into OSGi bundles for deployment into the FUSE ESB runtime. Once an application is packaged it can easily be deployed into the FUSE ESB runtime. Applications deployed in FUSE ESB are easily managed and updated.

Chapter 11. Packaging an Application

Applications must be packed as an OSGi bundle before they can be deployed into FUSE ESB. You will not need to include any FUSE Services Framework specific packages in your bundle. The FUSE Services Framework packages are included in FUSE ESB. You need to ensure you import the required packages when building your bundle.

Creating a bundle

To deploy a FUSE Services Framework application into FUSE ESB, you need to package it as an OSGi bundle. There are several tools available for assisting in the process. FUSE ESB uses the Maven bundle plug-in whose use is described in Appendix A on page 149.

Required bundle

The FUSE Services Framework runtime components are included in FUSE ESB as an OSGi bundle called `org.apache.cxf.cxf-bundle`. This bundle needs to be installed in the FUSE ESB container before your application's bundle can be started.

To inform the container of this dependency, you use the OSGi manifest's Required-Bundle property.

Required packages

In order for your application to use the FUSE Services Framework components, you need to import their packages into the application's bundle. Because of the complex nature of the dependencies in FUSE Services Framework, you cannot rely on the Maven bundle plug-in, or the **bnd** tool, to automatically determine the needed imports. You will need to explicitly declare them.

You need to import the following packages into your bundle:

- `javax.jws`
- `javax.wsdl`
- `META-INF.cxf`
- `META-INF.cxf.osgi`
- `org.apache.cxf.bus`
- `org.apache.cxf.bus.spring`

- org.apache.cxf.bus.resource
- org.apache.cxf.configuration.spring
- org.apache.cxf.resource
- org.apache.servicemix.cxf.transport.http_osgi
- org.springframework.beans.factory.config

Example

Example 11.1 on page 148 shows a manifest for a FUSE Services Framework application's OSGi bundle.

Example 11.1. FUSE Services Framework Application Manifest

```
Manifest-Version: 1.0
Built-By: FinnMcCumial
Created-By: Apache Maven Bundle Plugin
Bundle-License: http://www.apache.org/licenses/LICENSE-2.0.txt
Import-Package: javax.jws,javax.wsdl,META-INF.cxf,META-
INF.cxf.osgi,
org.apache.cxf.bus,org.apache.cxf.bus.spring,org.apache.bus.re
source,
org.apache.cxf.configuration.spring, org.apache.cxf.resource,
org.apache.servicemix.cxf.transport.http_cxf,
org.springframework.beans.factory.config
Bnd-LastModified: 1222079507224
Bundle-Version: 4.0.0.fuse
Bundle-Name: FUSE CXF Example
Bundle-Description: This is a sample CXF manifest.
Build-Jdk: 1.5.0_08
Private-Package: org.apache.servicemix.examples.cxf
Required-Bundle: org.apache.cxf.cxf-bundle
Bundle-ManifestVersion: 2
Bundle-SymbolicName: cxf-wsdl-first-osgi
Tool: Bnd-0.0.255
```

Appendix A. Using the Maven OSGi Tooling

Manually creating a bundle, or a collection of bundles, for a large project can be cumbersome. The Maven bundle plug-in makes the job easier by automating the process and providing a number of shortcuts for specifying the contents of the bundle manifest.

The FUSE ESB OSGi tooling uses the Maven bundle plug-in[1] from Apache Felix. The bundle plug-in is based on the **bnd**[2] tool from Peter Kriens. It automates the construction of OSGi bundle manifests by introspecting the contents of the classes being packaged in the bundle. Using the knowledge of the classes contained in the bundle, the plug-in can calculate the proper values to populate the Import-Packages and the Export-Package properties in the bundle manifest. The plug-in also has default values that are used for other required properties in the bundle manifest.

To use the bundle plug-in you will need to do the following:

1. Add the bundle plug-in to your project's POM file.

2. Configure the plug-in to correctly populate your bundle's manifest.

[1] http://cwiki.apache.org/FELIX/apache-felix-maven-bundle-plugin-bnd.html

[2] http://www.aqute.biz/Code/Bnd

Setting Up a FUSE ESB OSGi Project

Overview

A Maven project for building an OSGi bundle can be a simple single level project. It does not require any sub-projects. It does, however, require that you do the following:

1. Add the bundle plug-in to your POM.
2. Instruct Maven to package the results as an OSGi bundle.

Tip

There are several Maven archetypes to set up your project with the appropriate settings.

Directory structure

A project that constructs an OSGi bundle can be a single level project. It only requires that you have a top-level POM file and a `src` folder. As in all Maven projects, you place all Java source code in the `src/java` folder. You place any non-Java resources into the `src/resources` folder.

Non-Java resources include Spring configuration files, JBI endpoint configuration files, WSDL contracts, etc.

Note

FUSE ESB OSGi projects that use FUSE Services Framework, FUSE Mediation Router, or another Spring configured bean also include a `beans.xml` file located in the `src/resources/META-INF/spring` folder.

Adding a bundle plug-in

Before you can use the bundle plug-in you must add a dependency on Apache Felix. After you add the dependency, you can add the bundle plug-in to the plug-in portion of the POM.

Example A.1 on page 151 shows the POM entries required to add the bundle plug-in to your project.

Example A.1. Adding an OSGi Bundle Plug-in to a POM

```
...
<dependencies>
  <dependency> ❶
    <groupId>org.apache.felix</groupId>
    <artifactId>org.osgi.core</artifactId>
    <version>1.0.0</version>
  </dependency>
...
</dependencies>
...
<build>
  <plugins>
    <plugin> ❷
      <groupId>org.apache.felix</groupId>
      <artifactId>maven-bundle-plugin</artifactId>
      <configuration>
        <instructions>
          <Bundle-SymbolicName>${pom.artifactId}</Bundle-SymbolicName> ❸
          <Import-Package>*,org.apache.camel.osgi</Import-Package> ❹
          <Private-Package>org.apache.servicemix.examples.camel</Private-Package> ❺
        </instructions>
      </configuration>
    </plugin>
  </plugins>
</build>
...
```

The entries in Example A.1 on page 151 do the following:

❶ Adds the dependency on Apache Felix.

❷ Adds the bundle plug-in to your project.

❸ Configures the plug-in to use the project's artifact ID as the bundle's symbolic name.

❹ Configures the plug-in to include all Java packages imported by the bundled classes and also import the `org.apache.camel.osgi` package.

❺ Configures the plug-in to bundle the listed class, but not include them in the list of exported packages.

Note

You should edit the configuration to meet the requirements of your project.

For more information on configuring the bundle plug-in, see "Configuring a Bundle Plug-in" on page 155.

Activating a bundle plug-in

To instruct Maven to use the bundle plug-in, you instruct it to package the results of the project as a bundle. You do this by setting the POM file's `packaging` element to `bundle`.

Useful Maven archetypes

There are several Maven archetypes to generate a project that is preconfigured to use the bundle plug-in:

- "Spring OSGi archetype"
- "FUSE Services Framework code-first archetype"
- "FUSE Services Framework wsdl-first archetype"
- "FUSE Mediation Router archetype"

Spring OSGi archetype

The Spring OSGi archetype creates a generic project for building an OSGi project using Spring DM:

```
org.springframework.osgi/spring-bundle-osgi-archetype/1.1.2
```

You invoke the archetype using the following command:

```
mvn archetype:create
-DarchetypeGroupId=org.springframework.osgi
-DarchetypeArtifactId=spring-osgi-bundle-archetype
-DarchetypeVersion=1.12
-DgroupId=groupId
-DartifactId=artifactId
-Dversion=version
```

FUSE Services Framework code-first archetype

The FUSE Services Framework code-first archetype creates a project for building a service from Java:

```
org.apache.servicemix.tooling/servicemix-osgi-cxf-code-first-archetype/2008.01.0.3-fuse
```

You invoke the archetype using the following command:

```
mvn archetype:create
-DarchetypeGroupId=org.apache.servicemix.tooling
-DarchetypeArtifactId=spring-osgi-bundle-archetype
-DarchetypeVersion=2008.01.0.3-fuse
-DgroupId=groupId
-DartifactId=artifactId
-Dversion=version
```

FUSE Services Framework wsdl-first archetype

The FUSE Services Framework wsdl-first archetype creates a project for creating a service from WSDL:

```
org.apache.servicemix.tooling/servicemix-osgi-cxf-wsdl-first-archetype/2008.01.0.3-fuse
```

You invoke the archetype using the following command:

```
mvn archetype:create
-DarchetypeGroupId=org.apache.servicemix.tooling
-DarchetypeArtifactId=servicemix-osgi-cxf-wsdl-first-archetype
-DarchetypeVersion=2008.01.0.3-fuse
-DgroupId=groupId
-DartifactId=artifactId
-Dversion=version
```

FUSE Mediation Router archetype

The FUSE Mediation Router archetype creates a project for building a route that is deployed into FUSE ESB:

```
org.apache.servicemix.tooling/servicemix-osgi-camel-archetype/2008.01.0.3-fuse
```

You invoke the archetype using the following command:

```
mvn archetype:create
-DarchetypeGroupId=org.apache.servicemix.tooling
-DarchetypeArtifactId=servicemix-osgi-camel-archetype
-DarchetypeVersion=2008.01.0.3-fuse
-DgroupId=groupId
-DartifactId=artifactId
-Dversion=version
```

Configuring a Bundle Plug-in

Overview

A bundle plug-in requires very little information to function. All of the required properties have default settings to generate a valid OSGi bundle.

While you can create a valid bundle using just the default values, you will likely want to modify some of the values. You can specify most of the properties inside the plug-in's `instructions` element.

Configuration properties

Some of the commonly used configuration properties are:

- Bundle-SymbolicName
- Bundle-Name
- Bundle-Version
- Export-Package
- Private-Package
- Import-Package

Setting a bundle's symbolic name

By default, the bundle plug-in sets the value for the Bundle-SymbolicName property to *`groupId`*`+ "." + `*`artifactId`*, with the following exceptions:

- If *`groupId`* has only one section (no dots), the first package name with classes is returned.

  For example, if the groupId is `commons-logging:commons-logging`, the bundle's symbolic name is `org.apache.commons.logging`.

- If *`artifactId`* is equal to the last section of *`groupId`*, then *`groupId`* is used.

  For example, if the POM specifies the group ID and artifact ID as `org.apache.maven:maven`, the bundle's symbolic name is `org.apache.maven`.

- If *`artifactId`* starts with the last section of *`groupId`*, that portion is removed.

  For example, if the POM specifies the group ID and artifact ID as `org.apache.maven:maven-core`, the bundle's symbolic name is `org.apache.maven.core`.

To specify your own value for the bundle's symbolic name, add a `Bundle-SymbolicName` child in the plug-in's `instructions` element, as shown in Example A.2.

Example A.2. Setting a Bundle's Symbolic Name

```
<plugin>
  <groupId>org.apache.felix</groupId>
  <artifactId>maven-bundle-plugin</artifactId>
  <configuration>
   <instructions>
     <Bundle-SymbolicName>${pom.artifactId}</Bundle-SymbolicName>
     ...
    </instructions>
  </configuration>
</plugin>
```

Setting a bundle's name

By default, a bundle's name is set to `${pom.name}`.

To specify your own value for the bundle's name, add a `Bundle-Name` child to the plug-in's `instructions` element, as shown in Example A.3.

Example A.3. Setting a Bundle's Name

```
<plugin>
  <groupId>org.apache.felix</groupId>
  <artifactId>maven-bundle-plugin</artifactId>
  <configuration>
   <instructions>
     <Bundle-Name>JoeFred</Bundle-Name>
     ...
    </instructions>
  </configuration>
</plugin>
```

Setting a bundle's version

By default, a bundle's version is set to `${pom.version}`. Any dashes (`-`) are replaced with dots (`.`).

To specify your own value for the bundle's version, add a `Bundle-Version` child to the plug-in's `instructions` element, as shown in Example A.4.

Example A.4. Setting a Bundle's Version

```
<plugin>
  <groupId>org.apache.felix</groupId>
  <artifactId>maven-bundle-plugin</artifactId>
  <configuration>
   <instructions>
     <Bundle-Version>1.0.3.1</Bundle-Version>
     ...
    </instructions>
  </configuration>
</plugin>
```

Specifying exported packages

By default, the OSGi manifest's Export-Package list is populated by all of the packages in your project's class path that match the pattern *Bundle-SymbolicName*.*. These packages are also included in the bundle.

Important

If you use a Private-Package element in your plug-in configuration and do not specify a list of packages to export, the default behavior is to assume that no packages are exported. Only the packages listed in the Private-Package element are included in the bundle and none of them are exported.

The default behavior can result in very large packages as well as exporting packages that should be kept private. To change the list of exported packages you can add a Export-Package child to the plug-in's instructions element.

The Export-Package element specifies a list of packages that are to be included in the bundle and be exported. The package names can be specified using the * wildcard. For example, the entry com.fuse.demo.*, includes all packages on the project's classpath that start with com.fuse.demo.

You can specify packages to be excluded be prefixing the entry with !. For example, the entry, !com.fuse.demo.private, excludes the package com.fuse.demo.private.

When attempting to exclude packages, the order of entries in the list is important. The list is processed in order from the start and subsequent contradicting entries are ignored.

For example, to include all packages starting with com.fuse.demo except the package com.fuse.demo.private, list the packages in the following way:

```
!com.fuse.demo.private,com.fuse.demo.*
```

However, if you list the packages as:

```
com.fuse.demo.*,!com.fuse.demo.private
```

Then com.fuse.demo.private is included in the bundle because it matches the first pattern.

Specifying private packages

By default, all packages included in a bundle are exported. You can include packages in the bundle without exporting them. To specify a list of packages to be included in a bundle, but not exported, add a `Private-Package` child to the plug-in's `instructions` element.

The `Private-Package` element works similarly to the `Export-Package` element. You specify a list of packages to be included in the bundle. The bundle plug-in uses the list to find all classes on the project's classpath to be included in the bundle. These packages are packaged in the bundle, but not exported.

Important

If a package matches an entry in both the `Private-Package` element and the `Export-Package` element, the `Export-Package` element takes precedent. The package is added to the bundle and exported.

Example A.5 shows the configuration for including a private package in a bundle

Example A.5. Including a Private Package in a Bundle

```
<plugin>
  <groupId>org.apache.felix</groupId>
  <artifactId>maven-bundle-plugin</artifactId>
  <configuration>
   <instructions>
     <Private-Package>org.apache.cxf.wsdlFirst.impl</Private-Package>
     ...
    </instructions>
  </configuration>
</plugin>
```

Specifying imported packages

By default, the bundle plug-in populates the OSGi manifest's Import-Package property with a list of all the packages referred to by the contents of the bundle and not included in the bundle.

While the default behavior is typically sufficient for most projects, you might find instances where you want to import packages that are not automatically added to the list. The default behavior can also result in unwanted packages being imported.

To specify a list of packages to be imported by the bundle, add a `Import-Package` child to the plug-in's `instructions` element. The syntax for the package list is the same as for both the `Export-Package` and `Private-Package` elements.

Important

When you use the `Import-Package` element, the plug-in does not automatically scan the bundle's contents to determine if there are any required imports. To ensure that the contents of the bundle are scanned, you must place `*` as the last entry in the package list.

Example A.6 shows the configuration for including a private package in a bundle

Example A.6. Specifying the Packages Imported by a Bundle

```
<plugin>
  <groupId>org.apache.felix</groupId>
  <artifactId>maven-bundle-plugin</artifactId>
  <configuration>
   <instructions>
     <Import-Package>javax.jws,
         javax.wsdl,
         org.apache.cxf.bus,
         org.apache.cxf.bus.spring,
         org.apache.cxf.bus.resource,
         org.apache.cxf.configuration.spring,
         org.apache.cxf.resource,
         org.springframework.beans.factory.config,
         *
     </Import-Package>
     ...
   </instructions>
  </configuration>
</plugin>
```

More information

For more information on configuring a bundle plug-in, see:

- Apache Felix documentation[3]
- Peter Kriens' aQute Software Consultancy web site[4]

[3] http://cwiki.apache.org/FELIX/apache-felix-maven-bundle-plugin-bnd.html
[4] http://www.aqute.biz/Code/Bnd

Appendix B. FUSE Services Framework Binding IDs

Table B.1. Binding IDs for Message Bindings

Binding	ID
CORBA	http://cxf.apache.org/bindings/corba
HTTP/REST	http://apache.org/cxf/binding/http
SOAP 1.1	http://schemas.xmlsoap.org/wsdl/soap/http
SOAP 1.1 w/ MTOM	http://schemas.xmlsoap.org/wsdl/soap/http?mtom=true
SOAP 1.2	http://www.w3.org/2003/05/soap/bindings/HTTP/
SOAP 1.2 w/ MTOM	http://www.w3.org/2003/05/soap/bindings/HTTP/?mtom=true
XML	http://cxf.apache.org/bindings/xformat

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