Apache CXF

tutorialspoint

SIMPLY EASY LEARNING

www.tutorialspoint.com

https://www.facebook.com/tutorialspointindia

https://twitter.com/tutorialspoint

About the Tutorial

In this tutorial you will learn how to use CXF to create both a web service and a client that consumes the service. This tutorial will also walk you through the entire code development for both server and the client.

Audience

This tutorial has been prepared to cater the needs of both the beginners and experts in Apache CXF. The tutorial has a flow that takes you from the simpler concepts to in depth ones and lets you gain confidence as you progress through it.

Prerequisites

This tutorial uses Apache Maven at several instances. At some instances in this tutorial, you may come across usage of RESTful web services in Java.

If you are new to this technology, we suggest you to pick up a tutorial on these before you move ahead with Apache CXF.

Copyright & Disclaimer

@Copyright 2019 by Tutorials Point (I) Pvt. Ltd.

All the content and graphics published in this e-book are the property of Tutorials Point (I) Pvt. Ltd. The user of this e-book is prohibited to reuse, retain, copy, distribute or republish any contents or a part of contents of this e-book in any manner without written consent of the publisher.

We strive to update the contents of our website and tutorials as timely and as precisely as possible, however, the contents may contain inaccuracies or errors. Tutorials Point (I) Pvt. Ltd. provides no guarantee regarding the accuracy, timeliness or completeness of our website or its contents including this tutorial. If you discover any errors on our website or in this tutorial, please notify us at contact@tutorialspoint.com

Table of Contents

About the Tutorial i

Audience... i

Prerequisites... i

Copyright & Disclaimer i

Table of Contents.. ii

1. APACHECXF – INTRODUCTION... 1

2. APACHECXF – CXF WITH POJO 2

Developing Web Service 2

Web Service Interface.. 2

Web Service Implementation 3

Creating Server 3

Setting up Maven Project 5

Project Folder Structure.. 9

Running Server 10

Creating Client 11

Running Client 13

3. APACHE CXF – CXF WITH JAX-WS 14

Declaring Service Interface 14

Implementing Web Interface 14

Developing Server... 15

Deploying Server... 16

The Final pom.xml 18

Running the HelloWorld Service 21

Developing Client.. 22

4. APACHE CXF – CXF WITH WSDL FIRST 24

WSDL for HelloWorld 24

The wsdl2java Plugin 26

Generated Service Interface 28

Implementing the Service Interface 29

Developing Server 30

Deploying Server 32

The Final pom.xml 34

Running the HelloWorld Service 38

Developing Client 41

5. APACHE CXF – CXF WITH JAX-RS 42

Declaring Movie Element 42

Creating Movie Service Database 43

Developing Server 45

The Final pom.xml 46

Developing Client 49

Testing JAX-RS Application 50

6. APACHE CXF - CXF WITH JMS 51

Creating Service Interface 51

Implementing Service 51

Creating Server 52

Adding Dependencies 54

Running Server 57

Creating Client 57

7. APACHE CXF - CONCLUSION 60

1. ApacheCXF – Introduction

In today's environment, you can create a web service application using several options. You can use one or more of the several standard and widely accepted protocols for communication. For example SOAP, XML/HTTP, RESTful HTTP, and CORBA (Common Object Request Broker Architecture, which was very popular in olden days but not so frequently used now.

You also have a choice of different transports such as HTTP, JMS, JBI and the choice of front-end API's like JAX-RS and JAX-WS. Having so many options for web service development, there is a need for an open source services framework to glue all the above mentioned options together and that is what Apache CXF does.

In this tutorial, you will learn how to use CXF to create both a web service and a client that consumes the service, using one or more of the options that we have listed above. This tutorial will walk you through the entire code development for both server and the client. As each application can use only one of the options from each category, namely frontend, transport and protocol, considering all permutations and combinations of these three, the number of applications will be exorbitantly high.

This tutorial discusses the development of following projects in detail:

- CXF with Plain Old Java Objects (POJO)
- CXF with JAX-WS
- CXF with WSDL
- CXF with JAX-RS
- CXF with JMS

To keep it simple, we have used maven with its command line interface. You may use your preferred IDE for creating a maven project.

In the next chapter, let us get started with the first one.

2. ApacheCXF – CXF with POJO

In this chapter, you will learn how to develop a simple web application that sends a greetings message to the user. A web service project uses WSDL model. The CXF allows you to hide this WSDL model by providing a simple frontend to map Java APIs to the underlying WSDL.

In this simplest project, the interface of the web service will be directly exposed to the client and the client would use native Java APIs to call the web service.

First, we will create a web service. Every service has an interface that is exposed to the client. We may write this interface as a simple Java interface or as a WSDL document. In this Java-First approach, we will expose our service through a Java interface.

Developing Web Service

The service that we are going to create on the web will have a single web method called **greetings**. The method takes a **string** type argument in which we will send the user's name. The service will send back a greetings message to the caller with the received user name included in the message.

Web Service Interface

To expose the interface of our web service, we will create a Java interface as follows:

```
//HelloWorld.java
package com.tutorialspoint.cxf.pojo;


public interface HelloWorld {


    String greetings(String text);
}
```

The interface has only one method called **greetings**. The server will implement this interface. In our trivial application, this interface is directly exposed to the client. Typically, in a web service application, you use WSDL to describe the web service interface. In this simple application, we will provide this direct interface to the client developer. The client would then call the **greetings** message on the server object. So first let us create the web service.

Web Service Implementation

The **HelloWorld** interface is implemented in the **HelloWorldImpl** Java class as shown below:

```
//HelloWorldImpl.java
package com.tutorialspoint.cxf.pojo;


public class HelloWorldImpl implements HelloWorld {


    @Override
    public String greetings(String text) {
        return "Hi " + text;
    }
}
```

The **greetings** method receives a parameter of **string** type, appends it to a greeting message and returns the resultant string to the caller.

Next, we write the server application to host the **HelloWorld** service.

Creating Server

The server application consists of two parts:

- The first part creates a factory for our web service, and
- The second part writes a **main** method for instantiating it.

The server uses **ServerFactoryBean** class provided by CXF libraries to expose our **HelloWorld** interface to remote clients. Thus, we first instantiate the **ServerFactoryBean** class and then set its various properties:

```
ServerFactoryBean factory = new ServerFactoryBean();
```

We set the service class to be called by calling the **setServiceClass** method on the **factory** object:

```
factory.setServiceClass(HelloWorld.class);
```

We set the URL for calling our service by calling the factory's **setAddress** method. Note that the service will be published at this URL.

```
factory.setAddress("http://localhost:5000/Hello");
```

In this case, the service is deployed on the embedded server and will be listening to port 5000. You may opt for any port number of your choice.

Before creating the factory, you need to tell the factory about our service implementation class. This is done by calling the **setServiceBean** method on the **factory** object as shown here:

```
factory.setServiceBean(new HelloWorldImpl());
```

The service bean is set to the instance of our service implementation class. Finally, we create the factory by calling its **create** method:

```
factory.create();
```

Now, as we have developed the factory to run our web service, we will next write a **main** method to instantiate it and keep it running for some time.

Now, write a **main** method to instantiate the **HelloServer** class as follows:

```
public static void main(String[] args) throws Exception {
new HelloServer();
System.out.println("Listening on port 5000 ...");
```

Once instantiated, the **HelloServer** class will keep running indefinitely. For production deployments, you will definitely keep your server running forever. In the current situation, we would terminate the server after a predetermined time as follows:

```
Thread.sleep(5 * 60 * 1000);
     System.out.println("Server exiting ...");
System.exit(0);
```

The entire code for the **HelloServer** class is given below:

```
//HelloServer.java
package com.tutorialspoint.cxf.pojo;


import org.apache.cxf.frontend.ServerFactoryBean;


public class HelloServer {


    protected HelloServer() throws Exception {
        ServerFactoryBean factory = new ServerFactoryBean();
        factory.setServiceClass(HelloWorld.class);
        factory.setAddress("http://localhost:5000/Hello");
        factory.setServiceBean(new HelloWorldImpl());
        factory.create();
    }

```

```
    public static void main(String[] args) throws Exception {
        new HelloServer();
        System.out.println("Listening on port 5000 ...");
        Thread.sleep(5 * 60 * 1000);
        System.out.println("Server exiting ...");
        System.exit(0);
    }
}
```

The server application that we have created uses **ServerFactoryBean** class from CXF libraries. We must now include these libraries in our project to successfully compile the **HelloServer** class. We will use **Maven** to set up the project dependencies.

Setting up Maven Project

To create a Maven project, type the following command in your command-line window. Note that we have tested this on a Mac machine. For Windows and Linux installations, the instructions may differ at few places.

```
mvn archetype:generate
```

When asked for the properties, input the following values:

```
Define value for property 'groupId': : com.tutorialspoint
Define value for property 'artifactId': : cxf-pojo
Define value for property 'version':  1.0-SNAPSHOT: : 1.0
Define value for property 'package':  com.tutorialspoint: :
com.tutorialspoint.cxf.pojo
```

On the completion of the maven command, you will find the appropriate folder structure created in your current folder along with pom.xml file.

The generated directory structure is shown here:

```
.
|____cxf-pojo
| |____pom.xml
| |____src
| | |____test
| | | |____java
| | | | |____com
| | | | | |____tutorialspoint
| | | | | | |____cxf
| | | | | | | |____pojo
| | | | | | | | |____AppTest.java
| | |____main
| | | |____java
| | | | |____com
| | | | | |____tutorialspoint
| | | | | | |____cxf
| | | | | | | |____pojo
| | | | | | | | |____App.java
```

You will add the CXF dependencies in the **pom.xml** and also copy the above created Java files into the appropriate folder of the maven created structure. For your ready reference, we have given below the pom.xml file for the project that we created on our machine.

```
<?xml version="1.0" encoding="UTF-8"?>
<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/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.tutorialspoint</groupId>
    <artifactId>cxf-pojo</artifactId>
    <version>1.0</version>
    <packaging>jar</packaging>

    <profiles>
        <profile>
            <id>server</id>
            <build>
                <defaultGoal>test</defaultGoal>
                       <plugins>
```

```
                    <plugin>
                        <groupId>org.codehaus.mojo</groupId>
                        <artifactId>exec-maven-plugin</artifactId>
                        <executions>
                            <execution>
                                <phase>test</phase>
                                <goals>
                                    <goal>java</goal>
                                </goals>
                                <configuration>
                                    <mainClass>
com.tutorialspoint.cxf.pojo.HelloServer
</mainClass>
                                </configuration>
                            </execution>
                        </executions>
                    </plugin>
                </plugins>
            </build>
        </profile>
        <profile>
            <id>client</id>
            <build>
                <defaultGoal>test</defaultGoal>
                <plugins>
                    <plugin>
                        <groupId>org.codehaus.mojo</groupId>
                        <artifactId>exec-maven-plugin</artifactId>
                        <executions>
                            <execution>
                                <phase>test</phase>
                                <goals>
                                    <goal>java</goal>
                                </goals>
                                <configuration>
                                    <mainClass>
com.tutorialspoint.cxf.pojo.HelloClient
</mainClass>
                                </configuration>
```

```
                        </execution>
                    </executions>
                </plugin>
            </plugins>
        </build>
    </profile>
</profiles>

<dependencies>
    <dependency>
        <groupId>org.apache.cxf</groupId>
        <artifactId>cxf-rt-features-logging</artifactId>
        <version>3.3.0</version>
        <type>jar</type>
    </dependency>
    <dependency>
        <groupId>org.apache.cxf</groupId>
        <artifactId>cxf-rt-frontend-simple</artifactId>
        <version>3.3.0</version>
        <type>jar</type>
    </dependency>
    <dependency>
        <groupId>org.apache.cxf</groupId>
        <artifactId>cxf-rt-transports-http</artifactId>
        <version>3.3.0</version>
    </dependency>
    <dependency>
        <groupId>org.apache.cxf</groupId>
        <artifactId>cxf-rt-frontend-jaxws</artifactId>
        <version>3.3.0</version>
    </dependency>
    <!-- Jetty is needed if you're using the CXFServlet -->
    <dependency>
        <groupId>org.apache.cxf</groupId>
        <artifactId>cxf-rt-transports-http-jetty</artifactId>
        <version>3.3.0</version>
    </dependency>
</dependencies>
```

```
    <properties>
        <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
        <maven.compiler.source>1.8</maven.compiler.source>
        <maven.compiler.target>1.8</maven.compiler.target>
    </properties>
</project>
```

The above pom.xml may include additional dependencies which are irrelevant to this project, but are required for our next project in this tutorial. Anyway, there is no harm as such in including additional dependencies.

Project Folder Structure

The project folder structure on my machine after placing the server and client Java files is shown below for your quick reference:

```
|____cxf-pojo
| |____pom.xml
| |____src
| | |____test
| | | |____java
| | |____main
| | | |____resources
| | | |____java
| | | | |____com
| | | | | |____tutorialspoint
| | | | | | |____cxf
| | | | | | | |____pojo
| | | | | | | | |____HelloServer.java
| | | | | | | | |____HelloWorld.java
| | | | | | | | |____HelloWorldImpl.java
| | | | | | | | |____HelloClient.java
```

Running Server

To build the project, use the following command in your command-line window:

```
mvn clean install
```

You can start the server using the following command:

```
mvn -Pserver
```

This will start the server and you will see the following prompt on the console:

```
INFO: Creating Service {http://pojo.cxf.tutorialspoint.com/}HelloWorld from class com.tutorialspoint.cxf.pojo.HelloWorld

INFO: Setting the server's publish address to be http://localhost:5000/Hello

Listening on port 5000 ...
```

Now, in your browser window specify the URL of our published service. You will see the following output:

localhost:5000/Hello

localhost:5000/Hello

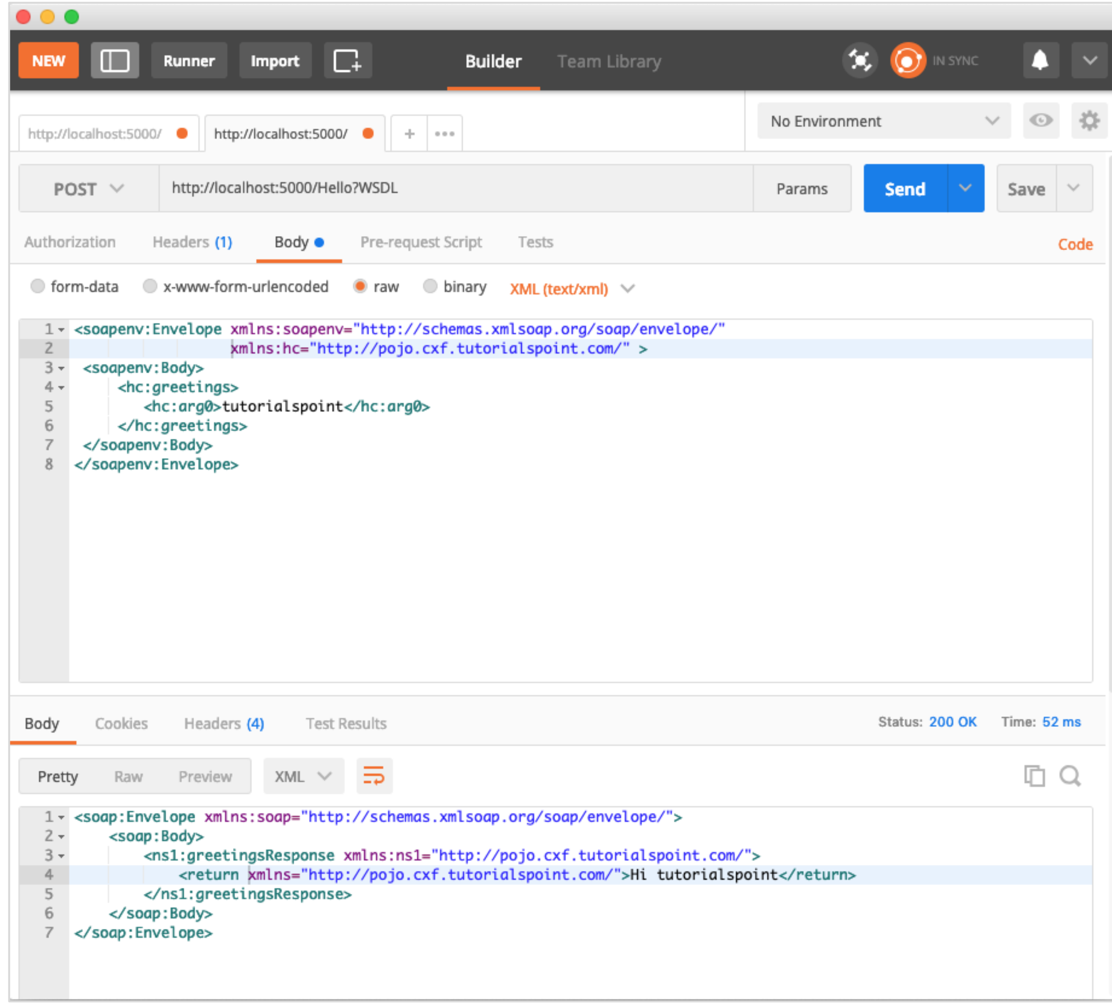
This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  <soap:Body>
    <soap:Fault>
      <faultcode>soap:Server</faultcode>
      <faultstring>
        No binding operation info while invoking unknown method with params unknown.
      </faultstring>
    </soap:Fault>
  </soap:Body>
</soap:Envelope>
```

This confirms that our service is running at the specified port on a localhost. Since we did not specify the **greetings** message in our call, a SOAP fault message is returned to the browser.

You may further test your web service using a SOAP client of your choice. Here we have used Postman to test our server.

The output is as shown here:



Observe that **SOAP Request** was hand-coded. After posting the request, the server sent a **SOAP Response** message, which is seen in the bottom portion of the screen shot.

From this, you can understand that CXF maintains the use of SOAP protocols for both request and response while providing you a unified view to a variety of web technologies that do exist in today's world. This greatly simplifies the web application development.

Our next task is to create a client that will consume the web service that you have created.

Creating Client

In the server application **HelloWorld** is the interface that exposes our web service. The web service itself just provides a plain greeting message to the client. Usually, the web service interface is exposed to the outside world using WSDL (Web Services Description Language). In this trivial application, we will expose our web service to the client by exposing directly the service interface and that is the **HelloWorld.class**.

For this purpose, CXF provides a factory class called **ClientProxyFactoryBean** that allows us to attach to the desired interface to the created factory instance.

First, we create a factory bean instance as follows:

```
ClientProxyFactoryBean factory = new ClientProxyFactoryBean();
```

We call the **setAddress** method on the factory bean instance to set the URL by which our web service can be invoked. In our case, we will use the URL used while creating the server in our earlier step:

```
factory.setAddress("http://localhost:5000/Hello");
```

Next, we call the **create** method on the **factory** instance to attach our service interface **HelloWorld.class** to it.

```
HelloWorld helloServer = factory.create(HelloWorld.class);
```

Finally, we call the **greetings** method to invoke the remote web service.

```
System.out.println(helloServer.greetings(System.getProperty("user.name")));
```

This would print a greetings message on your console.

The entire source for the client application is shown below:

```
//HelloClient.java
package com.tutorialspoint.cxf.pojo;

import org.apache.cxf.frontend.ClientProxyFactoryBean;

public class HelloClient {

    public static void main(String[] args) throws Exception {
        ClientProxyFactoryBean factory = new ClientProxyFactoryBean();
        factory.setAddress("http://localhost:5000/Hello");
        HelloWorld helloServer = factory.create(HelloWorld.class);

System.out.println(helloServer.greetings(System.getProperty("user.name")));
    }
}
```

Running Client

Make sure that the server is still running on your machine. In case, if it has timed out, restart the server with the following command:

```
mvn -Pserver
```

You will see the following message on the console:

```
Listening on port 5000 …
```

Now, before the server times out which we have set to 5 minutes, open another command line window and start the client with the following command:

```
mvn -Pclient
```

You will see a message similar to the following on the command line:

```
Hi tutorialspoint
```

Note that **tutorialspoint** is our user name. You will get a greeting with your own name.

In the next chapter, we will learn how to use CXF in a JAX-WS (Java API for XML Web Services) project.

3. Apache CXF – CXF with JAX-WS

In this JAX-WS application, we will use Java-first approach like the earlier POJO application. So first we will create an interface for our web service.

Declaring Service Interface

As in the earlier case, we will create a trivial service that has only one interface method called greetings. The code for the service interface is shown below:

```
//HelloWorld.java
package com.tutorialspoint.cxf.jaxws.helloworld;

import javax.jws.WebService;

@WebService
public interface HelloWorld {

    String greetings(String text);
}
```

We annotate the interface with a **@WebService** tag. Next, we will implement this interface.

Implementing Web Interface

The implementation of the web interface is shown here:

```
//HelloWorldImpl.java
package com.tutorialspoint.cxf.jaxws.helloworld;

public class HelloWorldImpl implements HelloWorld {

    @Override
    public String greetings(String name) {
        return ("hi " + name);
    }
}
```

The greetings method is annotated with **@Override** tag. The method returns a "hi" message to the caller.

Next, we will write the code for developing the server.

Developing Server

Unlike the POJO application, we will now decouple the interface by using the CXF supplied Endpoint class to publish our service. This is done in the following two lines of code:

```
HelloWorld implementor = new HelloWorldImpl();
      Endpoint.publish("http://localhost:9090/HelloServerPort",
                implementor,
                new LoggingFeature());
```

The first parameter of the publish method specifies the URL at which our service will be made available to the clients. The second parameter specifies the implementation class for our service. The entire code for the server is shown below:

```
//Server.java
package com.tutorialspoint.cxf.jaxws.helloworld;

import javax.xml.ws.Endpoint;
import org.apache.cxf.ext.logging.LoggingFeature;

public class Server {

     public static void main(String[] args) throws Exception {
     HelloWorld implementor = new HelloWorldImpl();
     Endpoint.publish("http://localhost:9090/HelloServerPort",
                implementor,
                new LoggingFeature());
     System.out.println("Server ready...");
     Thread.sleep(5 * 60 * 1000);
     System.out.println("Server exiting ...");
     System.exit(0);
     }
}
```

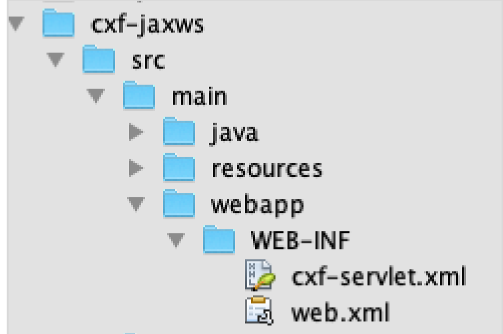
To deploy our server, you will need to make few more modifications to your project as listed below.

Deploying Server

Finally, to deploy the server application, you will need to make one more modification in pom.xml to setup your application as a web application. The code that you need to add into your **pom.xml** is given below:

```
      <profiles>
        <profile>
             <id>server</id>
             <build>
                   <defaultGoal>test</defaultGoal>
                   <plugins>
                   <plugin>
                         <groupId>org.codehaus.mojo</groupId>
                         <artifactId>exec-maven-plugin</artifactId>
                         <version>1.6.0</version>
                         <executions>
                         <execution>
                               <phase>test</phase>
                               <goals>
                                     <goal>java</goal>
                               </goals>
                               <configuration>
                                     <mainClass>
com.tutorialspoint.cxf.jaxws.helloworld.Server
</mainClass>
                               </configuration>
                         </execution>
                         </executions>
                   </plugin>
                   </plugins>
             </build>
        </profile>
      </profiles>
```

Before you deploy the application, you need to add two more files to your project. These are shown in the screenshot below:



These files are CXF standard files which define the mapping for **CXFServlet**. The code within the **web.xml** file is shown here for your quick reference:

```
//Web.xml
<?xml version="1.0" encoding="UTF-8"?>
<web-app xmlns="http://java.sun.com/xml/ns/javaee"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="2.5"
xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd">
    <display-name>cxf</display-name>
    <servlet>
        <description>Apache CXF Endpoint</description>
        <display-name>cxf</display-name>
        <servlet-name>cxf</servlet-name>
        <servlet-class>
org.apache.cxf.transport.servlet.CXFServlet
  </servlet-class>
        <load-on-startup>1</load-on-startup>
    </servlet>
    <servlet-mapping>
        <servlet-name>cxf</servlet-name>
        <url-pattern>/services/*</url-pattern>
    </servlet-mapping>
    <session-config>
        <session-timeout>60</session-timeout>
    </session-config>
</web-app>
```

In the **cxf-servlet.xml,** you declare the properties for your service's endpoint. This is shown in the code snippet below:

```
<beans ...>
    <jaxws:endpoint xmlns:helloworld="http://tutorialspoint.com/"
                  id="helloHTTP"
                  address="http://localhost:9090/HelloServerPort"
                  serviceName="helloworld:HelloServiceService"
                  endpointName="helloworld:HelloServicePort"
                  >
     </jaxws:endpoint>
 /beans>
```

Here we define the id for our service endpoint, the address on which the service will be available, the service name and the endpoint name. Now, you learnt how your service gets routed and processed by a CXF servlet.

The Final pom.xml

The **pom.xml** includes a few more dependencies. Rather than describing all the dependencies, we have included the final version of pom.xml below:

```
<?xml version="1.0" encoding="UTF-8"?>
<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/xsd/maven-4.0.0.xsd">
     <modelVersion>4.0.0</modelVersion>
     <groupId>com.tutorialspoint</groupId>
     <artifactId>cxf-jaxws</artifactId>
     <version>1.0</version>
     <packaging>jar</packaging>

     <properties>
     <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
     <maven.compiler.source>1.8</maven.compiler.source>
     <maven.compiler.target>1.8</maven.compiler.target>
     </properties>

     <profiles>
```

```
        <profile>
            <id>server</id>
            <build>
                <defaultGoal>test</defaultGoal>
                <plugins>
                <plugin>
                    <groupId>org.codehaus.mojo</groupId>
                    <artifactId>exec-maven-plugin</artifactId>
                    <version>1.6.0</version>
                    <executions>
                    <execution>
                        <phase>test</phase>
                        <goals>
                            <goal>java</goal>
                        </goals>
                        <configuration>
                            <mainClass>
com.tutorialspoint.cxf.jaxws.helloworld.Server
</mainClass>
                        </configuration>
                    </execution>
                    </executions>
                </plugin>
                </plugins>
            </build>
      </profile>
      <profile>
            <id>client</id>
            <build>
                <defaultGoal>test</defaultGoal>
                <plugins>
                <plugin>
                    <groupId>org.codehaus.mojo</groupId>
                    <artifactId>exec-maven-plugin</artifactId>
                    <executions>
                    <execution>
                        <phase>test</phase>
                        <goals>
                            <goal>java</goal>
```

```
                                </goals>
                                <configuration>
                                       <mainClass>
com.tutorialspoint.cxf.jaxws.helloworld.Client
</mainClass>
                                </configuration>
                         </execution>
                         </executions>
                  </plugin>
                  </plugins>
           </build>
       </profile>
     </profiles>

     <dependencies>
     <dependency>
           <groupId>org.apache.cxf</groupId>
           <artifactId>cxf-rt-frontend-jaxws</artifactId>
           <version>3.3.0</version>
     </dependency>
     <dependency>
           <groupId>org.apache.cxf</groupId>
           <artifactId>cxf-rt-transports-http</artifactId>
           <version>3.3.0</version>
     </dependency>
     <dependency>
           <groupId>org.apache.cxf</groupId>
           <artifactId>cxf-rt-features-logging</artifactId>
           <version>3.3.0</version>
     </dependency>
     <dependency>
           <groupId>org.apache.cxf</groupId>
           <artifactId>cxf-rt-transports-http-jetty</artifactId>
           <version>3.3.0</version>
     </dependency>
     </dependencies>
</project>
```

Note that it also includes a profile for building client that we will be learning in the later sections of this tutorial.

Running the HelloWorld Service

Now, you are ready to run the web app. In the command window, run the build script using the following command.

```
mvn clean install

mvn -Pserver
```

You will see the following message on the console:

```
INFO: Setting the server's publish address to be
http://localhost:9090/HelloServerPort

Server ready…
```

Like earlier, you can test the server by opening the server URL in your browser.

localhost:9090/HelloServerPort

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  <soap:Body>
    <soap:Fault>
      <faultcode>soap:Server</faultcode>
      <faultstring>
        No binding operation info while invoking unknown method with params unknown.
      </faultstring>
    </soap:Fault>
  </soap:Body>
</soap:Envelope>
```

As we did not specify any operation, only a fault message is returned to the browser by our application.

Now, try adding the **?wsdl** to your URL and you will see the following output:

localhost:9090/HelloServerPort?wsdl

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
▼<wsdl:definitions xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
 xmlns:tns="http://helloworld.tutorialspoint.com/" xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
 xmlns:ns1="http://schemas.xmlsoap.org/soap/http" name="HelloWorldImplService"
 targetNamespace="http://helloworld.tutorialspoint.com/">
  ▼<wsdl:types>
    ▼<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:tns="http://helloworld.tutorialspoint.com/"
    elementFormDefault="qualified" targetNamespace="http://helloworld.tutorialspoint.com/" version="1.0">
      <xs:element name="greetings" type="tns:greetings"/>
      <xs:element name="greetingsResponse" type="tns:greetingsResponse"/>
     ▼<xs:complexType name="greetings">
       ▼<xs:sequence>
          <xs:element minOccurs="0" name="arg0" type="xs:string"/>
        </xs:sequence>
      </xs:complexType>
     ▼<xs:complexType name="greetingsResponse">
       ▼<xs:sequence>
          <xs:element minOccurs="0" name="return" type="xs:string"/>
        </xs:sequence>
      </xs:complexType>
    </xs:schema>
  </wsdl:types>
 ▼<wsdl:message name="greetingsResponse">
    <wsdl:part element="tns:greetingsResponse" name="parameters"> </wsdl:part>
  </wsdl:message>
 ▼<wsdl:message name="greetings">
    <wsdl:part element="tns:greetings" name="parameters"> </wsdl:part>
  </wsdl:message>
 ▼<wsdl:portType name="HelloWorldPortType">
   ▼<wsdl:operation name="greetings">
      <wsdl:input message="tns:greetings" name="greetings"> </wsdl:input>
      <wsdl:output message="tns:greetingsResponse" name="greetingsResponse"> </wsdl:output>
    </wsdl:operation>
  </wsdl:portType>
 ▼<wsdl:binding name="HelloWorldImplServiceSoapBinding" type="tns:HelloWorldPortType">
    <soap:binding style="document" transport="http://schemas.xmlsoap.org/soap/http"/>
   ▼<wsdl:operation name="greetings">
      <soap:operation soapAction="" style="document"/>
     ▼<wsdl:input name="greetings">
        <soap:body use="literal"/>
      </wsdl:input>
     ▼<wsdl:output name="greetingsResponse">
        <soap:body use="literal"/>
      </wsdl:output>
    </wsdl:operation>
  </wsdl:binding>
 ▼<wsdl:service name="HelloWorldImplService">
   ▼<wsdl:port binding="tns:HelloWorldImplServiceSoapBinding" name="HelloWorldImplPort">
      <soap:address location="http://localhost:9090/HelloServerPort"/>
    </wsdl:port>
  </wsdl:service>
</wsdl:definitions>
```

So our server application is running as expected. You may use the SOAP Client such as **Postman** described earlier to further test your service.

In the next section, we will learn how to write a client that uses our service.

Developing Client

Writing the client in a CXF application is as trivial as writing a server. Here is the complete code for the client:

```
//Client.java
package com.tutorialspoint.cxf.jaxws.helloworld;


import javax.xml.namespace.QName;
import javax.xml.ws.Service;
```

```
import javax.xml.ws.soap.SOAPBinding;

public final class Client {

      private static final QName SERVICE_NAME
              = new QName("http://helloworld.jaxws.cxf.tutorialspoint.com/",
"HelloWorld");
      private static final QName PORT_NAME
              = new QName("http://helloworld.jaxws.cxf.tutorialspoint.com/",
"HelloWorldPort");

      private Client() {
      }

      public static void main(String[] args) throws Exception {
      Service service = Service.create(SERVICE_NAME);

      System.out.println("service created");
      String endpointAddress = "http://localhost:9090/HelloServerPort";
      service.addPort(PORT_NAME, SOAPBinding.SOAP11HTTP_BINDING,
endpointAddress);

      HelloWorld hw = service.getPort(HelloWorld.class);
      System.out.println(hw.greetings("World"));
      }
}
```

Here, we use the CXF supplied **Service** class to bind to the known service. We call the **create** method on the **Service** class to get an instance of the service. We set the known port by calling the **addPort** method on the **service** instance.

Now, we are ready to consume the service, which we do by first obtaining the service interface by calling the **getPort** method on the **service** instance. Finally, we call our **greetings** method to print the greetings message on the console.

Now, as you have learned the basics of CXF by using the Java-First approach, you will now learn how to use CXF with WSDL-First approach in our next chapter.

4. Apache CXF – CXF with WSDL first

The CXF-POJO application that you have developed results in a very tight coupling between the client and the server. Giving a direct access to the service interface can also pose severe security threats. Thus, decoupling between the client and the server is usually desired, which is achieved by using WSDL (Web Services Description Language).

We write the web service interface in a WSDL document which is XML-based. We will use a tool to map this WSDL to Java interfaces which are then implemented and used by our client and server applications. For providing decoupling, starting with a WSDL is a preferred way. For this, you need to first learn a new language - WSDL. Writing WSDL needs a careful approach and it would be better if you can gain some understanding on this before you start working on it.

In this lesson, we will start by defining a web service interface in a WSDL document. We will learn how to use CXF to create both server and client applications starting with WSDL. We will keep the application simple to maintain focus on the use of CXF. After the server application is created we will publish it to a desired URL using a built-in CXF class.

First, let us describe the WSDL that we are going to use.

WSDL for HelloWorld

The webservice that we are going to implement will have one single webmethod called **greetings** that accepts a **string** parameter holding the user name and returns a string message to the caller after appending a greetings message to the user name. The complete wsdl is shown below:

```
//Hello.wsdl
<?xml version="1.0" encoding="UTF-8"?>
<wsdl:definitions xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
                  xmlns:tns="http://helloworld.tutorialspoint.com/"
                  xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
                  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
                  name="HelloWorld"
targetNamespace="http://helloworld.tutorialspoint.com/">

    <wsdl:types>
        <xsd:schema attributeFormDefault="unqualified"
  elementFormDefault="qualified"
                    targetNamespace="http://helloworld.tutorialspoint.com/">
            <xsd:element name="greetings" type="tns:greetings"/>
            <xsd:complexType name="greetings">
                <xsd:sequence>
                    <xsd:element minOccurs="0" name="arg0" type="xsd:string"/>
```

```
                </xsd:sequence>
            </xsd:complexType>
            <xsd:element name="greetingsResponse"
type="tns:greetingsResponse"/>
            <xsd:complexType name="greetingsResponse">
                <xsd:sequence>
                    <xsd:element minOccurs="0" name="return"
type="xsd:string"/>
                </xsd:sequence>
            </xsd:complexType>
        </xsd:schema>
    </wsdl:types>
    <wsdl:message name="greetings">
        <wsdl:part element="tns:greetings" name="parameters">
        </wsdl:part>
    </wsdl:message>
    <wsdl:message name="greetingsResponse">
        <wsdl:part element="tns:greetingsResponse" name="parameters">
        </wsdl:part>
    </wsdl:message>
    <wsdl:portType name="HelloWorldPortType">
        <wsdl:operation name="greetings">
            <wsdl:input message="tns:greetings" name="greetings">
            </wsdl:input>
            <wsdl:output message="tns:greetingsResponse"
name="greetingsResponse">
            </wsdl:output>
        </wsdl:operation>
    </wsdl:portType>
    <wsdl:binding name="HelloWorldSoapBinding" type="tns:HelloWorldPortType">
        <soap:binding style="document"
transport="http://schemas.xmlsoap.org/soap/http"/>
        <wsdl:operation name="greetings">
            <soap:operation soapAction="" style="document"/>
            <wsdl:input name="greetings"></wsdl:input>
            <wsdl:output name="greetingsResponse">
                <soap:body use="literal"/>
            </wsdl:output>
        </wsdl:operation>
```

```
    </wsdl:binding>
    <wsdl:service name="HelloWorldService">
        <wsdl:port binding="tns:HelloWorldSoapBinding" name="HelloWorldPort">
            <soap:address location="http://localhost:9090/HelloServerPort"/>
        </wsdl:port>
    </wsdl:service>
</wsdl:definitions>
```

Note that writing a syntactically correct wsdl has always been a challenge to the developers; there are many tools and online editors are available for creating a wsdl. These editors ask for the names of messages that you want to implement along with the parameters that you wish to pass in a message and the type of return message that you want your client application to receive. If you know wsdl syntax, you may hand code the entire document or use one of the editors to create your own.

In the above wsdl, we have defined a single message called **greetings**. The message is delivered to the service called **HelloWorldService** that is running at **http://localhost:9090/HelloServerPort**.

With this, we will now proceed to server development. Before developing the server, we need to generate Java interface to our web service. This is to be done from the given wsdl. To do this, you use a tool called **wsdl2java**.

The wsdl2java Plugin

As we will be using maven to build the project, you will need to add the following plugin to the **pom.xml** file.

```
        <plugins>
            <plugin>
                <groupId>org.apache.cxf</groupId>
                <artifactId>cxf-codegen-plugin</artifactId>
                <version>3.3.0</version>
                <executions>
                    <execution>
                        <id>generate-sources</id>
                        <phase>generate-sources</phase>
                        <configuration>
                            <wsdlOptions>
                                <wsdlOption>
                                    <wsdl>src/main/resources/hello.wsdl</wsdl>
                              <faultSerialVersionUID>1</faultSerialVersionUID>
                                </wsdlOption>
                            </wsdlOptions>
```

```
                        </configuration>
                        <goals>
                            <goal>wsdl2java</goal>
                        </goals>
                    </execution>
                </executions>
            </plugin>
        </plugins>
```

Note that we specify the location of the **wsdl** file as **src/main/resources/Hello.wsdl**. You will have to make sure that you create an appropriate directory structure for your project and add the earlier shown **hello.wsdl** file to the specified folder.

The **wsdl2java** plugin will compile this wsdl and create Java classes in a pre-defined folder. The full project structure is shown here for your ready reference.

```
|____cxf-wsdl
| |____pom.xml
| |____src
| | |____test
| | | |____java
| | |____main
| | | |____resources
| | | | |____Hello.wsdl
| | | |____webapp
| | | | |____WEB-INF
| | | | | |____cxf-servlet.xml
| | | | | |____web.xml
| | | |____java
| | | | |____com
| | | | | |____tutorialspoint
| | | | | | |____helloworld
| | | | | | | |____Client.java
| | | | | | | |____HelloWorldImpl.java
| | | | | | | |____Server.java
```

Now, you are ready to create a server using the **wsdl2java** generated classes. The classes that wsdl2java has created is shown in the figure below:

```
|____generated-sources
| |____annotations
| |____cxf
| | |____com
| | | |____tutorialspoint
| | | | |____helloworld
| | | | | |____Greetings.java
| | | | | |____HelloWorldPortType.java
| | | | | |____ObjectFactory.java
| | | | | |____GreetingsResponse.java
| | | | | |____HelloWorldService.java
| | | | | |____package-info.java
```

Generated Service Interface

In the list of generated classes, you must have noticed one of them is a Java interface - this is **HelloWorldPortType.java**. Examine this file in your code editor. The file contents are shown here for your ready reference:

```
//HelloWorldPortType.java
package com.tutorialspoint.helloworld;

import javax.jws.WebMethod;
import javax.jws.WebParam;
import javax.jws.WebResult;
import javax.jws.WebService;
import javax.xml.bind.annotation.XmlSeeAlso;
import javax.xml.ws.RequestWrapper;
import javax.xml.ws.ResponseWrapper;

/**
 * This class was generated by Apache CXF 3.3.0
 * 2019-02-11T12:05:55.220+05:30
 * Generated source version: 3.3.0
 *
 */
@WebService(targetNamespace = "http://helloworld.tutorialspoint.com/",
name = "HelloWorldPortType")
```

```
@XmlSeeAlso({ObjectFactory.class})
public interface HelloWorldPortType {

    @WebMethod
    @RequestWrapper(localName = "greetings", targetNamespace =
"http://helloworld.tutorialspoint.com/", className =
"com.tutorialspoint.helloworld.Greetings")
    @ResponseWrapper(localName = "greetingsResponse", targetNamespace =
"http://helloworld.tutorialspoint.com/", className =
"com.tutorialspoint.helloworld.GreetingsResponse")
    @WebResult(name = "return", targetNamespace =
"http://helloworld.tutorialspoint.com/")
    public java.lang.String greetings(
        @WebParam(name = "arg0", targetNamespace =
"http://helloworld.tutorialspoint.com/")
        java.lang.String arg0
    );
}
```

Note that the interface contains a method called **greetings**. This was a message type in our wsdl. The **wsdl2java** tool has added this method to the generated interface. Now, you can understand that whatever messages you write in your wsdl, a corresponding method would be generated in the interface.

Now, your task would be to implement all these methods corresponding to the various messages that you have defined in your wsdl. Note that in the earlier example of Java-First, we started out with a Java interface for our web service. In this case, the Java interface is created from wsdl.

Implementing the Service Interface

The implementation of service interface is trivial. The full implementation is shown in the listing below:

```
//HelloWorldImpl.java
package com.tutorialspoint.helloworld;


public class HelloWorldImpl implements HelloWorldPortType {
    @Override
    public String greetings(String name) {
        return ("hi " + name);
    }
}
```

The code implements the sole interface method called **greetings**. The method takes one parameter of **string** type, prepends a "hi" message to it and returns the resultant string to the caller.

Next, we will write the server application.

Developing Server

Developing server application is once again trivial. Here, we will use the CXF supplied **Endpoint** class to publish our service. This is done in the following two lines of code:

```
HelloWorldPortType implementor = new HelloWorldImpl();
      Endpoint.publish("http://localhost:9090/HelloServerPort",
                implementor,
                new LoggingFeature());
```

First, we create an object of our service implementor class - **HelloWorldImpl**. Then, we pass this reference as a second parameter to the **publish** method. The first parameter is the address to which the service is published - the clients would use this URL to access the service. The entire source for the server application is given here:

```
//Server.java
package com.tutorialspoint.helloworld;

import javax.xml.ws.Endpoint;
import org.apache.cxf.ext.logging.LoggingFeature;

public class Server {

    public static void main(String[] args) throws Exception {
        HelloWorldPortType implementor = new HelloWorldImpl();
        Endpoint.publish("http://localhost:9090/HelloServerPort",
                implementor,
                new LoggingFeature());
        System.out.println("Server ready...");
        Thread.sleep(5 * 60 * 1000);
        System.out.println("Server exiting");
        System.exit(0);
    }
}
```

To build this server class you will need to add a build profile in your **pom.xml**. This is shown below:

```
<profile>
            <id>server</id>
            <build>
                <defaultGoal>test</defaultGoal>
                <plugins>
                    <plugin>
                        <groupId>org.codehaus.mojo</groupId>
                        <artifactId>exec-maven-plugin</artifactId>
                        <version>1.6.0</version>
                        <executions>
                            <execution>
                                <phase>test</phase>
                                <goals>
                                    <goal>java</goal>
                                </goals>
                                <configuration>
                                    <mainClass>
com.tutorialspoint.helloworld.Server
</mainClass>
                                </configuration>
                            </execution>
                        </executions>
                    </plugin>
                </plugins>
            </build>
            <dependencies>
                <dependency>
                    <groupId>org.apache.cxf</groupId>
                    <artifactId>cxf-rt-transports-http-jetty</artifactId>
                    <version>3.3.0</version>
                </dependency>
            </dependencies>
</profile>
```

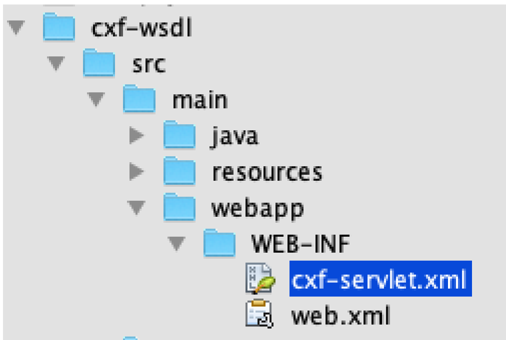
Note that the fully qualified name of the **Server** class is specified in the configuration. Also, the dependency tag specifies that we will be using the embedded jetty web server to deploy our server application.

Deploying Server

Finally, to deploy the server application, you will need to make one more modification in pom.xml to setup your application as a web application. The code that you need to add into your **pom.xml** is given below:

```
<defaultGoal>install</defaultGoal>
<pluginManagement>
    <plugins>
        <plugin>
            <artifactId>maven-war-plugin</artifactId>
            <version>3.2.2</version>
            <configuration>
                <webXml>src/main/webapp/WEB-INF/web.xml</webXml>
                <webResources>
                    <resource>x
                        <directory>src/main/resources</directory>
                        <targetPath>WEB-INF</targetPath>
                        <includes>
                            <include>*.wsdl</include>
                        </includes>
                    </resource>
                </webResources>
            </configuration>
        </plugin>
    </plugins>
</pluginManagement>
```

Before you deploy the application, you need to add two more files to your project. These are shown in the screenshot below:



These files are CXF standard files which define the mapping for **CXFServlet**. The code within the **web.xml** file is shown here for your quick reference:

```
//cxf-servlet.xml
```

```
<web-app xmlns="http://java.sun.com/xml/ns/javaee"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" version="2.5"
xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
http://java.sun.com/xml/ns/javaee/web-app_2_5.xsd">
    <display-name>cxf</display-name>
    <servlet>
        <description>Apache CXF Endpoint</description>
        <display-name>cxf</display-name>
        <servlet-name>cxf</servlet-name>
        <servlet-class>
org.apache.cxf.transport.servlet.CXFServlet
  </servlet-class>
        <load-on-startup>1</load-on-startup>
    </servlet>
    <servlet-mapping>
        <servlet-name>cxf</servlet-name>
        <url-pattern>/services/*</url-pattern>
    </servlet-mapping>
    <session-config>
        <session-timeout>60</session-timeout>
    </session-config>
</web-app>
```

In the **cxf-servlet.xml** you declare the properties for your service's endpoint. This is shown in the code snippet below:

```
<beans ...>
    <jaxws:endpoint xmlns:helloworld="http://tutorialspoint.com/"
                    id="helloHTTP"
                    address="http://localhost:9090/HelloServerPort"
                    serviceName="helloworld:HelloServiceService"
                    endpointName="helloworld:HelloServicePort"
                    >
    </jaxws:endpoint>
 /beans>
```

Here we define the id for our service endpoint, the address on which the service will be available, the service name and the endpoint name. Now, you understand how your service gets routed and processed by a CXF servlet.

The Final pom.xml

The **pom.xml** includes a few more dependencies. Rather than describing all the dependencies, we have included the final version of pom.xml below:

```
<?xml version="1.0" encoding="UTF-8"?>
<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/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.tutorialspoint</groupId>
    <artifactId>cxf-wsdl</artifactId>
    <version>1.0</version>
    <packaging>jar</packaging>
    <properties>
        <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
        <maven.compiler.source>1.8</maven.compiler.source>
        <maven.compiler.target>1.8</maven.compiler.target>
    </properties>

    <build>
        <defaultGoal>install</defaultGoal>
        <pluginManagement>
            <plugins>
                <plugin>
                    <artifactId>maven-war-plugin</artifactId>
                    <version>3.2.2</version>
                    <configuration>
                        <webXml>src/main/webapp/WEB-INF/web.xml</webXml>
                        <webResources>
                            <resource>
                                <directory>src/main/resources</directory>
                                <targetPath>WEB-INF</targetPath>
                                <includes>
                                    <include>*.wsdl</include>
                                </includes>
                            </resource>
                        </webResources>
                    </configuration>
                </plugin>
```

```
            </plugins>
        </pluginManagement>

        <plugins>
            <plugin>
                <groupId>org.apache.cxf</groupId>
                <artifactId>cxf-codegen-plugin</artifactId>
                <version>3.3.0</version>
                <executions>
                    <execution>
                        <id>generate-sources</id>
                        <phase>generate-sources</phase>
                        <configuration>
                            <wsdlOptions>
                                <wsdlOption>
                                    <wsdl>src/main/resources/Hello.wsdl</wsdl>
<faultSerialVersionUID>1</faultSerialVersionUID>
                                </wsdlOption>
                            </wsdlOptions>
                        </configuration>
                        <goals>
                            <goal>wsdl2java</goal>
                        </goals>
                    </execution>
                </executions>
            </plugin>
        </plugins>
    </build>

    <profiles>
        <profile>
            <id>server</id>
            <build>
                <defaultGoal>test</defaultGoal>
                <plugins>
                    <plugin>
                        <groupId>org.codehaus.mojo</groupId>
                        <artifactId>exec-maven-plugin</artifactId>
                        <version>1.6.0</version>
```

```
                        <executions>
                            <execution>
                                <phase>test</phase>
                                <goals>
                                    <goal>java</goal>
                                </goals>
                                <configuration>
                                    <mainClass>
com.tutorialspoint.helloworld.Server
</mainClass>
                                </configuration>
                            </execution>
                        </executions>
                    </plugin>
                </plugins>
            </build>
            <dependencies>
                <dependency>
                    <groupId>org.apache.cxf</groupId>
                    <artifactId>cxf-rt-transports-http-jetty</artifactId>
                    <version>3.3.0</version>
                </dependency>
            </dependencies>
        </profile>
        <profile>
            <id>client</id>
            <build>
                <defaultGoal>test</defaultGoal>
                <plugins>
                    <plugin>
                        <groupId>org.codehaus.mojo</groupId>
                        <artifactId>exec-maven-plugin</artifactId>
                        <executions>
                            <execution>
                                <phase>test</phase>
                                <goals>
                                    <goal>java</goal>
                                </goals>
                                <configuration>
```

```
                                    <mainClass>
com.tutorialspoint.helloworld.Client
</mainClass>
                                </configuration>
                            </execution>
                        </executions>
                    </plugin>
                </plugins>
            </build>
        </profile>
    </profiles>

    <dependencies>
        <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-frontend-jaxws</artifactId>
            <version>3.3.0</version>
        </dependency>
        <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-transports-http</artifactId>
            <version>3.3.0</version>
        </dependency>
        <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-management</artifactId>
            <version>3.3.0</version>
        </dependency>
        <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-features-metrics</artifactId>
            <version>3.3.0</version>
        </dependency>
        <dependency>
            <groupId>org.apache.cxf.xjc-utils</groupId>
            <artifactId>cxf-xjc-runtime</artifactId>
            <version>3.3.0</version>
        </dependency>
        <dependency>
```

```
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-features-logging</artifactId>
            <version>3.3.0</version>
        </dependency>
        <dependency>
            <groupId>org.codehaus.mojo</groupId>
            <artifactId>exec-maven-plugin</artifactId>
            <version>1.6.0</version>
        </dependency>
        <dependency>
            <groupId>org.slf4j</groupId>
            <artifactId>slf4j-api</artifactId>
            <version>1.8.0-beta2</version>
        </dependency>
        <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-transports-http-jetty</artifactId>
            <version>3.3.0</version>
        </dependency>
    </dependencies>
</project>
```

Note that it also includes a profile for building client that we will be learning soon in the later sections.

Running the HelloWorld Service

Now, you are ready to run the web app. In the command window, run the build script using the following command.

```
mvn clean install
```

This will generate the appropriate Java classes from your wsdl, compile your Java classes, deploy the server on the embedded jetty server and run your application.

You will see the following message on the console:

```
INFO: Setting the server's publish address to be
http://localhost:9090/HelloServerPort

Server ready…
```

As before, you can test the server by opening the server URL in your browser.

localhost:9090/HelloServerPort

This XML file does not appear to have any style information associated with it. The document tree is shown below.


```
▼<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/">
  ▼<soap:Body>
    ▼<soap:Fault>
       <faultcode>soap:Server</faultcode>
      ▼<faultstring>
         No binding operation info while invoking unknown method with params unknown.
       </faultstring>
     </soap:Fault>
   </soap:Body>
 </soap:Envelope>
```

As we did not specify any operation, only a fault message is returned to the browser by our application. Now, try adding the **?wsdl** to your URL and you will see the following output:

localhost:9090/HelloServerPor

localhost:9090/HelloServerPort?wsdl

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
▼<wsdl:definitions xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
 xmlns:tns="http://helloworld.tutorialspoint.com/" xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
 xmlns:ns1="http://schemas.xmlsoap.org/soap/http" name="HelloWorldImplService"
 targetNamespace="http://helloworld.tutorialspoint.com/">
  ▼<wsdl:types>
    ▼<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:tns="http://helloworld.tutorialspoint.com/"
     elementFormDefault="qualified" targetNamespace="http://helloworld.tutorialspoint.com/" version="1.0">
       <xs:element name="greetings" type="tns:greetings"/>
       <xs:element name="greetingsResponse" type="tns:greetingsResponse"/>
      ▼<xs:complexType name="greetings">
        ▼<xs:sequence>
           <xs:element minOccurs="0" name="arg0" type="xs:string"/>
         </xs:sequence>
       </xs:complexType>
      ▼<xs:complexType name="greetingsResponse">
        ▼<xs:sequence>
           <xs:element minOccurs="0" name="return" type="xs:string"/>
         </xs:sequence>
       </xs:complexType>
     </xs:schema>
   </wsdl:types>
  ▼<wsdl:message name="greetingsResponse">
     <wsdl:part element="tns:greetingsResponse" name="parameters"> </wsdl:part>
   </wsdl:message>
  ▼<wsdl:message name="greetings">
     <wsdl:part element="tns:greetings" name="parameters"> </wsdl:part>
   </wsdl:message>
  ▼<wsdl:portType name="HelloWorldPortType">
    ▼<wsdl:operation name="greetings">
       <wsdl:input message="tns:greetings" name="greetings"> </wsdl:input>
       <wsdl:output message="tns:greetingsResponse" name="greetingsResponse"> </wsdl:output>
     </wsdl:operation>
   </wsdl:portType>
  ▼<wsdl:binding name="HelloWorldImplServiceSoapBinding" type="tns:HelloWorldPortType">
     <soap:binding style="document" transport="http://schemas.xmlsoap.org/soap/http"/>
    ▼<wsdl:operation name="greetings">
       <soap:operation soapAction="" style="document"/>
      ▼<wsdl:input name="greetings">
         <soap:body use="literal"/>
       </wsdl:input>
      ▼<wsdl:output name="greetingsResponse">
         <soap:body use="literal"/>
       </wsdl:output>
     </wsdl:operation>
   </wsdl:binding>
  ▼<wsdl:service name="HelloWorldImplService">
    ▼<wsdl:port binding="tns:HelloWorldImplServiceSoapBinding" name="HelloWorldImplPort">
       <soap:address location="http://localhost:9090/HelloServerPort"/>
     </wsdl:port>
   </wsdl:service>
</wsdl:definitions>
```

So our server application is running as expected. You may use the SOAP Client such as **Postman** described earlier to further test your service.

The next part of this tutorial is to write a client that uses our service.

Developing Client

Writing the client in a CXF application is as important as writing a server. Here is the complete code for the client that essentially consists of only three lines, the rest of the lines just print the service information to the user.

```
//Client.java
package com.tutorialspoint.helloworld;


public class Client {


    public static void main(String[] args) throws Exception {
         //Create the service client with its default wsdlurl
        HelloWorldService helloServiceService = new HelloWorldService();


        System.out.println("service: " +
helloServiceService.getServiceName());
        System.out.println("wsdl location: " +
helloServiceService.getWSDLDocumentLocation());
        HelloWorldPortType helloService =
helloServiceService.getHelloWorldPort();
        System.out.println(helloService.greetings
(System.getProperty("user.name")));
    }
}
```

Here, we simply create an instance of our service **HelloWorldService**, get its port by calling **getHelloWorldPort** method, and then pass our **greetings** message to it. Run the client and you will see the following output:

```
service: {http://helloworld.tutorialspoint.com/}HelloWorldService
wsdl location: file:/Users/drsarang/Desktop/tutorialpoint/cxf-
wsdl/src/main/resources/Hello.wsdl
hi drsarang
```

So far you have learned how to use CXF with Java-First and WSDL-First architectures. In the Java-First approach, you used a POJO with **ServerFactoryBean** class from CXF libraries to create a server. To create a client you used **ClientProxyFactoryBean** class from CXF library. In the WSDL-First approach, you used **Endpoint** class to publish the service at the desired URL and a specified implementor. You can now extend these techniques to integrate different protocols and transports.

5. Apache CXF – CXF with JAX-RS

Before proceeding ahead into this chapter, we assume that you know how to write a RESTful web service in Java. I will show you how to use CXF on top of this JAX-RS (Java API for RESTful Web Services) . We will create a web service that maintains a list of latest movies. When the user requests a movie, he specifies the movie ID in his request, the server will locate the movie and return it to the client. In our trivial case, we will simply return the movie name to the client and not the actual binary MP4 file. So let us start creating a JAX-RS application.

Declaring Movie Element

We will declare an XML root element called Movie for storing the id and the name for a given movie. The element is declared in a file called Movie.java. The contents of the file are shown here:

```
//Movie.java
package com.tutorialspoint.cxf.jaxrs.movie;


import javax.xml.bind.annotation.XmlRootElement;


@XmlRootElement(name = "Movie")
public class Movie {


      private long id;
      private String name;


      public long getId() {
      return id;
      }


      public void setId(long id) {
      this.id = id;
      }


      public String getName() {
      return name;
      }


      public void setName(String name) {
            this.name = name;
```

```
    }
}
```

Note the use of **XmlRootElement** tag to declare the XML element for the **Movie** tag. Next, we will create a service that holds the list of movies in its database.

Creating Movie Service Database

To store the list of movies we use Java supplied **Map** that stores the key-value pairs. If the list is large, you will use an external database storage which will also be easier to manage. In our trivial case, we will store only five movies in our database. The code for the MovieService class is given below:

```
//MovieService.java
package com.tutorialspoint.cxf.jaxrs.movie;

import java.util.HashMap;
import java.util.Map;
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.PathParam;
import javax.ws.rs.Produces;

@Path("/movieservice/")
@Produces("text/xml")

public class MovieService {

    long currentId = 123;
    Map<Long, Movie> movies = new HashMap<>();

    public MovieService() {
    init();
    }

    @GET
    @Path("/movie/{id}/")
    public Movie getMovie(@PathParam("id") String id) {
    long idNumber = Long.parseLong(id);
    return movies.get(idNumber);
```

```
    }

    final void init() {
    Movie c1 = new Movie();
    c1.setName("Aquaman");
    c1.setId(1001);
    movies.put(c1.getId(), c1);

    Movie c2 = new Movie();
    c2.setName("Mission Imposssible");
    c2.setId(1002);
    movies.put(c2.getId(), c2);

    Movie c3 = new Movie();
    c3.setName("Black Panther");
    c3.setId(1003);
    movies.put(c3.getId(), c3);

    Movie c4 = new Movie();
    c4.setName("A Star is Born");
    c4.setId(1004);
    movies.put(c4.getId(), c4);

    Movie c5 = new Movie();
    c5.setName("The Meg");
    c5.setId(1005);
    movies.put(c5.getId(), c5);
    }
}
```

Note that we use the following two annotations to specify the URL path for our movie service and its return type:

```
@Path("/movieservice/")
@Produces("text/xml")
```

We use the @GET and @Path annotations to specify the URL for the GET request as follows:

```
@GET
@Path("/movie/{id}/")
```

The movie database itself is initialized in the init method, where we add five movie items to the database.

Our next task is to write a server application.

Developing Server

To create a server, we use CXF supplied **JAXRSServerFactoryBean** class.

```
JAXRSServerFactoryBean factory = new JAXRSServerFactoryBean();
```

We set its resource classes by calling the **setResourceClasses** method.

```
     factory.setResourceClasses(Movie.class);
     factory.setResourceClasses(MovieService.class);
```

We set the service provider by calling the **setResourceProvider** method.

```
     factory.setResourceProvider(MovieService.class,
                   new SingletonResourceProvider(new MovieService()));
```

We set the desired **publish** address by calling the **aetAddress** method:

```
      factory.setAddress("http://localhost:9000/");
```

Finally, we publish the server by calling the create method on the **factory** instance.

```
      factory.create();
```

The entire code for the server application is given below:

```
//Server.java
package com.tutorialspoint.cxf.jaxrs.movie;

import org.apache.cxf.jaxrs.JAXRSServerFactoryBean;
import org.apache.cxf.jaxrs.lifecycle.SingletonResourceProvider;

public class Server {

     public static void main(String[] args) throws Exception {

```

```
        JAXRSServerFactoryBean factory = new JAXRSServerFactoryBean();
        factory.setResourceClasses(Movie.class);
        factory.setResourceClasses(MovieService.class);
        factory.setResourceProvider(MovieService.class,
                     new SingletonResourceProvider(new MovieService()));
        factory.setAddress("http://localhost:9000/");
        factory.create();

        System.out.println("Server ready...");
        Thread.sleep(5 * 60 * 1000);
        System.out.println("Server exiting ...");
        System.exit(0);
        }
}
```

The Final pom.xml

Here we have included the final version of pom.xml below:

```
<?xml version="1.0" encoding="UTF-8"?>
<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/xsd/maven-4.0.0.xsd">
     <modelVersion>4.0.0</modelVersion>
     <groupId>com.tutorialspoint</groupId>
     <artifactId>cxf-jaxrs</artifactId>
     <version>1.0</version>
     <packaging>jar</packaging>

     <properties>
     <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
     <maven.compiler.source>1.8</maven.compiler.source>
     <maven.compiler.target>1.8</maven.compiler.target>
     </properties>



     <profiles>
```

```
	<profile>
		<id>server</id>
		<build>
			<defaultGoal>test</defaultGoal>
			<plugins>
			<plugin>
				<groupId>org.codehaus.mojo</groupId>
				<artifactId>exec-maven-plugin</artifactId>
				<version>1.6.0</version>
				<executions>
				<execution>
					<phase>test</phase>
					<goals>
						<goal>java</goal>
					</goals>
					<configuration>
						<mainClass>
com.tutorialspoint.cxf.jaxrs.movie.Server
</mainClass>
					</configuration>
				</execution>
				</executions>
			</plugin>
			</plugins>
		</build>
		<dependencies>
			<dependency>
			<groupId>org.apache.cxf</groupId>
			<artifactId>cxf-rt-transports-http-jetty</artifactId>
			<version>3.3.0</version>
			</dependency>
		</dependencies>
	</profile>
	<profile>
		<id>client</id>
		<build>
			<defaultGoal>test</defaultGoal>
			<plugins>
			<plugin>
```

```
                        <groupId>org.codehaus.mojo</groupId>
                        <artifactId>exec-maven-plugin</artifactId>
                        <executions>
                        <execution>
                              <phase>test</phase>
                              <goals>
                                    <goal>java</goal>
                              </goals>
                              <configuration>
                                    <mainClass>
com.tutorialspoint.cxf.jaxrs.movie.Client
</mainClass>
                              </configuration>
                        </execution>
                        </executions>
                  </plugin>
                  </plugins>
            </build>
      </profile>
      </profiles>

      <dependencies>
      <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-transports-http</artifactId>
            <version>3.3.0</version>
      </dependency>
      <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-transports-http-jetty</artifactId>
            <version>3.3.0</version>
      </dependency>
      <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-frontend-jaxrs</artifactId>
            <version>3.3.0</version>
      </dependency>
      <dependency>
            <groupId>jakarta.ws.rs</groupId>
```

```
            <artifactId>jakarta.ws.rs-api</artifactId>
            <version>2.1.5</version>
      </dependency>
      <dependency>
            <groupId>org.apache.httpcomponents</groupId>
            <artifactId>httpclient</artifactId>
            <version>4.5.7</version>
      </dependency>
      </dependencies>
</project>
```

Developing Client

Writing the RS client is trivial. We simply create a URL object and open its stream. We use CXF supplied IOUtils class to copy the contents of input stream to a local stream.

```
URL url = new URL("http://localhost:9000/movieservice/movie/1002");
        try (InputStream instream = url.openStream();
CachedOutputStream outstream = new CachedOutputStream()) {
            IOUtils.copy(instream, outstream);
```

The entire code for the client application is given below:

```
//Client.java
package com.tutorialspoint.cxf.jaxrs.movie;

import java.io.InputStream;
import java.net.URL;
import org.apache.cxf.helpers.IOUtils;
import org.apache.cxf.io.CachedOutputStream;

public class Client {

    public static void main(String[] args) throws Exception {
        URL url
= new URL("http://localhost:9000/movieservice/movie/1002");
        try (InputStream instream = url.openStream();
CachedOutputStream outstream = new CachedOutputStream()) {
            IOUtils.copy(instream, outstream);
            String str = outstream.getOut().toString();
```

```
                System.out.println(str);
            }
        }
}
```

Testing JAX-RS Application

Run the server using the following command in the command-line window:

```
mvn -Pserver
```

Now, you will see the following message on the console:

```
INFO: Setting the server's publish address to be http://localhost:9000
```

Now, open your browser and type the following URL:

```
http://localhost:9000/movieservice/movie/1002
```

You will see the following in the browser window.

localhost:9000/movieservice/movie/1002

This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
- <Movie>
    <id>1002</id>
    <name>Mission Imposssible</name>
  </Movie>
```

You may invoke the service by using a Java client application that we have developed by running the following command in a separate command-line window.

```
mvn -Pclient
```

You will see the following output:

```
<?xml version="1.0" encoding="UTF-8"
standalone="yes"?><Movie><id>1002</id><name>Mission Imposssible</name></Movie>
```

CXF samples provides several examples on how to use CXF with JAX-RS. The interested readers are encouraged to study these samples.

6. Apache CXF - CXF with JMS

As mentioned earlier, you can use CXF with JMS transport. In this case, the client will send a JMS message to a known Messaging Server. Our server application is continuously listening to the messaging server for the incoming messages. When the message arrives, it processes the message, executes the client request and sends the response as another message to the client.

As earlier, we will first create a sample server application that provides a singular web method called **sayHi**.

Creating Service Interface

The service interface for our **HelloWorld** service is shown here:

```
//HelloWorld.java
package com.tutorialspoint.service;

import javax.jws.WebMethod;
import javax.jws.WebParam;
import javax.jws.WebService;

@WebService
public interface HelloWorld {

    @WebMethod
    String sayHi(@WebParam(name = "name") String name);
}
```

Implementing Service

The implementation of the service interface is defined as follows:

```
//HelloWorldImpl.java
package com.tutorialspoint.service.impl;

import javax.jws.WebService;
import com.tutorialspoint.service.HelloWorld;

@WebService
```

```
public class HelloWorldImpl implements HelloWorld {


    @Override
    public String sayHi(String name) {
        return "Hello " + name;
    }
}
```

The implementation simply returns a Hello message to the user. As you see, the interface and its implementation are similar to all the earlier projects in this tutorial that you have studied so far.

Now, comes the most important point which is to create a server application that sets up a message queue and keeps on listening to the incoming messages.

Creating Server

In the server application, first we create a **JMS** end point as follows:

```
    private static final String JMS_ENDPOINT_URI =
        "jms:queue:test.cxf.jmstransport.queue?timeToLive=1000"
            + "&jndiConnectionFactoryName=ConnectionFactory"
            + "&jndiInitialContextFactory"
            + "=org.apache.activemq.jndi.ActiveMQInitialContextFactory"
            + "&jndiURL=tcp://localhost:61616";
```

Note that we set up a queue on a specified port that lives for a specified amount of time. We now create a messaging service by instantiating **org.apache.activemq.broker.BrokerService** class. This is a server class for **ActiveMQ** messaging server.

```
    BrokerService broker = new BrokerService();
```

You may use any other messaging server of your choice other than **ActiveMQ**. We now connect this server to a desired URI.

```
    broker.addConnector("tcp://localhost:61616");
```

We set up the directory for the data storage of the incoming messages:

```
    broker.setDataDirectory("target/activemq-data");
```

Finally, we start the server using the start method:

```
    broker.start();
```

Next, we create an instance of our service bean **HelloWorld** using the server factory bean class as used in our earlier POJO application:

```
    Object implementor = new HelloWorldImpl();
    JaxWsServerFactoryBean factory = new JaxWsServerFactoryBean();
    factory.setServiceClass(HelloWorld.class);
```

Next, we set up the JMS endpoint on the factory so that the factory will keep on listening to the incoming messages:

```
    factory.setTransportId
(JMSSpecConstants.SOAP_JMS_SPECIFICATION_TRANSPORTID);
    factory.setAddress(JMS_ENDPOINT_URI);
```

Finally, we set up the implementer class in the factory and start running it:

```
    factory.setServiceBean(implementor);
    factory.create();
```

At this point your server is up and running. Note that since we have used the factory bean class as in the POJO application, the need for CXFServlet and the web.xml file is not required.

The full server application code is shown here:

```
//ServerJMS.java
package com.tutorialspoint.server;

import java.util.Collections;
import org.apache.cxf.ext.logging.LoggingFeature;
import org.apache.cxf.jaxws.JaxWsServerFactoryBean;
import org.apache.cxf.transport.jms.spec.JMSSpecConstants;
import com.tutorialspoint.service.HelloWorld;
import com.tutorialspoint.service.impl.HelloWorldImpl;
import org.apache.activemq.broker.BrokerService;

public final class ServerJMS {

    private static final String JMS_ENDPOINT_URI =
        "jms:queue:test.cxf.jmstransport.queue?timeToLive=1000"
            + "&jndiConnectionFactoryName=ConnectionFactory"
            + "&jndiInitialContextFactory"
```

```
            + "=org.apache.activemq.jndi.ActiveMQInitialContextFactory"
            + "&jndiURL=tcp://localhost:61616";

    public static void main(String[] args) throws Exception {

        BrokerService broker = new BrokerService();
        broker.addConnector("tcp://localhost:61616");
        broker.setDataDirectory("target/activemq-data");
        broker.start();

        Object implementor = new HelloWorldImpl();
        JaxWsServerFactoryBean factory = new JaxWsServerFactoryBean();
        factory.setServiceClass(HelloWorld.class);
        factory.setTransportId
(JMSSpecConstants.SOAP_JMS_SPECIFICATION_TRANSPORTID);
        factory.setAddress(JMS_ENDPOINT_URI);
        factory.setServiceBean(implementor);
        factory.setFeatures(Collections.singletonList(new
LoggingFeature()));
        factory.create();

        System.out.println("Server ready...");
        Thread.sleep(5 * 60 * 1000);
        System.out.println("Server exiting");
        System.exit(0);
    }
}
```

Adding Dependencies

The server application that we have created uses ActiveMQ messaging server. Thus, you will need to add few more dependencies to your project. The complete pom.xml file is shown here for you to understand the additional needed dependencies.

```
<?xml version="1.0" encoding="UTF-8"?>
<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/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.tutorialspoint</groupId>
    <artifactId>cxf-jms</artifactId>
```

```
    <version>1.0</version>
    <packaging>jar</packaging>

    <properties>
        <project.build.sourceEncoding>UTF-
8</project.build.sourceEncoding>
        <maven.compiler.source>1.8</maven.compiler.source>
        <maven.compiler.target>1.8</maven.compiler.target>
    </properties>

    <profiles>
        <profile>
            <id>server</id>
            <build>
                <defaultGoal>test</defaultGoal>
                <plugins>
                    <plugin>
                        <groupId>org.codehaus.mojo</groupId>
                        <artifactId>exec-maven-plugin</artifactId>
                        <version>1.6.0</version>
                        <executions>
                            <execution>
                                <phase>test</phase>
                                <goals>
                                    <goal>java</goal>
                                </goals>
                                <configuration>
                                    <mainClass>
com.tutorialspoint.server.ServerJMS
</mainClass>
                                </configuration>
                            </execution>
                        </executions>
                    </plugin>
                </plugins>
            </build>
        </profile>
        <profile>
            <id>client</id>
            <build>
```

```
                <defaultGoal>test</defaultGoal>
                <plugins>
                    <plugin>
                        <groupId>org.codehaus.mojo</groupId>
                        <artifactId>exec-maven-plugin</artifactId>
                        <executions>
                            <execution>
                                <phase>test</phase>
                                <goals>
                                    <goal>java</goal>
                                </goals>
                                <configuration>
                                    <mainClass>
com.tutorialspoint.client.ClientJMS
</mainClass>
                                </configuration>
                            </execution>
                        </executions>
                    </plugin>
                </plugins>
            </build>
        </profile>
    </profiles>

    <dependencies>
        <dependency>
            <groupId>org.apache.activemq</groupId>
            <artifactId>activemq-broker</artifactId>
            <version>5.15.8</version>
        </dependency>
        <dependency>
            <groupId>org.apache.activemq</groupId>
            <artifactId>activemq-kahadb-store</artifactId>
            <version>5.15.8</version>
        </dependency>
        <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-frontend-jaxws</artifactId>
            <version>3.3.0</version>
        </dependency>
```

```
        <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-transports-jms</artifactId>
            <version>3.3.0</version>
        </dependency>
        <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-features-logging</artifactId>
            <version>3.3.0</version>
        </dependency>
        <dependency>
            <groupId>org.apache.cxf</groupId>
            <artifactId>cxf-rt-transports-http-jetty</artifactId>
            <version>3.3.0</version>
        </dependency>
    </dependencies>
</project>
```

Running Server

To start running the server, as in the earlier cases, type the following command in your command window:

```
mvn -Pserver
```

This will start the ActiveMQ message server, set up the messaging queue and create a factory bean that keeps listening to this queue.

Our next task is to create a client application.

Creating Client

In the client application, first we set up the JMS endpoint same as the one used in the server application:

```
private static final String JMS_ENDPOINT_URI =
    "jms:queue:test.cxf.jmstransport.queue?timeToLive=1000"
            + "&jndiConnectionFactoryName=ConnectionFactory"
            + "&jndiInitialContextFactory"
            + "=org.apache.activemq.jndi.ActiveMQInitialContextFactory"
            + "&jndiURL=tcp://localhost:61616";
```

We create a factory as in the POJO application.

```
    JaxWsProxyFactoryBean factory = new JaxWsProxyFactoryBean();
```

We set the endpoint URI and the implementer class as follows:

```
    factory.setTransportId
                (JMSSpecConstants.SOAP_JMS_SPECIFICATION_TRANSPORTID);
    factory.setAddress(JMS_ENDPOINT_URI);
    HelloWorld client = factory.create(HelloWorld.class);
```

Finally, we call the service method and print its resultant output:

```
    String reply = client.sayHi("TutorialsPoint");
    System.out.println(reply);
```

The complete client code is given below:

```
// ClientJMS.java
package com.tutorialspoint.client;

import com.tutorialspoint.service.HelloWorld;
import org.apache.cxf.jaxws.JaxWsProxyFactoryBean;
import org.apache.cxf.transport.jms.spec.JMSSpecConstants;

public final class ClientJMS {

    private static final String JMS_ENDPOINT_URI =
        "jms:queue:test.cxf.jmstransport.queue?timeToLive=1000"
            + "&jndiConnectionFactoryName=ConnectionFactory"
            + "&jndiInitialContextFactory"
            + "=org.apache.activemq.jndi.ActiveMQInitialContextFactory"
            + "&jndiURL=tcp://localhost:61616";

    public static void main(String[] args) throws Exception {

        JaxWsProxyFactoryBean factory = new JaxWsProxyFactoryBean();
        factory.setTransportId
                (JMSSpecConstants.SOAP_JMS_SPECIFICATION_TRANSPORTID);
        factory.setAddress(JMS_ENDPOINT_URI);
```

```
        HelloWorld client = factory.create(HelloWorld.class);
        String reply = client.sayHi("TutorialsPoint");
        System.out.println(reply);
        System.exit(0);
    }
}
```

7. Apache CXF - Conclusion

CXF provides a unified approach to mix-n-match several web protocols and transports that exist in today's world for creating web applications. You learned how to start with a traditional Java interface to create a web application that uses CXF. Next, you learned how to create a web application and its client starting with WSDL.

The WSDL provides an XML representation of your service interface. You used wsdl2java tool to create Java interfaces from WSDL and finally wrote both the server and the client using the created interfaces. The tutorial also briefly introduced you to use CXF in your RESTful web service application. Finally, we also discussed how CXF can be used with JMS. You may now refer to CXF-samples for further study.

Note: The entire project source code may be downloaded from here.