Bare JAX-WS

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Abstract

This document is a member of the Bare Series of WAS topics distributed in both stand-alone and in collection form. The latest renderings and source are available on GitHub at http://pglezen.github.io/was-config.

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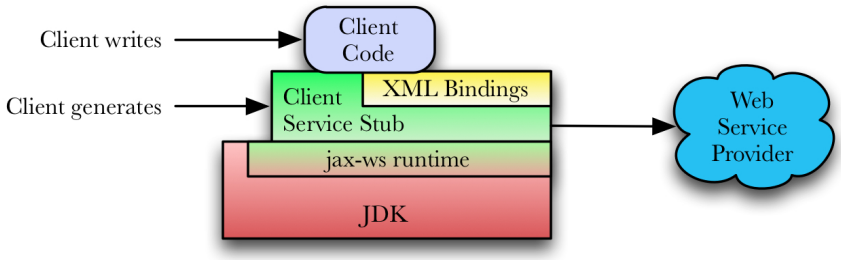
1. Bare JAX-WS Web Services

1.1. JAX-WS Clients

Java **A**PI for **X**ML - **W**eb **S**ervices (JAX-WS) is a specification that addresses Java web services development. For web service clients, this amounts to generating Java client service stubs and XML bindings for use in invoking the web service. Figure 1 illustrates how these components fit together. The green and yellow components are generated from the WSDL. The green is the service stub. Its objects make the remote call to the service provider. The yellow represents the XML-type-to-Java-type bindings (or simply XML bindings). The XML bindings are actually addressed by a separate specification called **J**ava **A**PI for **X**ML **B**indings (JAXB) that is referenced by JAX-WS. This is part of what makes JAX-WS so much more powerful than its predecessor, **J**ava **A**PI for **X**ML - **R**emote **P**rocedure **C**all (JAX-RPC).

Figure 1. JAX-WS Overview



Another recent improvement is the inclusion of the JAX-WS runtime in the Java 6 SE (standard edition). One no longer needs to reference special "thin client" libraries to make web service clients run. The generated bindings run directly against a Java 6 or later runtime. And not only are the runtime classes available in the JRE, the *wsimport* utility, responsible for generating the bindings from the WSDL, is part of the JDK on any platform. No special IDEs or tools are needed.

The XML bindings are Java classes that map to the XML schema types defined in the WSDL. (One says that a Java type is bound to the XML schema type.) These types play the role of parameters for the service invocation. The invocation

functions themselves are methods on the service stub objects. The bindings objects are passed as parameters to the service objects.

The generated service and binding objects tie into the JAX-WS runtime. This may be part of the JDK as in the diagram above. Or it may be implemented by a vendor such as Apache CXF or IBM WebSphere Application Server. In any case, it is responsible for

- marshaling the data structures into a serialized XML stream, and
- implementing the network protocol to transport the XML stream to the server.

Finally, the client code is the consumer of the service. It issues the request to the service stub and does whatever it requires with the result.

Web service clients may be *managed* or *unmanaged*. Managed clients are typically associated with an application server. The client is managed in the sense that aspects of its configuration are controllable through the administrative capabilities of the application server. References to the service stub objects are usually retrieved from JNDI. Unmanaged clients, also known as *thin clients*, do not rely on any underlying application server structure for configuration. Their service client proxy objects are directly instantiated. Their configuration is usually done by setting properties on the service stub instances. There is nothing wrong with running a thin client inside an application server. It simply won't benefit from enterprise manageability features.

1.1.1. Thin Clients

A thin client is one that does not expect the presense of any application server infrastructure. That's not to say a thin client can't run within an application server container. It simply doesn't depend on the container for resources or initialization.

Generating a thin client is easy and requires nothing more than a valid WSDL and JDK 6. The command for generating the JAX-WS bindings is **wsimport**. It should be in your command line path so long as your JDK is. To verify its version and presence in your path, query its version.

```
$ wsimport -version
JAX-WS RI 2.1.6 in JDK 6
$
```

We'll use the WSDL listed in Section 2.1. It's a standalone WSDL file with a single operation that queries information about a credit card account. Let's start with the following invocation of wsimport.

```
thinclient$ wsimport -d bin -s src -p org.acme.cc.jaxws ccQuery.wsdl
parsing WSDL...
generating code...
compiling code...
thinclient$
```

The options have the following meanings.

- `-d` directory into which the compiled class files are placed
- `-s` directory into which the source code is generated
- `-p` package into which the source code is generated

If you run this command without first creating the `bin` and `src` directories, the command will give an error. Otherwise you get the following generated bindings classes.

```
thinclient/src/org/acme/cc/jaxws$ ls -l
```

```
total 64
-rw-r--r--  1 pglezen  staff  1073 Jun 16 13:42 CCPortType.java
-rw-r--r--  1 pglezen  staff  2341 Jun 16 13:42 CCService.java
-rw-r--r--  1 pglezen  staff  1363 Jun 16 13:42 ObjectFactory.java
-rw-r--r--  1 pglezen  staff  1813 Jun 16 13:42 QueryFault.java
-rw-r--r--  1 pglezen  staff  1053 Jun 16 13:42 QueryFaultMsg.java
-rw-r--r--  1 pglezen  staff  2061 Jun 16 13:42 QueryRequest.java
-rw-r--r--  1 pglezen  staff  3727 Jun 16 13:42 QueryResponse.java
-rw-r--r--  1 pglezen  staff   108 Jun 16 13:42 package-info.java
thinclient/src/org/acme/cc/jaxws$
```

The problem with this generation of bindings concerns the `CCService` class. It needs to find a copy of the WSDL and without any additional arguments to **wsimport**, it uses the fully-qualified path name to the WSDL file from which the bindings were generated.

```
URL baseUrl;
baseUrl = org.acme.cc.jaxws.CCService.class.getResource(".");
url = new URL(baseUrl, "file:/Users/pglezen/thinclient/ccQuery.wsdl");
```

Clearly we don't want code referencing an absolute path on a developer's workstation. We provide information to **wsimport** via the `-wsdllocation`. From the code snippet above, one can see that the base of the URL begins with the package directory of the class itself. The WSDL will be found if we add it to the directory holding `CCService.java`.

```
thinclient$ wsimport -d bin -s src -p org.acme.cc.jaxws -wsdllocation ccQuery.wsdl
 ccQuery.wsdl
```

This results in the following snippet in `CCService.java`.

```
URL baseUrl;
baseUrl = org.acme.cc.jaxws.CCService.class.getResource(".");
url = new URL(baseUrl, "ccQuery.wsdl");
```

But then we have to make sure to copy the WSDL file to the source directory where `CCService.java` resides. An alternative is to count the directory levels between `CCService.java` (four in this case) and specify this to the **wsimport**. Then we can simply place copy the WSDL to the `bin` directory.

```
thinclient$ wsimport -d bin -s src -p org.acme.cc.jaxws
            -wsdllocation ../../../../ccQuery.wsdl ccQuery.wsdl
```

This result in the following snippet in `CCService.java`.

```
try {
  URL baseUrl;
  baseUrl = org.acme.cc.jaxws.CCService.class.getResource(".");
  url = new URL(baseUrl, "../../../../ccQuery.wsdl");
} catch (MalformedURLException e) {
  logger.warning("Failed to create URL for the wsdl
          Location: '../../../../ccQuery.wsdl', retrying as a local file");
  logger.warning(e.getMessage());
}
```

It makes for a funny-looking warning message if the WSDL is not found. The lesser evil is probably a matter of choice.

The final step is a main method to drive everything. An example is shown in Example 1. If `Main.java` is in the current directory, it may be compiled as shown below.

```
pglezen:~/thinclient$ ls
Main.java bin/    ccQuery.wsdl  src/
pglezen:~/thinclient$ javac -d bin -classpath bin Main.java
pglezen:~/thinclient$
```

The `-d` option tells **javac** the root directory in which to place the class files. By putting it relative to `bin` directory, it will be placed with the bindings. Since the `Main` class references the bindings, and the bindings have already been compiled into the `bin` directory, it is all that's needed for the `-classpath` option.

Example 1. Main.java

```
package org.acme.cc.client;

import java.util.Map;

import javax.xml.ws.BindingProvider;

import org.acme.cc.jaxws.CCService;
import org.acme.cc.jaxws.CCPortType;
import org.acme.cc.jaxws.QueryRequest;
import org.acme.cc.jaxws.QueryResponse;
import org.acme.cc.jaxws.QueryFaultMsg;

public class Main {

   public static void main(String[] args) {
      String endpointUrl = "http://localhost:9080/cc/CCService";
      if (args.length == 1) {
         endpointUrl = args[0];
      }
      System.out.println("Using endpoint URL " + endpointUrl);
      CCService service = new CCService();  ❶
      CCPortType port = service.getCCPort();  ❷
      BindingProvider bp = (BindingProvider)port;  ❸
      Map<String, Object> reqCtx = bp.getRequestContext();
      reqCtx.put("javax.xml.ws.service.endpoint.address", endpointUrl);

      QueryRequest request = new QueryRequest();
      request.setCcNo("2982-3929-5122-4829");
      request.setLastName("Brown");

      QueryResponse response = null;

      try {
         response = port.query(request);  ❹
      System.out.println("Remote method returned.");
      } catch (QueryFaultMsg fault) {
         System.out.println("Caught service exception.");
         System.out.println("\tmsg = " + fault);
      }
      if (response != null) {
         System.out.println("Got response.");
         System.out.println("Account Num = " + response.getAcctNo());
         System.out.println(" First name = " + response.getFirstName());
         System.out.println("    Balance = " + response.getBalance());
      }
   }
}
```

❶ The `CCService` class corresponds to the `<wsdl:service>` definition that starts on line 79 of Section 2.1. This class extends `javax.xml.ws.Service` as required by the JAX-WS specification.

❷ The `CCPortType` interface corresponds to the `<wsdl:portType>` definition that starts on line 52 of Section 2.1. The implementation is retrieved using the `getCCPort()` method on the service class. Such a method

exists on the service class for each `<wsdl:port>` defined as in line 80 of Section 2.1. Often there will be only one such definition. Examples of when there might be more are when there are multiple port-types or multiple SOAP bindings (1.1 and 1.2) for a single port-type.

❸ The cast from a `CCPortType` to a `BindingProvider` may seem dangerous since `CCPortType` does not extend `BindingProvider`. But the JAX-WS specification requires that the implementation of `CCPortType` returned by the `getCCPort()` method also implement the `BindingProvider` interface.

❹ This line is the actual remote invocation.

The `javax.xml.ws.BindingProvider` interface is key to the ability to dynamically set the remot endpoint. This and other capabitlities are described in Section 4.2.1 on the JAX-WS 2.1 specification [3].

2. Source Listings

2.1. `ccQuery.wsdl`

```
 1 <?xml version="1.0" encoding="UTF-8"?>
   <wsdl:definitions targetNamespace="urn:issw:bare:wssec:cc:query"
                           xmlns:tns="urn:issw:bare:wssec:cc:query"
                           xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
 5                         xmlns:wsdlsoap="http://schemas.xmlsoap.org/wsdl/soap/"
                           xmlns:xsd="http://www.w3.org/2001/XMLSchema">
     <wsdl:types>
       <schema targetNamespace="urn:issw:bare:wssec:cc:query"
               xmlns="http://www.w3.org/2001/XMLSchema">
10       <element name="QueryRequest">
           <complexType>
             <sequence>
               <element name="ccNo"     type="xsd:string"/>
               <element name="lastName" type="xsd:string"/>
15           </sequence>
           </complexType>
         </element>
         <element name="QueryResponse">
           <complexType>
20           <sequence>
               <element name="ccNo"      type="string"/>
               <element name="acctNo"    type="string"/>
               <element name="lastName"  type="string"/>
               <element name="firstName" type="string"/>
25             <element name="balance"   type="int"/>
             </sequence>
           </complexType>
         </element>
         <element name="QueryFault">
30         <complexType>
             <sequence>
               <element name="ccNo"  type="string"/>
               <element name="txnId" type="int"/>
             </sequence>
35         </complexType>
         </element>
       </schema>
     </wsdl:types>

40   <wsdl:message name="QueryRequestMsg">
       <wsdl:part element="tns:QueryRequest" name="parameters"/>
     </wsdl:message>
```

```
     <wsdl:message name="QueryResponseMsg">
 45    <wsdl:part element="tns:QueryResponse" name="parameters"/>
     </wsdl:message>

     <wsdl:message name="QueryFaultMsg">
       <wsdl:part element="tns:QueryFault" name="parameters"/>
 50  </wsdl:message>

     <wsdl:portType name="CCPortType">
       <wsdl:operation name="query">
          <wsdl:input  message="tns:QueryRequestMsg"  name="queryRequest"/>
 55       <wsdl:output message="tns:QueryResponseMsg" name="queryResponse"/>
          <wsdl:fault  message="tns:QueryFaultMsg"    name="queryFault"/>
       </wsdl:operation>
     </wsdl:portType>

 60  <wsdl:binding name="CCSoapBinding" type="tns:CCPortType">
       <wsdlsoap:binding style="document" transport="http://schemas.xmlsoap.org/soap/
http"/>
       <wsdl:operation name="query">
         <wsdlsoap:operation soapAction="ccQuery" style="document"/>

 65      <wsdl:input name="queryRequest">
           <wsdlsoap:body use="literal"/>
         </wsdl:input>

         <wsdl:output name="queryResponse">
 70        <wsdlsoap:body use="literal"/>
         </wsdl:output>

         <wsdl:fault name="queryFault">
           <wsdlsoap:fault name="queryFault" use="literal"/>
 75      </wsdl:fault>
       </wsdl:operation>
     </wsdl:binding>

     <wsdl:service name="CCService">
 80    <wsdl:port binding="tns:CCSoapBinding" name="CCPort">
         <wsdlsoap:address location="http://localhost/services/statement"/>
       </wsdl:port>
     </wsdl:service>
   </wsdl:definitions>
 85
```

3. References

[1] WAS 8.0 Info Center, IBM. Online: http://pic.dhe.ibm.com/infocenter/wasinfo/v8r0/

[2] WS-SecurityPolicy 1.2 Specification, December, 2006. OASIS. Online: http://docs.oasis-open.org/ws-sx/ws-securitypolicy/200512

[3] JAX-WS 1.2 Specification, May, 2007. Sun Microsystems, Inc. Online: http://jcp.org/aboutJava/communityprocess/mrel/jsr224/index2.html

[4] Developing Web Service Applications, IBM. Red Paper Online: http://www.redbooks.ibm.com/redpapers/pdfs/redp4884.pdf