pro!vision

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Apache CXF and Sling

Consuming and Publishing SOAP Services

About Me

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Spezialized Solution Provider for CMS and Web Projects
International Day CQ Projects since 2003
Customers in Automotive and Telecommunication
Adobe Premium Partner

Located in Berlin & Frankfurt am Main

Overview

- Goal: JAX-WS Support in Apache Sling
- Apache CXF Overview
- CXF and OSGi
- ClassLoader Issues & Solutions
- Sample Application
- JAX-WS SOAP Client
- JAX-WS SOAP Server

JAX-WS Support in Apache Sling

- Goals
  - Consume SOAP Webservices from Sling Applications
  - Publish SOAP Webservices in Apache Sling
    - e.g. for delivering Content from JCR
  - Generate Proxy-Classes from WSDL
  - Use JAX-WS with JAXB Annotations
  - Support for latest WS-* Standards
    - e.g. WS-Addressing

JAX-WS Support in Apache Sling

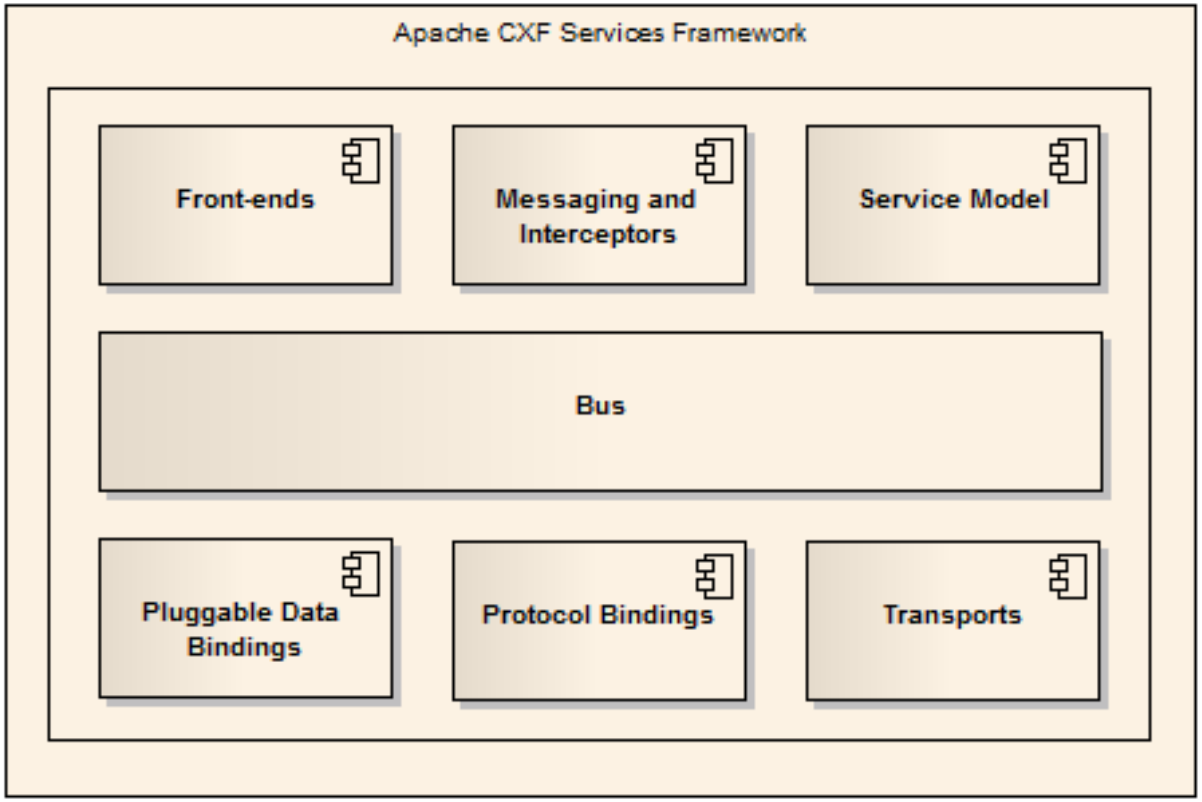
- JAX-WS vs. JAX-RS
  - In this talk we focus on JAX-WS (for SOAP Webservices), not JAX-RS (for RESTful Services)
  - Apache Sling has it's own RESTful concepts
  - See SLING-2192 for an Example of integrating JAX-RS Support in Apache Sling using Apache Wink
  - Basically the integration should work for JAX-RS as well

Apache CXF Overview

- **Apache CXF:**
  An Open-Source Services Framework
  - Implements APIs like JAX-WS and JAX-RS
  - Speaks a variety of protocols such as SOAP, XML/HTTP, RESTful HTTP vie HTTP, JMS etc.
  - Supports various WS-* web service specs
  - Flexible and highly configurable
  - Optimized for integration with Spring (but we will use it standalone)

Apache CXF Overview

- Overall CXF architecture



Apache CXF Overview

- **Depends internally on XML APIs and 3rdparty Implementations**

Available in JDK 1.6

- javax.jws.soap
- javax.xml.bind
- javax.xml.soap
- javax.xml.ws
- javax.activation
- ....

Others

- com.ctc.wstx
- org.codehaus.stax2
- com.ibm.wsdl
- org.apache.xml.resolver
- org.apache.ws.commons.schema
- ...

- **Goal: Supply CXF with all required dependencies internally, but export only org.apache.cxf.***

CXF and OSGi

- CXF provides prepacked OSGI bundle JARs:
  - **cxf-bundle-minimal**
    - Contains minimal set of CXF JARs in one single bundle
    - Does not contain 3rdparty Dependencies/XML APIs
  - **cxf-dosgi-ri-singlebundle-distribution**
    - Contains minimal set of CXF JARs in one single bundle
    - Contains all 3rdparty Dependencies and XML APIs
    - Contains a lot of additional JARs like Spring, Jetty, PAX, cxf-dosgi, slf4j, Commons Logging, log4j, jdom etc.
    - Reference Implementation of Distribution Provider component of the OSGi Remote Services Specification

CXF and OSGi

- Both approaches have drawbacks
  - **cxf-bundle-minimal**
    - Dozens of additional 3rdparty Bundles needed
  - **cxf-dosgi-ri-singlebundle-distribution**
    - Works, but is much more than we wanted
    - Contains dependencies that are exported already from system bundle
    - "Feels unstable" in Sling Environment e.g. when starting/stopping bundle

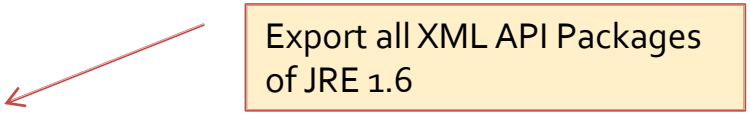
CXF and OSGi

- Solution
  - **System Bundle Extension for XML APIs included in JRE 1.6**
    - See also discussion in SLING-2103
    - *Sample project: framework-extension-xml-jre-1.6*
  - **Handcrafted CXF Bundle**
    - Repackages required CXF JARs including 3rdparty References needed for JAX-WS
    - References XML APIs from System Bundle
    - Keeps single JARs in Bundle to avoid problems with CXF Bus configuration (overlapping META-INF/cxf resources)
    - *Sample project: cxfbundle*
  - **With JRE 1.5**: Use cxf-dosgi-ri-singlebundle-distribution

- System Bundle Extension XML APIs JRE 1.6

framework-extension-xml-jre-1.6/pom.xml

```
<project>
    <artifactId>org.apache.sling.fragment.xml-jre-1.6</artifactId>
    <version>0.0.1-SNAPSHOT</version>
    <packaging>jar</packaging>
    <name>Apache Sling System Bundle Extension: XML APIs for JRE 1.6</name>
...
            <plugin>
                <artifactId>maven-jar-plugin</artifactId>
                <configuration>
                    <forceCreation>true</forceCreation>
                    <archive>
                        <manifestFile>
                            ${project.build.outputDirectory}/META-INF/MANIFEST.MF
                        </manifestFile>
                        <manifestEntries>
                            <Export-Package>
                                javax.xml,
                                javax.xml.bind,
                                javax.xml.bind.annotation,
                                javax.xml.bind.annotation.adapters,
                                javax.xml.bind.attachment,
                                javax.xml.bind.helpers,
                                javax.xml.bind.util,
                                ...
                            </Export-Package>
                        </manifestEntries>
                    </archive>
                </configuration>
            </plugin>
...
</project>
```



see also http://blog.meschberger.ch/2008/10/osgi-framework-extension-as-maven.html

Handcrafted CXF Bundle

cxfbundle/pom.xml

```
<project>
  <artifactId>adaptto.slingcxf.cxfbundle</artifactId>
  <packaging>bundle</packaging>
  <version>1.0.0-SNAPSHOT</version>
  <name>.adaptTo() CXF Bundle</name>
...
      <plugin>
        <groupId>org.apache.felix</groupId>
        <artifactId>maven-bundle-plugin</artifactId>
        <extensions>true</extensions>
        <configuration>
          <instructions>

            <!-- bundle supplied resource prefixes -->
            <Include-Resource>{maven-resources}</Include-Resource>

            <!-- Do not inline jars, include as jar files -->
            <Embed-Dependency>*;scope=compile|runtime;inline=false</Embed-Dependency>
            <Embed-Transitive>true</Embed-Transitive>

            <!-- use _exportcontents instead of Export-Package to avoid conflict with Embed-Dependency an inline=true -->
            <_exportcontents>
              org.apache.cxf.*;version=${project.version}
            </_exportcontents>

            <!-- declare optional dependencies -->
            <Import-Package>
              com.sun.msv.*;resolution:=optional,
              com.sun.xml.bind.marshaller.*;resolution:=optional,
              com.sun.xml.fastinfoset.stax.*;resolution:=optional,
              ...
              *
            </Import-Package>

          </instructions>
        </configuration>
      </plugin>
...
</project>
```

Include all dependencies (except those excluded by <exclusion> Elements in the <dependencies> Section) as Inline JARs

Export only Apache CXF API

Ignore some imports to external 3rdparty Libraries not required for our usecases

but see also http://blog.meschberger.ch/2011/04/to-embed-or-to-inline.html

ClassLoader Issues & Solutions

- We've got our OSGI Bundles, let's use CXF
- But every call fails with errors like:

```
Caused by: javax.xml.bind.JAXBException
        at javax.xml.bind.ContextFinder.newInstance(Unknown Source)
        at javax.xml.bind.ContextFinder.find(Unknown Source)
        at javax.xml.bind.JAXBContext.newInstance(Unknown Source)
        at org.apache.cxf.jaxb.JAXBContextCache.createContext(JAXBContextCache.java:258)
        at org.apache.cxf.jaxb.JAXBContextCache.getCachedContextAndSchemas(JAXBContextCache.java:167)
        at org.apache.cxf.jaxb.JAXBDataBinding.createJAXBContextAndSchemas(JAXBDataBinding.java:418)
        at org.apache.cxf.jaxb.JAXBDataBinding.initialize(JAXBDataBinding.java:290)
        ... 75 more
Caused by: java.lang.ClassNotFoundException: com.sun.xml.internal.bind.v2.ContextFactory
        at
      org.apache.sling.commons.classloader.impl.ClassLoaderFacade.loadClass(ClassLoaderFacade.java:127)
        at java.lang.ClassLoader.loadClass(Unknown Source)
        at javax.xml.bind.ContextFinder.safeLoadClass(Unknown Source)
        ... 82 more
```

- (Stacktraces and classes not found vary)

ClassLoader Issues & Solutions

- Reason: Illegal class loading in OSGI context
  - Referenced library calls currentThread.getContextClassLoader().loadClass
  - In this case it's not CXF, but the JAXB implementation
  - We cannot fix the 3rdparty Implementation

- Solution
  - See CQ5 KB Article: OsgiClassLoading3Party.html

```
ClassLoader oldClassLoader = Thread.currentThread().getContextClassLoader();
Thread.currentThread().setContextClassLoader(FrameworkXYZ.class.getClassLoader());
try {
  // execute 3rd party code
} finally {
  Thread.currentThread().setContextClassLoader(oldClassLoader);
}
```

Reference class from 3rdparty Bundle which is executed

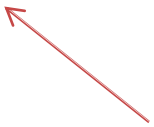
Sample Application

- Directory structure
  - framework-extension-xml-jre-1.6
    - System bundle extension for XML APIs in JRE 1.6
  - cxfbundle
    - Handcrafted OSGI bundle for CXF incl. dependencies
  - helloworld-proxy
    - Auto-generated Proxy classes for Webservice with JAX-WS/JAXB Annotations (from WSDL)
  - helloworld-application
    - Sample Sling application with SOAP Client and Server
  - See README.txt

Sample Application

- Generate Proxy classes from WSDL
  - Using Apache CXF CodeGen plugin

```
<plugin>
  <groupId>org.apache.cxf</groupId>
  <artifactId>cxf-codegen-plugin</artifactId>
  <version>${apache-cxf-version}</version>
  <executions>
    <execution>
      <id>generate-sources</id>
      <phase>generate-sources</phase>
      <configuration>
        <sourceRoot>${project.build.directory}/generated/cxf</sourceRoot>
        <wsdlRoot>${basedir}/src/main/wsdl</wsdlRoot>
        <wsdlOptions>
          <wsdlOption>
            <wsdl>${basedir}/src/main/wsdl/helloworld.wsdl</wsdl>
          </wsdlOption>
        </wsdlOptions>
      </configuration>
      <goals>
        <goal>wsdl2java</goal>
      </goals>
    </execution>
  </executions>
</plugin>
```



This is our „hello world“ Sample WSDL

Sample Application

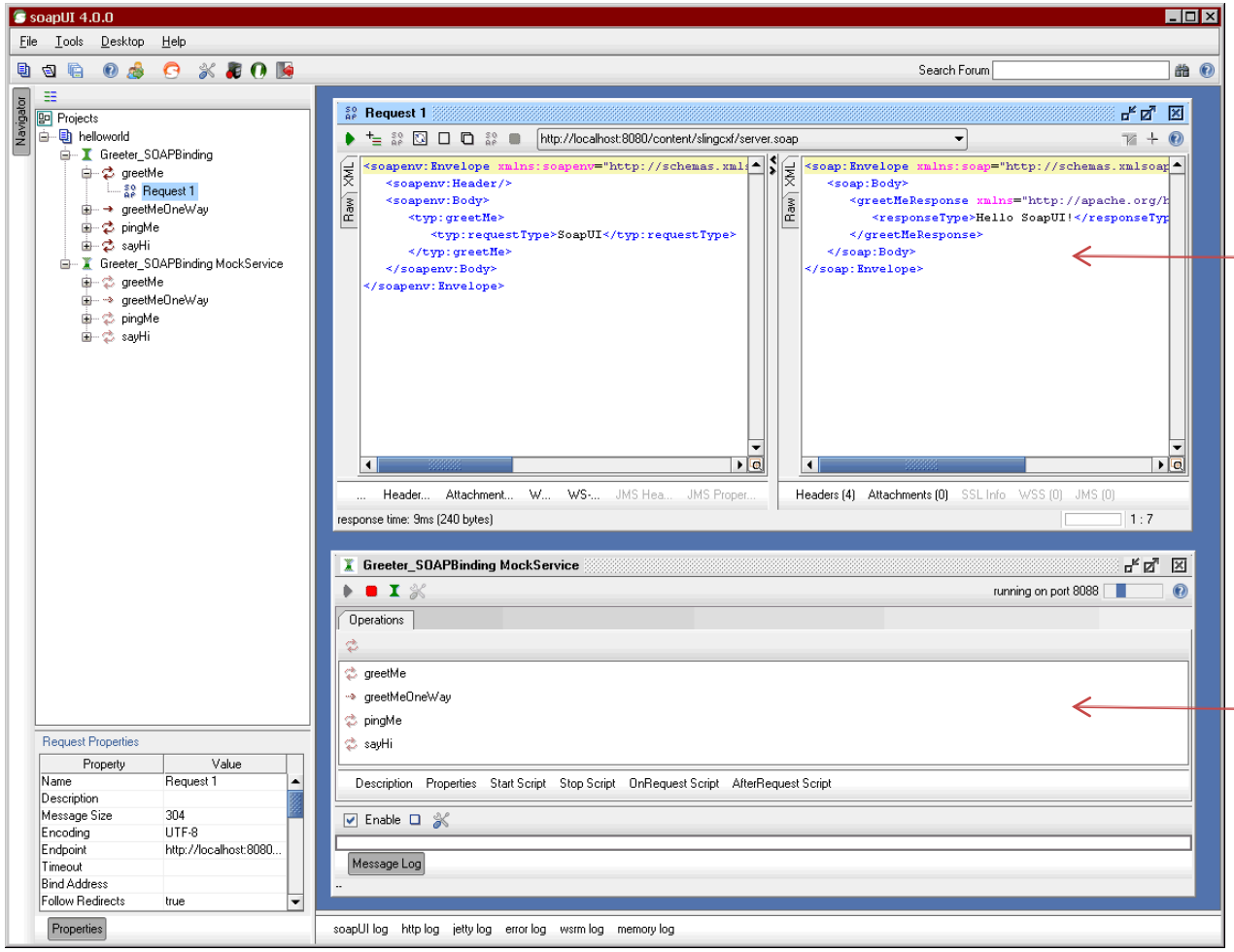
- Interface of Sample Webservice
  - with JAXB/JAX-WS Annotations

```
@WebService(targetNamespace = "http://apache.org/hello_world_soap_http", name = "Greeter")
@XmlSeeAlso({org.apache.hello_world_soap_http.types.ObjectFactory.class})
public interface Greeter {

    @WebResult(name = "responseType", targetNamespace =
       "http://apache.org/hello_world_soap_http/types")
    @RequestWrapper(localName = "greetMe", targetNamespace =
       "http://apache.org/hello_world_soap_http/types", className =
       "org.apache.hello_world_soap_http.types.GreetMe")
    @WebMethod
    @ResponseWrapper(localName = "greetMeResponse", targetNamespace =
       "http://apache.org/hello_world_soap_http/types", className =
       "org.apache.hello_world_soap_http.types.GreetMeResponse")
    public java.lang.String greetMe(
        @WebParam(name = "requestType", targetNamespace =
       "http://apache.org/hello_world_soap_http/types")
        java.lang.String requestType
    );

...

}
```

We will use this method for our sample usecases

Sample Application

- Testing against SoapUI



Download from:
http://www.soapui.org/

Test SOAP Call to SOAP Server in Apache Sling

SOAP Mock Service to Test SOAP Call from Apache Sling

JAX-WS SOAP Client

- Goals
  - Do not clutter application code with ClassLoader handling code
  - Create generic factory methods to get read-to-use proxy objects
  - Ensure correct ClassLoader handling on Proxy initialization and on invoke of a SOAP client method

JAX-WS SOAP Client

- Solution
  - Create Factory class for Client Initiliaztion
  - Create subclasses of JaxWsClientFactoryBean and ClientImpl to ensure correct ClassLoader handling on SOAP method invoke
  - Enforce usage in Factory class
- Execute SOAP client in sample project

JAX-WS SOAP Client

- ## JaxWS Client Factory

helloworld-application/src/main/java/adaptto/slingcxf/client/util/JaxWsClientFactory.java

```
/**
 * Create webservice port via JAXWS proxy factory.
 *
 * This method fixes numerous problems with 3rdparty libs used by CXF and
 * CXF itself and classloader issues with OSGI. Using this method the
 * initialization phase of JAXB mapping is wrapped in an OSGI-aware
 * classloader. Furthermore each client instances is wrapped in an
 * OSGI-aware subclass (see {@link OsgiAwareClientImpl}), which ensures that
 * each invoke call on a webservice method is itself executed within an
 * OSGI-aware classloader context.
 *
 * @param <T> Port class
 * @param pClass Port class
 * @param pPortUrl Port url (this is not the WSDL location)
 * @param pUsername Username for port authentication
 * @param pPassword Password for port authentication
 * @return Port object
 */
@SuppressWarnings("unchecked")
public static <T> T create(Class<T> pClass, String pPortUrl) {
    ClassLoader oldClassLoader = Thread.currentThread().getContextClassLoader();
    try {
        // set classloader to CXF bundle class loader to avoid OSGI classloader problems
        Thread.currentThread().setContextClassLoader(BusFactory.class.getClassLoader());

        JaxWsProxyFactoryBean factory = new JaxWsProxyFactoryBean(new OsgiAwareClientFactoryBean());
        factory.setServiceClass(pClass);
        factory.setAddress(pPortUrl);
        return (T) factory.create();
    }
    finally {
        Thread.currentThread().setContextClassLoader(oldClassLoader);
    }
}
```

Workaround for Context ClassLoader handling

Inject custom „OSGi-aware“ implementation of factory bean

JAX-WS SOAP Client

- OsgiAwareClientFactoryBean

helloworld-application/src/main/java/adaptto/slingcxf/client/util/OsgiAwareClientFactoryBean.java

```
/**
 * Factory bean that creates {@link OsgiAwareClientImpl} objects instead of
 * {@link org.apache.cxf.endpoint.ClientImpl} objects to ensure correct
 * classloader usage in OSGI context.
 */
class OsgiAwareClientFactoryBean extends org.apache.cxf.jaxws.JaxWsClientFactoryBean {

    @Override
    protected Client createClient(Endpoint ep) {
        // use osgi-aware client impl instead of {@link
        // org.apache.cxf.endpoint.ClientImpl}
        return new OsgiAwareClientImpl(getBus(), ep, getConduitSelector());
    }

}
```

Inject custom „OSGi-aware" implementation of client implementation

JAX-WS SOAP Client

- ## OsgiAwareClientImpl

helloworld-application/src/main/java/adaptto/slingcxf/client/util/OsgiAwareClientImpl.java

```
/**
 * Enhances {@link ClientImpl} by ensuring that each webservice method invoke is
 * called within the context of an OSGI aware classloader.
 */
class OsgiAwareClientImpl extends org.apache.cxf.endpoint.ClientImpl {

    public OsgiAwareClientImpl(Bus pB, Endpoint pE, Conduit pC) {
        super(pB, pE, pC);
    }

...

    @Override
    public Object[] invoke(BindingOperationInfo pOi, Object[] pParams, Map<String, Object> pContext, Exchange pExchange)
            throws Exception {
        ClassLoader oldClassLoader = Thread.currentThread().getContextClassLoader();
        try {
            // set classloader to CXF bundle class loader to avoid OSGI classloader problems
            Thread.currentThread().setContextClassLoader(BusFactory.class.getClassLoader());

            return super.invoke(pOi, pParams, pContext, pExchange);
        } finally {
            Thread.currentThread().setContextClassLoader(oldClassLoader);
        }
    }

}
```

Workaround for Context ClassLoader handling

JAX-WS SOAP Client

- GreeterClientService
  - Allow Configuration of Webservice URL via OSGi config

helloworld-application/src/main/java/adaptto/slingcxf/client/GreeterClientService.java

```
/**
 * Service for configuring SOAP proxy client instance
 */
@Component(metatype=true, label="slingcxf Greeter Client Service")
@Service(GreeterClientService.class)
public class GreeterClientService {

    @Property(label="Greeter Webservice URL", value=GreeterClientService.DEFAULT_PORTURL)
    private static final String PROPERTY_PORTURL = "portUrl";
    private static final String DEFAULT_PORTURL = "http://localhost:8088/mockGreeter_SOAPBinding";

    private Greeter greeterInstance;
    private final Logger log = LoggerFactory.getLogger(getClass());

    @Activate
    protected final void activate(final Map<String, String> config) {
        try {
            // get port url from OSGI config
            String portUrl = PropertiesUtil.toString(config.get(PROPERTY_PORTURL), DEFAULT_PORTURL);
            // instantiate greeter SOAP client proxy
            this.greeterInstance = JaxWsClientFactory.create(Greeter.class, portUrl);
        }
        catch (RuntimeException ex) {
            log.error("Unable to instanciate SOAP service proxy client.", ex);
        }
    }

    /**
     * @return Greeter SOAP client proxy instance
     */
    public Greeter getInstance() {
        return this.greeterInstance;
    }

}
```

Create JAX-WS SOAP Client using generated Proxy Interface and our Factory method

JAX-WS SOAP Client

- Client Sample JSP
  - Executes method of SOAP webservice

helloworld-application/src/main/webapp/app-root/components/client/html.jsp

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN""http://www.w3.org/TR/1999/REC-html401-19991224/loose.dtd">
<%@page import="org.apache.hello_world_soap_http.Greeter"%>
<%@page import="adaptto.slingcxf.client.GreeterClientService"%>
<%@taglib prefix="sling" uri="http://sling.apache.org/taglibs/sling/1.0"%>
<sling:defineObjects/>
<html>
  <head>
    <title>.adaptTo() Sling CXF Integration - SOAP Client</title>
  </head>
  <body>

...

    <h2>Response from Webservice</h2>
<%
        String greetName = StringUtils.defaultString(request.getParameter("greetName"), "Apache Sling");
        GreeterClientService greeterClientService = sling.getService(GreeterClientService.class);
        Greeter greeter = greeterClientService.getInstance();
%>
        <p>Greet me: <strong><%=greeter.greetMe(greetName)%></strong></p>

  </body>

</html>
```

Execute SOAP Service method

JAX-WS SOAP Server

- Goals
  - Do not clutter application code with ClassLoader handling code
  - Transparent mapping of SOAP Action URLs in Sling Component URL name schema
  - Make use of Sling Security for Authentication
  - Provide Access to Sling Context Objects (Resource Resolver, JCR Session etc.)

JAX-WS SOAP Server

- Solution
  - Ensure SOAP Server can be initialized without Spring Context
  - Create subclass of CXFNonSpringServlet to ensure correct ClassLoader handling
  - Register as Sling Servlet and map it to a resource type
  - Map to virtual path using a RequestWrapper
  - Provide access to request context using ThreadLocal
- Execute SOAP server in sample project

JAX-WS SOAP Server

AbstractJaxWsServer part I

helloworld-application/src/main/java/adaptto/slingcxf/server/util/AbstractJaxWsServer.java

```
/**
 * Abstract servlet-based implementation for CXF-based SOAP services. Ensures
 * that correct class loader is used is during initialization and invoking
 * phases. Via getCurrentRequest() and getCurrentResponse() it is possible to
 * access these objects from SOAP method implementations.
 */
public abstract class AbstractJaxWsServer extends org.apache.cxf.transport.servlet.CXFNonSpringServlet {

    @Override
    public void init(ServletConfig pServletConfig) throws ServletException {
        ClassLoader oldClassLoader = Thread.currentThread().getContextClassLoader();
        try {
            // set classloader to CXF bundle class loader to avoid OSGI classloader problems
            Thread.currentThread().setContextClassLoader(BusFactory.class.getClassLoader());

            super.init(pServletConfig);

            // register SOAP service
            ServerFactoryBean factory = new JaxWsServerFactoryBean();
            factory.setBus(getBus());
            factory.setAddress(RequestWrapper.VIRTUAL_PATH);
            factory.setServiceClass(getServerInterfaceType());
            factory.setServiceBean(this);
            factory.create();

        } finally {
            Thread.currentThread().setContextClassLoader(oldClassLoader);
        }
    }

    /**
     * @return Interface of SOAP service
     */
    protected abstract Class getServerInterfaceType();

...
```

Workaround for Context ClassLoader handling

Map to virtual URI path (from RequestWrapper)

JAX-WS Interface class is specified by subclass

The subclass itself is the implementation of the JAX-WS SOAP Server

JAX-WS SOAP Server

- ## AbstractJaxWsServer part II

helloworld-application/src/main/java/adaptto/slingcxf/server/util/AbstractJaxWsServer.java

```
...
    @Override
    protected void invoke(HttpServletRequest pRequest, HttpServletResponse pResponse) throws ServletException {
        RequestContext.getThreadLocal().set(new RequestContext(pRequest, pResponse));
        ClassLoader oldClassLoader = Thread.currentThread().getContextClassLoader();
        try {
            // set classloader to CXF bundle class loader to avoid OSGI classloader problems
            Thread.currentThread().setContextClassLoader(BusFactory.class.getClassLoader());

            super.invoke(new RequestWrapper(pRequest), pResponse);
        } finally {
            Thread.currentThread().setContextClassLoader(oldClassLoader);
            RequestContext.getThreadLocal().remove();
        }
    }

    /**
     * @return Servlet request for current threads SOAP request
     */
    protected SlingHttpServletRequest getCurrentRequest() {
        RequestContext requestContext = RequestContext.getRequestContext();
        if (requestContext == null) {
            throw new IllegalStateException("No current soap request context available.");
        }
        return (SlingHttpServletRequest)requestContext.getRequest();
    }

    /**
     * @return Servlet response for current threads SOAP request
     */
    protected SlingHttpServletResponse getCurrentResponse() {
        RequestContext requestContext = RequestContext.getRequestContext();
        if (requestContext == null) {
            throw new IllegalStateException("No current soap request context available.");
        }
        return (SlingHttpServletResponse)requestContext.getResponse();
    }
}
```

Put Request/Response in ThreadLocal

Workaround for Context ClassLoader handling

Inject custom RequestWrapper to simulate virtual path to which the SOAP server is registered in CXF

JAX-WS SOAP Server

- ## RequestWrapper

helloworld-application/src/main/java/adaptto/slingcxf/server/util/RequestWrapper.java

```
/**
 * Request wrapper that maps all pathinfo to a virtual path, to whom the SOAP
 * services are registered to.
 */
class RequestWrapper extends javax.servlet.http.HttpServletRequestWrapper {

    public static final String VIRTUAL_PATH = "/soaprequest";

    public RequestWrapper(HttpServletRequest pRequest) {
        super(pRequest);
    }

    @Override
    public String getPathInfo() {
        return VIRTUAL_PATH;
    }

}
```

Define virtual path for request handling inside CXF

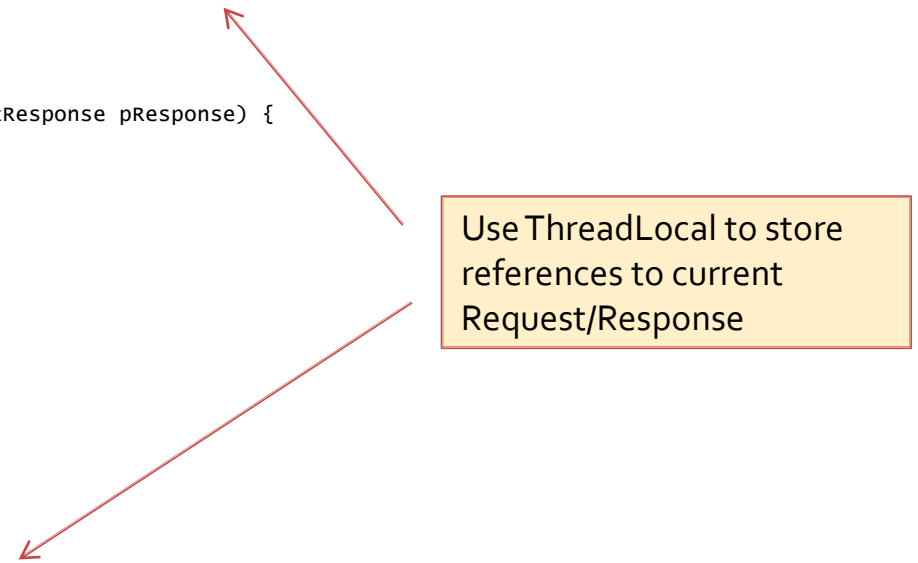
Override „getPathInfo()“ in RequestWrapper to simulate virtual path for CXF address mapping implementation

JAX-WS SOAP Server

- RequestContext

helloworld-application/src/main/java/adaptto/slingcxf/server/util/RequestContext.java

```
/**
 * Manages request/response context of incoming SOAP server HTTP requests using
 * a ThreadLocal.
 */
class RequestContext {

    private static ThreadLocal<RequestContext> mThreadLocal = new ThreadLocal<RequestContext>();

    private final HttpServletRequest mRequest;
    private final HttpServletResponse mResponse;

    RequestContext(HttpServletRequest pRequest, HttpServletResponse pResponse) {
        mRequest = pRequest;
        mResponse = pResponse;
    }

    public HttpServletRequest getRequest() {
        return mRequest;
    }

    public HttpServletResponse getResponse() {
        return mResponse;
    }

    /**
     * @return Context for current SOAP server request
     */
    public static RequestContext getRequestContext() {
        return mThreadLocal.get();
    }

    static ThreadLocal<RequestContext> getThreadLocal() {
        return mThreadLocal;
    }

}
```



JAX-WS SOAP Server

- ## Example SOAP Server implementation

helloworld-application/src/main/java/adaptto/slingcxf/server/GreeterServer.java

```
/**
 * Implementation for {@link Greeter} SOAP service.
 */
@SlingServlet(
    resourceTypes = "/apps/slingcxf/components/server",
    extensions = AbstractJaxWsServer.SOAP_EXTENSION,
    methods = { "GET", "POST" }
)
public class GreeterServer extends AbstractJaxWsServer implements Greeter {
    private static final long serialVersionUID = 1L;

    protected Class getServerInterfaceType() {
        return Greeter.class;
    }

    public void pingMe() throws PingMeFault {
        // nothing to do
    }

    public String sayHi() {
        return "Hi!";
    }

    public void greetMeOneWay(String requestType) {
        // nothing to do
    }

    public String greetMe(String name) {
        // get pattern for greeting response from JCR
        Resource resource = getCurrentRequest().getResource();
        ValueMap properties = resource.adaptTo(ValueMap.class);
        String greetResponsePattern = properties.get("greetResponsePattern", "Hello ${name}!");

        // replace placeholder with the client's name
        return StringUtils.replace(greetResponsePattern, "${name}", name);
    }

}
```

Register JAX-WS SOAP Server implementation as Sling Servlet to a resource type

Define which JAX-WS interface is implemented by this server

Sample implementation of „greetMe“ method

Q & A

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