Introduction to Apache Axis2: Next Generation Web Services

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Agenda

- What and Why Apache Axis2?
- Understanding AXIOM
- Learning Axis2 Basics
- Understanding the Deployment Model
- Axis2 Installation
- Writing a Service and Deploying using POJO (Plain Old Java Object)

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What is Apache Axis2?

- Apache Axis2 is the core engine for Web services
- It is a complete re-design and re-write of widely used Apache Axis

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What is Apache Axis?

- Apache Axis is an implementation of the SOAP
  - An envelope that defines a framework for describing what is in a message and how to process it
  - A set of encoding rules for expressing instances of application-defined data types
  - A convention for representing remote procedure calls and responses.

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Why Apache Axis2?

- More flexible, efficient, and configurable in comparison to Axis1.x
- Supports SOAP 1.1 and SOAP 1.2 as well as REST style of Web services
- Support the easy addition of plug-in "modules"
  - WS-ReliableMessaging
  - WS-Coordination and WS-AtomicTransaction
  - WS-Security
  - WS-Addressing

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Key Features of Apache Axis2 (1/4)

- Speed: much faster than the old version
  - Use its own object model and StAX
- Low memory foot print
- AXIOM: extensible, highly performance, and developer convenient
  - Light-weight object model

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Key Features of Apache Axis2 (2/4)

- Hot deployment
  - New services can be added without having to shut down the server
- Asynchronous Web services
  - Supports asynchronous Web services invocation using non-blocking clients and transports
- MEPs support
  - Support Message Exchange Patterns (MEPs)

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Key Features of Apache Axis2 (3/4)

- Transport framework
  - A clean and simple abstraction for integrating and using Transports (over various protocols such as SMTP and FTP)
- WSDL support
  - Axis2 supports WSDL 1.1 and 2.0 which allows you to easily build stubs to access remote services

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Key Features of Apache Axis2 (4/4)

- Add-ons
  - Have been incorporated with WSS4J for security, Sandesha for reliable messaging, Kandula for coordination, atomic transaction, and business activity
- Compositions and Extensibility
  - Modules and phases improve support for composability and extensibility

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Supported Specifications

- SOAP 1.1 and 1.2
- Message Transmission Optimization Mechanism (MTOM), XML Optimized Packaging (XOP) and SOAP with Attachments
- WSDL 1.1, including both SOAP and HTTP bindings
- WS-Addressing
- WS-Policy
- SAAJ 1.1

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Supported Transports and Data Bindings

- Supported Transports
  - HyperText Transfer Protocol (HTTP)
  - Simple Mail Transfer Protocol (SMTP)
  - Java Message Service (JMS)
  - Transmission Control Protocol (TCP)
- Supported Data Bindings
  - Axis Data Binding (ADB)
  - XMLBeans
  - JibX
  - JaxMe

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Tools Included in Axis2 version 1.1

- Axis2 Web Application (Web App)
- WSDL2WS
  - Eclipse plug in / Maven2 WSDL2Code Plug in
- Service Archive Wizard
  - Eclipse plug in / Maven2 AAR Plug -in
- Java2WSDL
  - Maven 2 Java2WSDL Plug-in

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Extension Modules

- Apache Rampart: Supporting WS-Security (and soon WS-Policy)
- Apache Sandesha2: Supporting Ws-Reliable Messaging
- Apache Axis2 comes built in with a module that supports WS-Addressing

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AXIOM (AXIS Object Model)

- Objects are created “on demand” using a pull model
- Allows direct access to the underlying pull stream with or without building the tree
- Allows the event based navigation of the OM tree
- Support for storing binary data

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Message Processing Stages

- There are three main stages
  - Transport Receiver
    - Transport related processing
  - Dispatching
    - Finding service and operation
  - Message Receiver
    - Last handler of the chain

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Contexts and Descriptions Hierarchy

- Descriptors keep static information
  - Information extracted from deployment descriptors
- Contexts keep runtime information
- This information needs to be in various scope
- Good to keep contexts and descriptions separate

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What's the Fuss with Deployment

- Axis 1.x deployment requires you to
  - Modify the XML files
  - Call the admin client
  - Add to the classpath
  - Restart the server
- For a beginner, a bit of headache ☹

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New Deployment Model

- Archive based deployment
  - Bundle all together and drop in
- Directory based deployment (similar structure as archive)
- Hot deployment ☺
- An archive file can contain
  - Class files
  - Third party libraries
  - Any other resources required by the service

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Axis2 Service

- Can be deployed as an archive (.aar) file or as a directory with all necessary resources
- Service configurations are given by the services.xml which contains
  - ServiceClass parameter
  - Namespaces
  - Expose transports
  - Operation
  - Modules to be engaged
  - Module configurations

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Axis2 Installation

- Download and install Java SDK
- Download and deploy a servlet container such as Apache Tomcat
- Download distribution from

http://ws.apache.org/axis2

- Copy axis2.war to <TOMCAT>/webapps folder
- Start Tomcat server
- Start URL at http://localhost:8080/axis2

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Download and Install Java SDK

- Download and install JavaSE SDK v1.5 update 9 which can be downloaded from
  - http://gear.kku.ac.th/~krunapon/xmlws >> tools >> JDK 1.5.0.09 with NetBeans Bundle
- Note that JavaSE 6 has compatibility problem with Apache Ant tool
- Set %JAVA_HOME% environment variable to the directory at where JavaSE SDK 1.5 is located

```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Krunapon>echo %JAVA_HOME%
C:\Program Files\Java\jdk1.5.0_09
```

Download a Servlet Container (Tomcat)

- In this case, we use Tomcat 5.5.20 which can be download from
  - http://tomcat.apache.org/ >> Download >> Tomcat 5.x
  - http://gear.kku.ac.th/~krunapon/xmlws >> tools >> Tomcat 5.5.20
- Unzip apache-tomcat-5.5.20.zip

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Deploy and Start Tomcat Server

- Set %CATALINA_HOME% environment variable to the Tomcat directory
- Start Tomcat server by running startup.bat which is at %CATALINA_HOME%/bin

```
C:\apache\tomcat\apache-tomcat-5.5.20\bin>startup.bat
Using CATALINA_BASE:   c:\apache\tomcat\apache-tomcat-5.5.20
Using CATALINA_HOME:   c:\apache\tomcat\apache-tomcat-5.5.20
Using CATALINA_TMPDIR: c:\apache\tomcat\apache-tomcat-5.5.20\temp
Using JRE_HOME:        C:\Program Files\Java\jdk1.5.0_09
C:\apache\tomcat\apache-tomcat-5.5.20\bin>_
```

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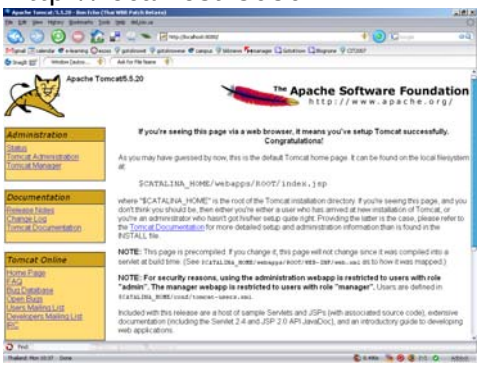
Open the Homepage of Tomcat

http://localhost:8080



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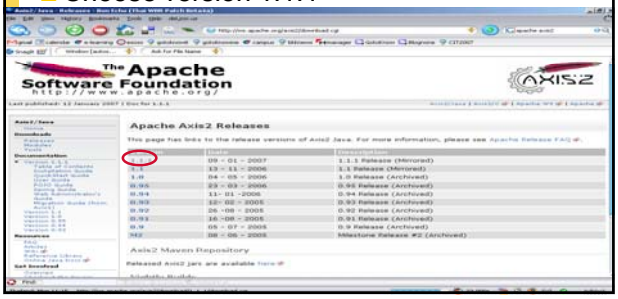
Download Apache Axis2 (1/2)

- Download Apache Axis2
  http://ws.apache.org/axis2/download.cgi
- Choose version 1.1.1



Download Apache Axis2 (2/2)

- Choose Standard Binary Distribution

- Extract axis2-1.1.1.zip
- Set %AXIS2_HOME% to the axis2 directory

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Install Apache Axis2 Overview

- Obtain axis2.war which can use one of these two methods
  - Download axis2.war from http://ws.apache.org/axis2/download/1_1_1/download.cgi
  - Create axis2.war by using Apache Ant which can be downloaded from http://ant.apache.org/bindownload.cgi
- Copy axis2.war to %CATALINA_HOME%/webapps directory

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Download axis2.war

- In Distribution Name column, choose WAR (Web Archieve Distribution)
- In Download column, choose zip

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Creating axis2.war using Apache Ant

- Download Apache Ant which can be downloaded from http://ant.apache.org/bindownload.cgi
- Set %PATH% environment variable to %ANT_HOME%/bin
- Run ant create.war at directory %AXIS2_HOME%\webapp
  - "ant" command needs the input source file "build.xml"

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Running Apache Ant

```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Krunapon>cd %AXIS2_HOME%\webapp

C:\apache\axis2-1.1.1\webapp>ant create.war
Buildfile: build.xml

init:
    [mkdir] Created dir: C:\apache\axis2-1.1.1\dist\temp
     [copy] Copying 53 files to C:\apache\axis2-1.1.1\dist\temp

prepare.repo:
     [copy] Copying 5 files to C:\apache\axis2-1.1.1\dist\temp\WEB-INF
    [mkdir] Created dir: C:\apache\axis2-1.1.1\dist\temp\WEB-INF\conf
     [copy] Copying 1 file to C:\apache\axis2-1.1.1\dist\temp\WEB-INF\co

create.war:
      [war] Building war: C:\apache\axis2-1.1.1\dist\axis2.war
   [delete] Deleting directory C:\apache\axis2-1.1.1\dist\temp

BUILD SUCCESSFUL
Total time: 4 seconds
```

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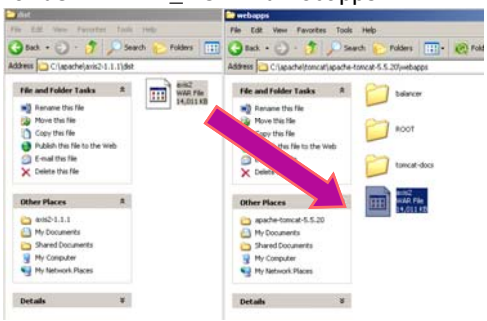
Copy axis2.war

- Copy axis2.war from %AXIS2_HOME%\dist to %CATALINA_HOME%\webapps



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http://localhost:8080/axis2

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List Available Services

http://localhost:8080/axis2/services/listServices

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http://localhost:8080/axis2

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Axis2 Happiness Page

http://localhost:8080/axis2/axis2-web/HappyAxis.jsp

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http://localhost:8080/axis2

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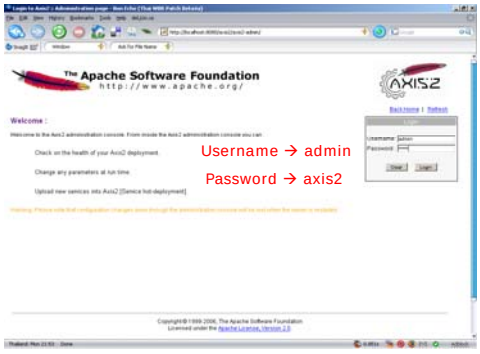
Axis2 Administration Console

http://localhost:8080/axis2/axis2-admin/



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Axis2 Web Admin Module

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Axis2 Services Context

- The Directory Structure of axis2.war

```
axis2-web
META-INF
WEB-INF
    classes
    conf
        axis2.xml
    lib
    modules
    services
        services.list
        ...
        version.aar
web.xml
```

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Axis2 Services Structure

- Services can be deployed as *.aar files
- The *.aar can be built using ant command in the directory that has build.xml

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Deploy Sample Web Service : StockQuoteService

- Go to %AXIS2_HOME%\samples\quickstart which has the structure as follows
  - resources
    - META-INF
      - Services.xml
  - src
    - Java files
  - build.xml
- Create StockQuoteService.aar by running command “ant generate.service”

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Create StockQuoteService.aar

```
C:\apache\axis2-1.1.1>cd %AXIS2_HOME%\samples\quickstart

C:\apache\axis2-1.1.1\samples\quickstart>ant generate.service
Buildfile: build.xml

compile.service:
    [mkdir] Created dir: C:\apache\axis2-1.1.1\samples\quickstart\build
    [mkdir] Created dir: C:\apache\axis2-1.1.1\samples\quickstart\build\
    [javac] Compiling 1 source file to C:\apache\axis2-1.1.1\samples\qui
build\classes
    [javac] Note: C:\apache\axis2-1.1.1\samples\quickstart\src\samples\q
t\service\pojo\StockQuoteService.java uses unchecked or unsafe operation
    [javac] Note: Recompile with -Xlint:unchecked for details.

generate.service:
     [copy] Copying 1 file to C:\apache\axis2-1.1.1\samples\quickstart\b
sses
      [jar] Building jar: C:\apache\axis2-1.1.1\samples\quickstart\build
oteService.aar

BUILD SUCCESSFUL
Total time: 11 seconds
```

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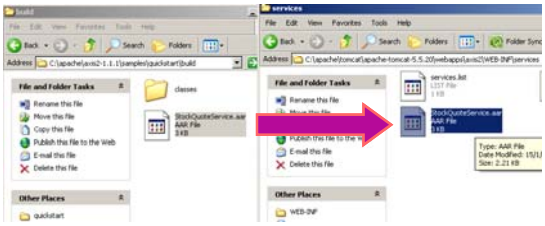
Deploy StockQuoteService

Now copy StockQuoteService.aar from %AXIS2_HOME%\samples\quickstart\build to %CATALINA_HOME%\webapps\axis2\WEB-INF\services



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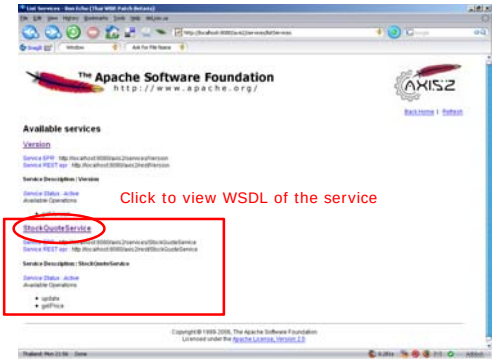
Deployed StockQuoteService

http://localhost:8080/axis2/services/listServices



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WSDL of StockQuoteService

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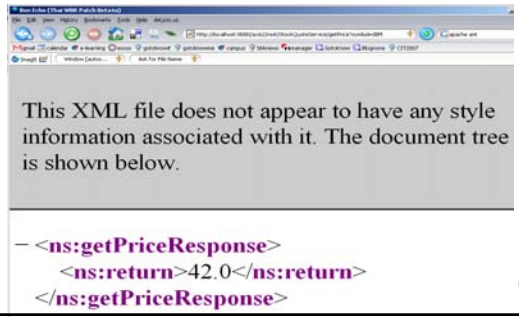
Call Stock Quote Service

- http://localhost:8080/axis2/rest/StockQuoteService/getPrice?symbol=IBM



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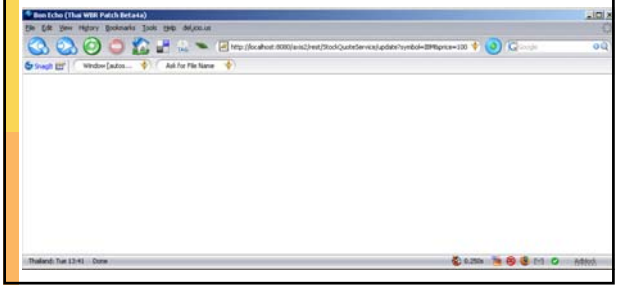
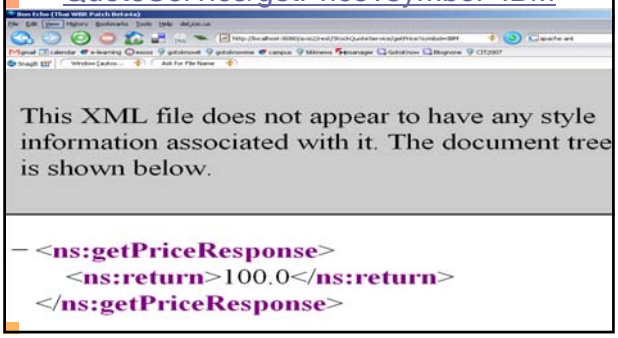
Update Stock Quote Price

- http://localhost:8080/axis2/rest/StockQuoteService/update?symbol=IBM&price=100



Call Stock Quote Service after Update

- http://localhost:8080/axis2/rest/StockQuoteService/getPrice?symbol=IBM



Create CalculatorService Overview

- Create directory CalculatorService
  - Edit Java source file
  - Edit services.xml
  - Edit build.xml
- Use ant to create CalculatorService.aar
- Copy CalculatorService.aar to %CATALINAME_HOME%\webapps\axis2\WEB-INF\services

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Create CalculatorService

- Create directory CalculatorService

(May copy from StockQuoteService)

- resources
  - META-INF
    - Services.xml
- src
  - service
    - pojo
      - CalculatorService.java
- build.xml
- README.txt

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Edit Java Source File (1/2)

```
package service.pojo;
public class CalculatorService {
        public int add(int a, int b) {
        return a+b;
   }
   public int sub(int a, int b) {
        return a-b;
   }
}
```

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Edit Java Source File (2/2)

```
public int mult(int a, int b) {
        return a*b;
   }

   public int div(int a, int b) {
        if (b != 0)
                return a/b;
        else
                return 0;
   }
}
```

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Edit services.xml

```
<service name="CalculatorService" scope="application"
   targetNamespace="http://quickstart.samples/">
   <description>
      Calculator Service
   </description>
   <messageReceivers>
      <messageReceiver mep="http://www.w3.org/2004/08/wsdl/in-only"
    class="org.apache.axis2.rpc.receivers.RPCInOnlyMessageReceiver"/>
      <messageReceiver mep="http://www.w3.org/2004/08/wsdl/in-out"

    class="org.apache.axis2.rpc.receivers.RPCMessageReceiver"/>
   </messageReceivers>
   <schema schemaNamespace="http://quickstart.samples/xsd"/>
   <parameter
    name="ServiceClass">service.pojo.CalculatorService</parameter>
</service>
```

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Edit build.xml (1/3)

```
<project basedir="." default="generate.service">
  <property environment="env"/>
  <property name="AXIS2_HOME" value="${env.AXIS2_HOME}"/>
  <property name="build.dir" value="build"/>
  <path id="axis2.classpath">
    <fileset dir="${AXIS2_HOME}/lib">
      <include name="*.jar"/>
    </fileset>
  </path>
  <target name="compile.service">
    <mkdir dir="${build.dir}"/>
    <mkdir dir="${build.dir}/classes"/>
    <!--First let's compile the classes-->
    <javac debug="on"
        fork="true"
        destdir="${build.dir}/classes"
        srcdir="${basedir}/src"
        classpathref="axis2.classpath">
    </javac>
  </target>
```

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Edit build.xml (2/3)

```
<target name="generate.wsdl" depends="compile.service">
    <taskdef name="java2wsdl"
          classname="org.apache.ws.java2wsdl.Java2WSDLTask"
          classpathref="axis2.classpath"/>
    <java2wsdl className="service.pojo.CalculatorService"
          outputLocation="${build.dir}"
          targetNamespace="http://quickstart.samples/"
          schemaTargetNamespace="http://quickstart.samples/xsd">
      <classpath>
        <pathelement path="${axis2.classpath}"/>
        <pathelement location="${build.dir}/classes"/>
      </classpath>
    </java2wsdl>
  </target>
```

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Edit build.xml (3/3)

```
<target name="generate.service" depends="compile.service">
    <!--aar them up -->
    <copy toDir="${build.dir}/classes" failonerror="false">
      <fileset dir="${basedir}/resources">
        <include name="**/*.xml"/>
      </fileset>
    </copy>
    <jar destfile="${build.dir}/CalculatorService.aar">
      <fileset excludes="**/Test.class" dir="${build.dir}/classes"/>
    </jar>
  </target>

  <target name="clean">
    <delete dir="${build.dir}"/>
  </target>
</project>
```

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Use ant to create CalculatorService.aar

- Go to directory CalculatorService
- Run command “ant generate.service”

```
C:\apache\tomcat\apache-tomcat-5.5.20\webapps\axis2\services\CalculatorService>
ant generate.service
Buildfile: build.xml

compile.service:
    [mkdir] Created dir: C:\apache\tomcat\apache-tomcat-5.5.20\webapps\axis2\ser
vices\CalculatorService\build
    [mkdir] Created dir: C:\apache\tomcat\apache-tomcat-5.5.20\webapps\axis2\ser
vices\CalculatorService\build\classes
    [javac] Compiling 1 source file to C:\apache\tomcat\apache-tomcat-5.5.20\web
apps\axis2\services\CalculatorService\build\classes

generate.service:
     [copy] Copying 1 file to C:\apache\tomcat\apache-tomcat-5.5.20\webapps\axis
2\services\CalculatorService\build\classes
      [jar] Building jar: C:\apache\tomcat\apache-tomcat-5.5.20\webapps\axis2\se
rvices\CalculatorService\build\CalculatorService.aar

BUILD SUCCESSFUL
Total time: 2 seconds
```

Now we have CalculatorService.aar in directory CalculatorService\build

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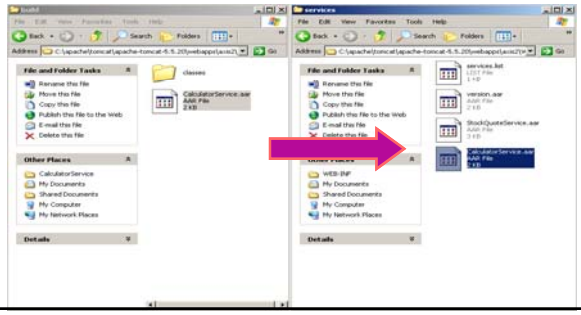
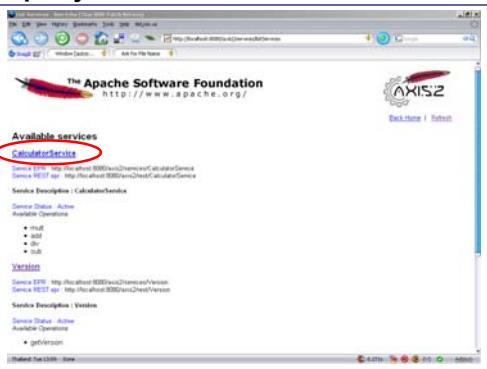
Deploy CalculatorService

- Copy CalculatorService.arr from CalculatorService\build to %CATALINA_HOME%\webapps\axis2\WEB-INF\services



Deployed CalculatorService



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WSDL of CalculatorService

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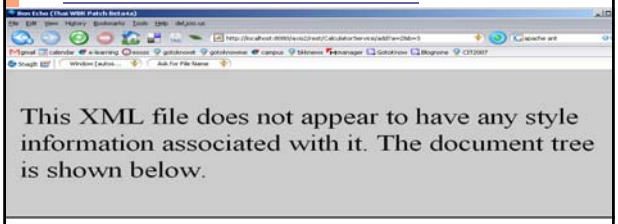
Call Calculator Service (Add Operation)

- http://localhost:8080/axis2/rest/CalculatorService/add?a=2&b=3



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

```
− <ns:addResponse>
    <ns:return>5</ns:return>
  </ns:addResponse>
```

References

- The Apache Software Foundation, “Apache Axis2/Java”, http://ws.apache.org/axis2/, Retrieved on January 9, 2007
- Deepal Jayasinghe and Ruchith Fernando, “Building Enterprise Applications with Axis2”
- Chathura Herath and Eran Chinthaka, “Axis 2 Tutorial”

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