

Web Services Middleware

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Web Services

Definition

A **Web service** is a software system designed to support interoperable machine-to-machine interaction over a network.

- Interoperate using XML-based standards
- Self-contained and self-describing
- XML + HTTP
- Platform, object model, and programming language independent
- Basic standards SOAP, WSDL, and UDDI

SOAP

- SOAP 1.2 is a W3C standard for exchanging XML-based messages over a computer network.
- It defines a message structure
- Message exchange using a variety of underlying protocols
- It defines the rules for processing a SOAP message
- SOAP defines message exchange patterns
- Why SOAP anyway? Simple Object Access Protocol Simple Object Access Protocol Simple Object Access Protocol Simple Object Access Protocol

Skeleton SOAP Message

```
<?xml version="1.0"?>
<soap:Envelope
xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding"

<soap:Header>
  ...
</soap:Header>

<soap:Body>
  ...
  <soap:Fault>
    ...
  </soap:Fault>
</soap:Body>

</soap:Envelope>
```

SOAP Examples

- SOAP Request

```
<?xml version="1.0"?>
<soap:Envelope
xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
soap:encodingStyle="http://www.w3.org/2001/12/soap-enco

<soap:Body>
  <m:GetPrice xmlns:m="http://www.foo.org/prices">
    <m:Item>Apples</m:Item>
  </m:GetPrice>
</soap:Body>

</soap:Envelope>
```

- SOAP Reply

```
<soap:Body>
  <m:GetPriceResponse xmlns:m="http://www.foo.com/pri
    <m:Price> 2 </m:Price>
  </m:GetPriceResponse>
</soap:Body>
```

WSDL

- Web Service Description Language using an XML document
- It specifies the location of the service
- It specifies the methods that the service exposes
- WSDL 2.0 about to become a W3C recommendation

WSDL basic structure

<definitions>

<types>

Definition of types used, XMLSchema

</types>

<message>

Definition of parts of each message and the data elements

</message>

<portType>

Definition the operations performed and involved messages

</portType>

<binding>

Communication protocol used

</binding>

</definitions>

WSDL Example

```
<message name="getTermRequest">  
  <part name="term" type="xs:string"/>  
</message>
```

```
<message name="getTermResponse">  
  <part name="value" type="xs:string"/>  
</message>
```

```
<portType name="glossaryTerms">  
  <operation name="getTerm">  
    <input message="getTermRequest"/>  
    <output message="getTermResponse"/>  
  </operation>  
</portType>
```


WSDL Example (cont.)

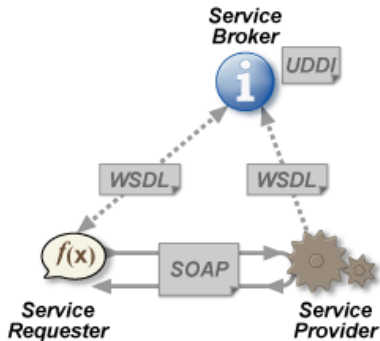
```
<binding type="glossaryTerms" name="b1">
  <soap:binding style="document"
    transport="http://schemas.xmlsoap.org/soap/http" />
  <operation>
    <soap:operation
      soapAction="http://example.com/getTerm"/>
    <input>
      <soap:body use="literal"/>
    </input>
    <output>
      <soap:body use="literal"/>
    </output>
  </operation>
</binding>
```

UDDI

- Universal Discovery, Description, and Integration
- **Service providers** use UDDI to **advertise the services** they offer.
- **Service Requesters** use UDDI to **discover services** that suit their requirements

Putting It All Together

- UDDI **advertise the services** by providing WSDLs
- WSDL **specifies location and methods** of the service
- SOAP defines the **messages format and processing**



Extensible standards to define, publish and use Web Services.

How are WS related to middleware?

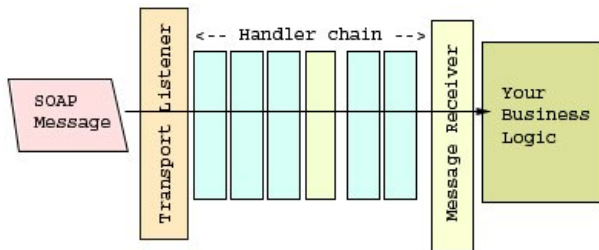
Definition

Middleware systems are comprised of abstractions and services to facilitate the **design**, **development**, **integration** and **deployment** of distributed applications in heterogeneous networking environments.

- This is exactly what Web Service are about!
- XML + HTTP provide a uniform and widely accessible interface!

Axis2

- Apache's core engine for Web services
- Fast, low memory footprint, flexibility, stability, ..., and **extensible**
- Core engine



This is nice, but . . .

- What about reliability, transactions, security, policies ... ?
- SOAP does not define any of these :(
- But it is extensible! :)

And more Web Service Plataform!

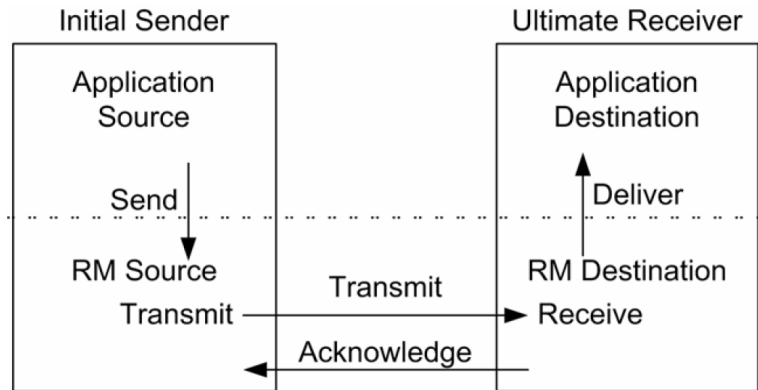
WS-Notification	Standardise the way WS interact using <u>Notifications</u> or <u>Events</u> . Event Driven Architectures using WS	Pubsubscribe
WS-Coordination	Coordinate the actions of distributed apps. It enables transaction processing, workflow, and other systems for coordination	Kandula
WS-BPEL	Business Process Execution Language. Compose WS functionality in the right order	Twister
WS-Security	Message integrity, confidentiality, and single message authentication	WSS4J
WS-Policy	To express a set of requirements that have to be met in order to consume a web service	WS-Commons

Using all these together we can do anything that an Enterprise Middleware does!

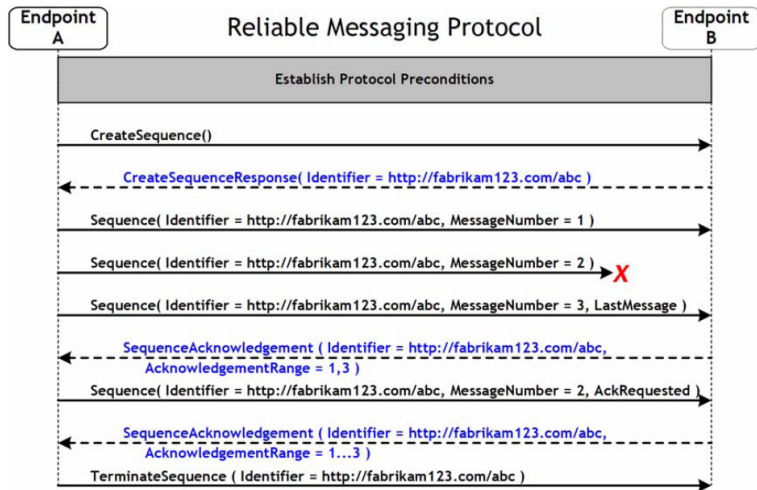
WS-ReliableMessaging

- Many errors may interrupt a conversation.
- Messages may be lost, duplicated or reordered and lost of volatile state.
- WS-RM is a protocol to deliver messages reliably in the presence of software component, system, or network failures
- The protocol allows to identify, track, and manage the reliable delivery of messages
- Transport-independent and extensible
- Delivery assurances: AtMostOnce, AtLeastOnce, ExactlyOnce, and InOrder.

WS-RM: Model and example



WS-RM: Model and example



WS-RM: Sandesha2

- Sandesha2 is an implementation for the server and client side
- To use on the server side, just add the module to the Axis2 handler stack
- In the client side . . .

WS-RM: Sandesha2, client side

```
ServiceClient client =new ServiceClient(configContext,null)
// set client options options

client.engageModule(new QName ("sandesh2"));

Callback cb1 = new TestCallback ("Callback 1");
client.sendReceiveNonBlocking (
    getEchoOMBlock ("echo1", "sequence1"), cb1);
Callback cb2 = new TestCallback ("Callback 2");
client.sendReceiveNonBlocking(
    getEchoOMBlock ("echo2", "sequence1"), cb2);

clientOptions.setProperty(
    SandeshaClientConstants.LAST_MESSAGE, "true");
Callback cb3 = new TestCallback ("Callback 3");
client.sendReceiveNonBlocking(
    getEchoOMBlock ("echo3", "sequence1"), cb3);
```

Questions?

Discussion

- Additional text-processing and bandwidth introduced by XML
 - ▶ CPU to serialize/de-serialize, message and transport encryption, XML-tags for all elements, ...
 - ▶ Problem solved by technology?
 - ▶ Are there XML alternatives?
 - ▶ Web Services Invocation Framework. Takes advantage of WSDL's capability to offer multiple bindings for the same service
 - ▶ Trade between performance and highly flexible protocols

Discussion (2)

- Middleware's success and proliferation has recreated, at a higher level, the very problem it was designed to address.
- Web services provide middleware for middleware
- WS-Security (message level security), WS-Reliable Messaging, WS-Addressing only works for SOAP, not at abstract WSDL level
- Web based services vs Web services, which is better?
 - ▶ Each one to solve different problems :)

Discussion (3)

- With RMI or CORBA, you get the functionality of a remote class just as you would a local class, but with WS . . .
 - ▶ You cannot enforce business logic on the client
 - ▶ You cannot access read-only properties objects
 - ▶ You cannot serialize datatypes such as HashTable
 - ▶ You cannot enforce logic in property getters or setters on objects
- All these differences are because . . . It is all about XML messages rather than objects and methods!

Discussion (4)

- Open Source implementation (Apache) vs proprietary solution (IBM)

References

- Sun SOA, <http://java.sun.com/developer/technicalArticles/WebServices/soa/>
- Web service Architecture, <http://www.w3.org/TR/2004/NOTE-ws-arch-20040211/>
- Web Services Introduction http://www.w3schools.com/webservices/ws_intro.asp
- SOAP Tutorial <http://www.w3schools.com/soap/>
- WSDL, <http://www.w3.org/TR/wsdl>
- UDDI.org <http://www.uddi.org>
- Apache Web Services, <http://ws.apache.org/>
- WS-Reliable Messaging spec, <ftp://www6.software.ibm.com/software/developer/library/ws-reliablemessaging200502.pdf>
- WS-IF, <http://www-128.ibm.com/developerworks/library/ws-wsif.html>
- WS-Notification, <http://www.ibm.com/developerworks/library/specification/ws-notification/>
- WS-Coordination, <http://www.ibm.com/developerworks/library/ws-coor/>
- WS-BPEL, http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wsbpel
- WS-Security, <http://www.oasis-open.org/committees/wss/>
- WS-Policy, <http://www.ibm.com/developerworks/library/ws-polfram/>