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ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

Εισαγωγή στην Επιστήμη και Τεχνολογία των Υπηρεσιών

Ενότητα 14: JAX-WS

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Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

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XML
JAX-WS
635.444

David Silberberg

Lecture 25

Overview of JAX-WS

- JAX-WS stands for Java API for XML Web Services
  - Builds clients and services that communicate using XML
  - Enables developers to write message oriented and RPC-oriented web services
- Java programming language API for creating web services
  - Part of the Java EE platform from Sun Microsystems
  - Like the other Java EE APIs, JAX-WS uses *annotations* (introduced in Java SE 5)
  - Simplifies the development and deployment of web services and clients
- The Reference Implementation of JAX-WS
  - Part of project GlassFish – an open source Java EE application server
  - Called JAX-WS RI (For Reference Implementation)
  - Production quality implementation

JAX-WS Hides the Complexity of SOAP & WSDL

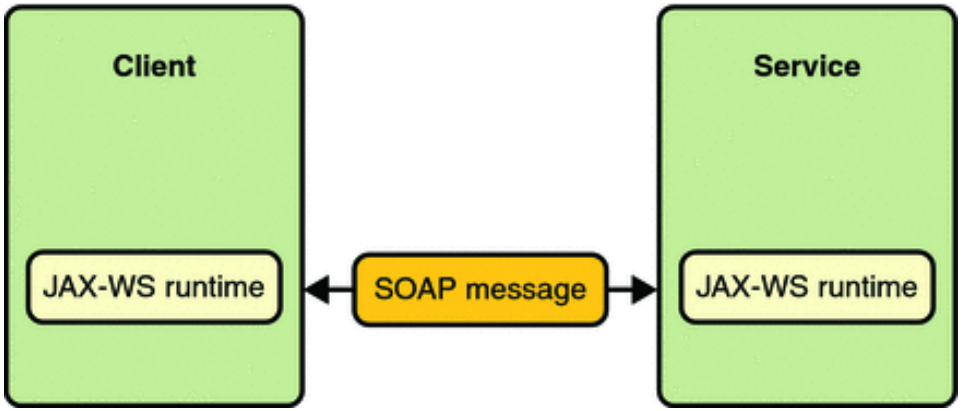
- SOAP is the XML-based protocol used
  - Envelope structure, encoding rules, and conventions for representing web service invocations and responses
  - Calls and responses are transmitted as SOAP messages via HTTP
- WSDL is the XML-based model for describing web services
- JAX-WS API hides the complexity of SOAP and WSDL
  - Server side development
    - Specify the web service operations by defining methods in a JAVA interface
    - Code the classes that implement those methods
  - Client side development
    - Create a proxy (a local object representing the service)
    - Invokes methods on the proxy.
  - Developer does not generate or parse SOAP messages
  - JAX-WS runtime system converts the API calls and responses to and from SOAP

Advantage of JAX-WS

- Platform independence provided by Java
- Java independence
  - JAX-WS clients can access web services not running on a Java platform
  - JAX-WS services can be called by non-Java clients
- Reason for Java independence of JAX-WS
  - Uses standards HTTP, SOAP, and the WSDL defined by the W3C
  - WSDL is an XML format for describing services as sets of endpoints operating on messages.

JAX-WS Architecture

- The architecture is a simple client/server architecture
- JAX-WS enables developers to write clients and services as java classes and methods
- JAX-WS technology manages communication between a web service and client.



Service Endpoint Interfaces

- Service
  - Java class that imports `javax.jws.WebService`
  - `@WebService` annotation defines the class as a web service endpoint
- Service endpoint implementation (SEI)
  - Java class
  - Defines the services methods that clients can call
- Service endpoint interface
  - Java Interface
  - Declares service interfaces that clients can call
  - Can be specified explicitly
    - Must specify endpointInterface elements to the `@WebService` annotation
  - Not required when building a JAX-WS endpoint
    - Implementation class implicitly defines an SEI
- The `wsgen` tool is applied to the endpoint implementation class to generate the web service artifacts that connect a web service client to the JAX-WS runtime

Basic Steps for Creating Client/Server

- Server
  - Code the implementation class
  - Compile the implementation class
  - Use `wsgen` to generate the artifacts required to deploy the service
  - Package the files into a WAR (Web ARchive) file
  - Deploy the WAR file
    - Web service artifacts used to communicate with clients are generated by the Application Server during deployment
- Client
  - Code the client class
  - Use `wsimport` to generate and compile the web service artifacts needed to connect to the service
  - Compile the client class
  - Run the client

JAX-WS Service Requirements

- Service class
  - Must import either the `javax.jws.WebService` or `javax.jws.WebServiceProvider`
  - May explicitly reference an SEI through the endpointInterface element of the `@WebService` annotation
    - If no endpointInterface is specified, an SEI is implicitly defined for the server class
  - Must not be declared `final`
  - Must not be abstract
  - Must have a default public constructor
  - Must not define the finalize method
  - May use the `javax.annotation.PostConstruct` or `javax.annotation.PreDestroy` annotations on its methods for life cycle event callbacks
- Service methods
  - Must be `public` and not be declared `static` or `final`
  - Exposed to clients
    - Must be annotated with `javax.jws.WebMethod`
    - Must have JAXB-compatible parameters and return types
- Construction and Destruction
  - The `@PostConstruct` method is called by the container before the implementing class begins responding to web service clients
  - The `@PreDestroy` method is called by the container before the endpoint is removed from operation

Coding the Service Endpoint Implementation Class

```
package helloservice.endpoint;// package name is helloservice

import javax.jws.WebService;  // required import

@WebService                   // required annotation
public class Hello {
   private String message = new String("Hello, ");

   public void Hello() {}     // default public constructor

   @WebMethod                 // required annotation
   public String sayHello(String name) {
        return message + name + ".";
   }
}
```

Building, Packaging, and Deploying the Service

- Build and package service
  - From a terminal window, go to the directory where the service is located
  - Type `ant` (calls the default target)
  - Automatically builds and packages the application into an WAR file (`helloservice.war`) located in the dist directory
- Deploy service
  - From a terminal window, go to the directory where the service is located
  - Start the Application Server (e.g., *Sun GlassFish Enterprise Server* – previously known as *Sun Java System Application Server*)
  - Type: `ant deploy`
- View WSDL
  - Type the URL `http://localhost:8080/`**`helloservice`**`/`**`hello`**`?WSDL` into a web browser
- All in one command – `ant all`
- Undeploy – `ant undeploy`

JAX-WS Client

Client performs the following steps:

- `javax.xml.ws.WebServiceRef` annotation declares a reference to a web service
- `@WebServiceRef` uses the `wsdlLocation` element to specify the URI of the deployed service's WSDL file

```
@WebServiceRef(wsdlLocation=
                          "http://localhost:8080/helloservice/hello?wsdl")
static HelloService service;
```

- Retrieves a proxy to the service, also known as a port, by invoking `getHelloPort` on the service.

```
Hello port = service.getHelloPort(); // implements SEI define by service
```

- Invokes the port's `sayHello` method with a `name` parameter

```
String response = port.sayHello(name);
```

JAX-WS Client Code

```
package simpleclient;

import javax.xml.ws.WebServiceRef;          // required import
import helloservice.endpoint.HelloService; // import the HelloService class
import helloservice.endpoint.Hello;         // import Hello class

public class HelloClient {

    @WebServiceRef(wsdlLocation="http://localhost:8080/
            helloservice/hello?wsdl")

    static HelloService service;            // HelloService variable

    public static void main(String[] args) {
        try {
            HelloClient client = new HelloClient();
            client.doTest(args);
        } catch(Exception e) {
            e.printStackTrace();
        }
    }
```

JAX-WS Client Code – continued

```
    public void doTest(String[] args) {
        try {
            System.out.println("Retrieving the port from the service: " +
            service);
            Hello port = service.getHelloPort();    // get a handle on the service

            System.out.println("Invoking the sayHello operation on the port.");

            String name;
            if (args.length > 0) {
                name = args[0];
            } else {
                name = "No Name";
            }

            String response = port.sayHello(name);  // call the service

            System.out.println(response);
        } catch(Exception e) {
            e.printStackTrace();
        }
    }
}
```

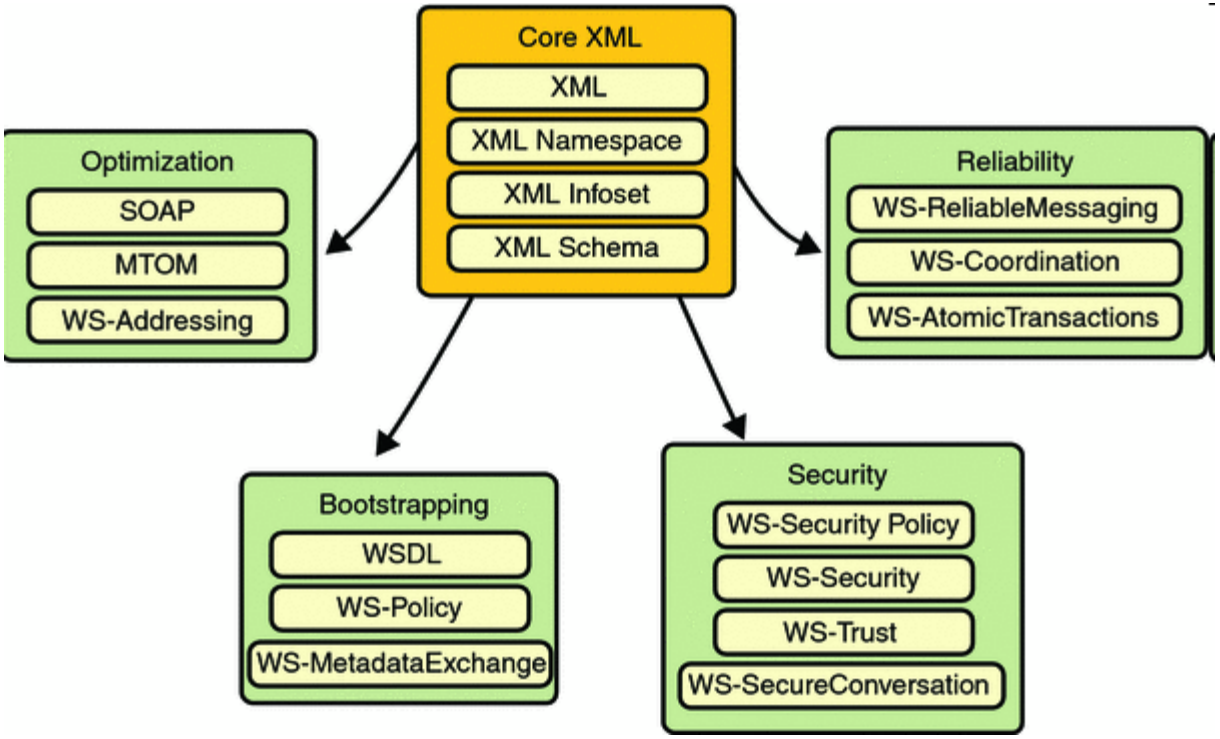
Building and Running the Client

- Make sure that `helloservice` is deployed
- From a terminal window, go to the directory containing the client code
- Type: `ant`
  - Calls the default target
  - Builds and packages the application into a JAR file – in this case `simpleclient.jar`
  - Places it into the dist directory
- To run the client, type: `ant run`
- JAX-WS uses JAXB to map Java programming language types to and from XML definitions
  - Insulates developers from the mappings
  - However, not every class in the Java language can be used as a method parameter or return type in JAX-WS (limited by JAXB)

Web Services – Bigger Picture

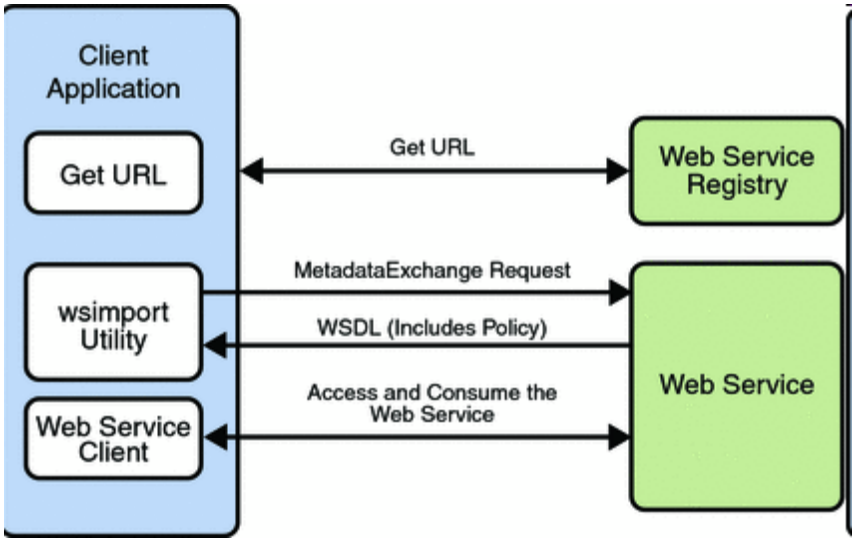
- Since 2005, Sun has worked closely with Microsoft to ensure interoperability of web services enterprise technologies
  - Security
  - Reliable messaging
  - Atomic transactions
- Metro, part of GlassFish, is a one-stop web services shop
  - Web Services portion is known as WSIT (Web Service Interoperability Technologies)
  - Implementation of a number of open web services specifications to support enterprise features
- WSIT augments JAX-WS capabilities

WSIT Architecture



Bootstrapping and Configuration

- Consists of
  - Using a URL to access a web service
  - Retrieving its WSDL file
  - Using the WSDL file to create a web service client that can access and consume a web service



Bootstrapping and Configuration Steps

- Client acquires the URL for a web service that it wants to access
  - Many ways to acquire the URL
  - Perhaps look up the URL in a Web Services registry
- Client uses the URL and the `wsimport` tool to send a `WS-MetadataExchange Request` to access the web service and retrieve the WSDL file
  - WSDL file contains a description of the web service endpoint
  - Includes WS-Policy assertions that describe the security, reliability, transactional, etc., capabilities and requirements of the service
- Client uses the WSDL file to create the web service client
- Client accesses the web service

Message Optimization Technology

- When large binary objects (such as documents, images, music files, etc.) are encoded into XML format for inclusion in SOAP messages, even larger files are produced
- When a web service processes and transmits these large files over the network, the performance of the web service application and the network are negatively affected
  - Performance may degrade to a point that it is no longer useful
  - Network gets bogged down with more traffic than the allotted bandwidth can handle
- Message Optimization encodes the binary objects to optimize
  - SOAP application processing time
  - Bandwidth required to transmit the SOAP message over the network
  - Recommended if binary encoded XML documents are larger than 1KB

Reliable Messaging

- Quality of Service (QoS) technology reliable web services
  - Reliability is measured by a system's ability to deliver messages from point A to point B
  - Purpose is to ensure the delivery of application messages to web service endpoints
- Ensures that messages in a given message sequence are delivered once and, optionally, in the correct order
  - Recovers when messages are lost or out of sequence
  - Lost messages are retransmitted
  - Out of sequence messages are retransmitted in order
- Reliable Messaging used when
  - Communication failures result in the network being unavailable or connections being dropped
  - Application messages are being lost in transit
  - Application messages are arriving at their destination out of order and ordered delivery is a requirement
- Uses more memory (especially if the ordered delivery option is enabled) since messages must be stored (even after they are sent) until receipt is acknowledged

Security Technology

- WS-Security provides interoperable message content integrity and confidentiality
  - Even when messages pass through intermediary nodes before reaching their destination endpoint
  - WS-Security is in addition to existing transport-level security such as TSL (or its predecessor SSL)
- Enhances security by implementing WS-Secure Conversation
  - Enables client and server to establish a shared security context when a multiple-message-exchange sequence is initiated
  - Subsequent messages use derived session keys that increase the overall security while reducing the security processing overhead for each message
- Two additional features to improve security
  - *Web Services Trust*: Clients use SOAP messages to request security tokens that establish trusted communications
  - *Web Services Security Policy*: Services use security assertions that represent preferences and requirements for web service endpoints

Τέλος Ενότητας

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